5.3.1 Habitat Attributes

Table 8 provides an estimate of the density of tree hollow resources per hectare for each vegetation community within the survey area.

TABLE 8 – HOLLOW DENSITY

Vegetation Community (Andrews.Neil 2006)	Hollows per hectare (ha)				
	Small	Medium	Large	Owl	Total
Map Unit 1 - Coastal Sand Apple / Blackbutt Forest	30	22	8	1	61
Map Unit 5 - Swamp Forest	12	8	0	0	20

As indicated in Table 8 it is estimated that there are approximately 61 hollows/ha within Map Unit 1 and 20 hollows/ha within Map Unit 5. The majority of hollows are in the small and medium size class indicating that hollows are unlikely to be a limiting factor influencing the occurrence of hollow dependant fauna species such as Squirrel Glider *Petaurus norfolcensis*.

Based on known food sources (Menkhorst *et al*. 1988; Sharpe & Goldingay 1998; Smith & Murray 2003), Table 9 provides an estimate of the density of understorey foraging resources for Squirrel Glider per hectare for each vegetation community.

TABLE 9 – UNDERSTOREY FORAGING RESOURCES FOR SQUIRREL GLIDER

Foraging Resource		Density (individuals/ha)	
		Map Unit 1	Map Unit 5
Banksia spp.	Nectar and Pollen	108	14
Acacia spp.	Gum	5	6
Persoonia spp.	Fruit, insects	20	14
Melaleuca spp.	Nectar, insects	0	126
Leptospermum spp.	insects	0	42

Table 9 indicates that there is a high density of lower strata foraging resources within the survey area. *Banksia serrata* was one of the dominant middle stratum species throughout Map Unit 1 while *Melaleuca quinquenervia* was dominant in Map Unit 5. In addition to these resources, dominant upper stratum species within the study area (*Angophora costata*, *Corymbia gummifera* and *Eucalyptus pilularis*) are known to be utilised by Squirrel Glider for nectar, sap and insect exudates (Menkhorst *et al*. 1988; Sharpe & Goldingay 1998; Smith & Murray 2003).

5.3.2 Non-flying Mammals

Field surveys resulted in the identification of 10 non-flying mammals consisting of 5 terrestrial mammals (*Vulpes vulpes* European Red Fox; *Oryctolagus cuniculus* European Rabbit; *Rattus rattus* Black Rat; *Isoodon macrurous* Northern Brown Bandicoot, and; *Wallabia bicolour* Swamp Wallaby) and 5 arboreal mammals (*Pseudocheirus peregrinus* Common Ringtail Possum; *Trichosurus vulpecula* Common Brushtail Possum; *Acrobates pygmaeus* Feather-tail Glider; *Petaurus norfolcensis* Squirrel Glider, and; *Phascolarctos cinereus* Koala). Of these, Squirrel Glider and Koala are listed as Vulnerable pursuant to the TSC Act and are discussed in section 6.

Trapping:

Table 10 shows the results of trapping surveys. Trap station locations are shown in Figure 3.

TABLE 10 – TRAPPING RESULTS

Date	Trap Station	Type	Tree Species (if arboreal)	Fauna Species	ID	Sex	Capture/ Recapture	Weight (g)	Patagium Colour	Tooth Wear	Age	Comments
12/09/2006	9	Elliott A	Terrestrial	*Rattus rattus*		F	C					Sub-adult
12/09/2006	9	HWR Glider	Angophora costata	*Rattus* sp.								Scats in trap
12/09/2006	4	HWR Glider	Banksia serrata	*Petaurus norfolcensis*	FLR	F	C	195	Creamy	W	1	
13/09/2006	3	Elliott A	Terrestrial	*Rattus rattus*								
13/09/2006	9	HWR Glider	Angophora costata	*Petaurus norfolcensis*	RLP	F	C	204	White	MW	1-2	
13/09/2006	4	HWR Glider	Eucalyptus pilularis	*Petaurus norfolcensis*	FLR	F	R					
13/09/2006	4	HWR Glider	Eucalyptus pilularis	*Petaurus norfolcensis*	RLP	M	C	210	Creamy	W	2	
14/09/2006	3	Elliott A	Terrestrial	*Rattus rattus*								
14/09/2006	9	HWR Glider	Eucalyptus pilularis	*Petaurus norfolcensis*		F	C		Rusty	MW	2	
14/09/2006	9	HWR Glider	Eucalyptus pilularis	*Petaurus norfolcensis*		M	C		White	NW	0-1	
14/09/2006	4	HWR Glider	Eucalyptus pilularis	*Petaurus norfolcensis*	FLR	F	R					
14/09/2006	5	HWR Glider	Eucalyptus robusta	*Petaurus norfolcensis*		M	C	180	White	MW	1-2	

KEY:

Tooth Wear (*Petaurus* spp.)*	
W:	Worn - incisor teeth worn flat
MW:	Moderately Worn - incisor teeth rounded
NW:	Not Worn - incisor teeth sharply pointed

Age (*Petaurus* spp.) (Indicative only)*	
0-1	Incisor teeth NW; Patagium white
1-2	Incisor teeth NW-MW; Patagium creamy white - creamy
2-3	Incisor teeth MW - W; Patagium creamy rusty - rusty
3+	Incisor teeth W; Patagium rusty

**Source: Quin (1995)*

As indicated in Table 10, 2 species, Black Rat *Rattus rattus* and Squirrel Glider *Petaurus norfolcensis* (V TSC Act), were captured during trapping surveys within the survey area. 6 individual Squirrel Glider were captured, where possible each glider was followed to its den tree on release. Three den trees were located (Figure 5). 3 Black Rats were captured. No other animals were captured during the survey period.

Koala Spot Surveys:

A summary of the results of the Koala spot surveys is shown in Table 11. Table 11 should be viewed with reference to Figure 3. As indicated by Table 11 and Figure 3, the highest Koala activity recorded during the survey period was 30% within the swamp forest in the southern section of the survey area. No Koala activity was recorded within the ridge top areas or on the eastern side of the survey area.

TABLE 11 – KOALA SPOT SURVEY RESULTS

Spot	Community	Easting (WGS 84)	Northing (WGS 84)	% Activity
1	Coastal Sands Apple/Blackbutt	413625	6377840	20
2	Coastal Sands Apple/Blackbutt	413568	6377738	15
3	Coastal Sands Apple/Blackbutt	413579	6377564	0
4	Coastal Sands Apple/Blackbutt	413630	6377526	0
5	Swamp Forest	413378	6377427	30
6	Swamp Forest	413325	6377392	0
7	Coastal Sands Apple/Blackbutt	413840	6377683	0
8	Coastal Sands Apple/Blackbutt	413848	6377748	0
9	Coastal Sands/Swamp Forest Ecotone	413983	6378185	25

A total of 180 trees comprising 6 species were searched for Koala scats with scats recorded at the base of 18 individual trees (Table 12). An indication of preferred tree species within and adjacent to the survey area was obtained by calculating the percentage of surveyed trees with scats (Table 12).

TABLE 12 – KOALA ACTIVITY PER TREE SPECIES

Tree Species	Number Surveyed	Number with Scats	% Activity
Angophora costata	77	8	10.39
Banksia serrata	9	2	22.22
Corymbia gummifera	44	2	4.55
Eucalyptus pilularis	28	1	3.57
Eucalyptus robusta	10	3	30
Melaleuca quinquenervia	12	2	16.67

Table 12 indicates that within and adjacent to the survey area *Eucalyptus robusta* is likely to be the preferred feed species. It should be noted that this would only provide an indication of foraging preferences within and adjacent to the survey area, a larger sample size would be required to gain a statistically valid result.

Spotlighting:

5 arboreal mammals were observed during spotlighting (Table 13). 3 Koala *Phascolarctos cinereus* were observed within the western section of the study area and 1 Squirrel Glider *Petaurus norfolcensis* was observed adjacent to the swamp forest in the southern section of the survey area (Figure 5).

TABLE 13 – SPOTLIGHT SURVEY RESULTS

Date	Time	Scientific Name	Common Name	No. Observed	Comments
11/9/2006	1914	*Phascolarctos cinereus*	Koala	1	Foraging in *Angophora costata*
11/9/2006	1948	*Trichosurus vulpecula*	Common Brushtail Possum	1	
12/9/2006	1910	*Phascolarctos cinereus*	Koala	1	Foraging in *A. costata*
12/9/2006	1910	*Phascolarctos cinereus*	Koala	1	Foraging within *Eucalyptus robusta* off site.
12/9/2006	1935	*Petaurus norfolcensis*	Squirrel Glider	1	About to enter trap placed on *Corymbia gummifera.*
12/9/2006	1945	*Trichosurus vulpecula*	Common Brushtail Possum	1	
12/9/2006	2000	*Acrobates pygmaeus*	Feathertail Glider	1	Foraging within *Allocasuarina* sp.
12/9/2006	2005	*Pseudocheirus peregrinus*	Common Ringtail Possum	1	
12/9/2006	2010	*Pseudocheirus peregrinus*	Common Ringtail Possum	1 Adult; 1 Juvenile	

Opportunistic Observations:

4 mammal species were recorded opportunistically during the survey period. Swamp Wallaby *Wallabia bicolour* was observed within the study area on 11 September 2006; scats consistent with those of this species (Triggs 2004) were also found throughout the study area. Scats of European Red Fox *Vulpes vulpes* and European Rabbit *Oryctolagus cuniculus* were observed throughout the study area. Feeding signs consistent with those of either Northern Brown Bandicoot *Isoodon macrourus* or Long-nosed Bandicoot *Perameles nasuta* (Triggs 2004) were observed throughout the Coastal Sand Apple/Blackbutt Forest. *Isoodon macrurous* has previously been recorded within the study area (ERM 2005a) and as such these feeding signs are considered to be attributed to this species.

5.3.3 Flying Mammals

Ultrasonic Bat Detection:

Table 14 provides a summary of the results of ultrasonic bat detection surveys. Raw data is provided in Appendix 6.

TABLE 14 – RESULTS OF ULTRASONIC DETECTION

Scientific Name	Common Name	Legal Status	No. of Sequences	Accuracy*		
				Def	Prob	Pos
Chalinolobus gouldii	Gould's Wattled Bat		10	3	7	
Chalinolobus morio	Chocolate Wattled Bat		9	1	2	6
Miniopterus australis	Little Bent-wing Bat	V	37	25	11	1
Nyctophilus gouldii	Gould's Long-eared Bat		52			52
Nyctophilus geoffroyii	Lesser Long-eared Bat		52			52
Vespadelus vulturnus	Little Forest Bat		6	1	1	4
Mormopterus norfolkensis	Eastern Free-tail Bat	V	29	13	14	2
Mormopterus species 2	East Coast Free-tail Bat		2	1	1	

*Def = 100% accuracy; Prob = >50% accuracy; Pos = <50% accuracy.

As indicated in Table 14, 6 microchiropteran bat species were positively identified within the survey area during the survey period (*Chalinolobus gouldii, C. morio, Miniopterus australis, Vespadelus vulturnus, Mormopterus norfolkensis, M.* sp. 2) while 2 species were recorded to a lesser degree of accuracy (*Nyctophilus gouldii*, *N. geoffroyi*). Call sequences attribute to either *Nyctophilus gouldii* or *N. geoffroyi* are probably attributed to the latter species as it was likely observed during spotlighting. *N. geoffroyi* has a very distinctive light ventral surface (Churchill 1998). *Miniopterus australis* and *Mormopterus norfolkensis* are both listed as Vulnerable pursuant to the TSC Act.

Spotlighting:

No megachiropteran bat species were observed during spotlighting however Grey-headed Flying Fox *Pteropus poliocephalus* has previously been recorded flying over the study area (Conacher Travers 1998). A number of microchiropteran bats which were probably *Nyctophilus geoffroyi* were observed. Individuals observed had distinctly light ventral surfaces and the foraging behaviour (i.e slow manoeuvrable flight in mid to low canopy) was consistent with this species. It was also noted that echolocation was not continuous during these observations; species in this genus are known to stop echolocation as they approach fluttering insects and instead use passive listening to capture their prey (Churchill 1998).

5.3.4 Avifauna

Diurnal Avifauna:

49 diurnal bird species were recorded within and adjacent to the study area during the survey period (Appendix 5). 4 migratory bird species listed pursuant to the EPBC Act were recorded in the artificial wetland on the western side of Old Soldiers Point Road (Table 7; Figure 5).

Nocturnal Avifauna:

Tawney Frogmouth *Podargus strigoides* was recorded within the survey area during the survey period. Powerful Owl *Ninox strenua* was recorded in close proximity to the study area by ERM (2005a) however it was not observed within the study area.

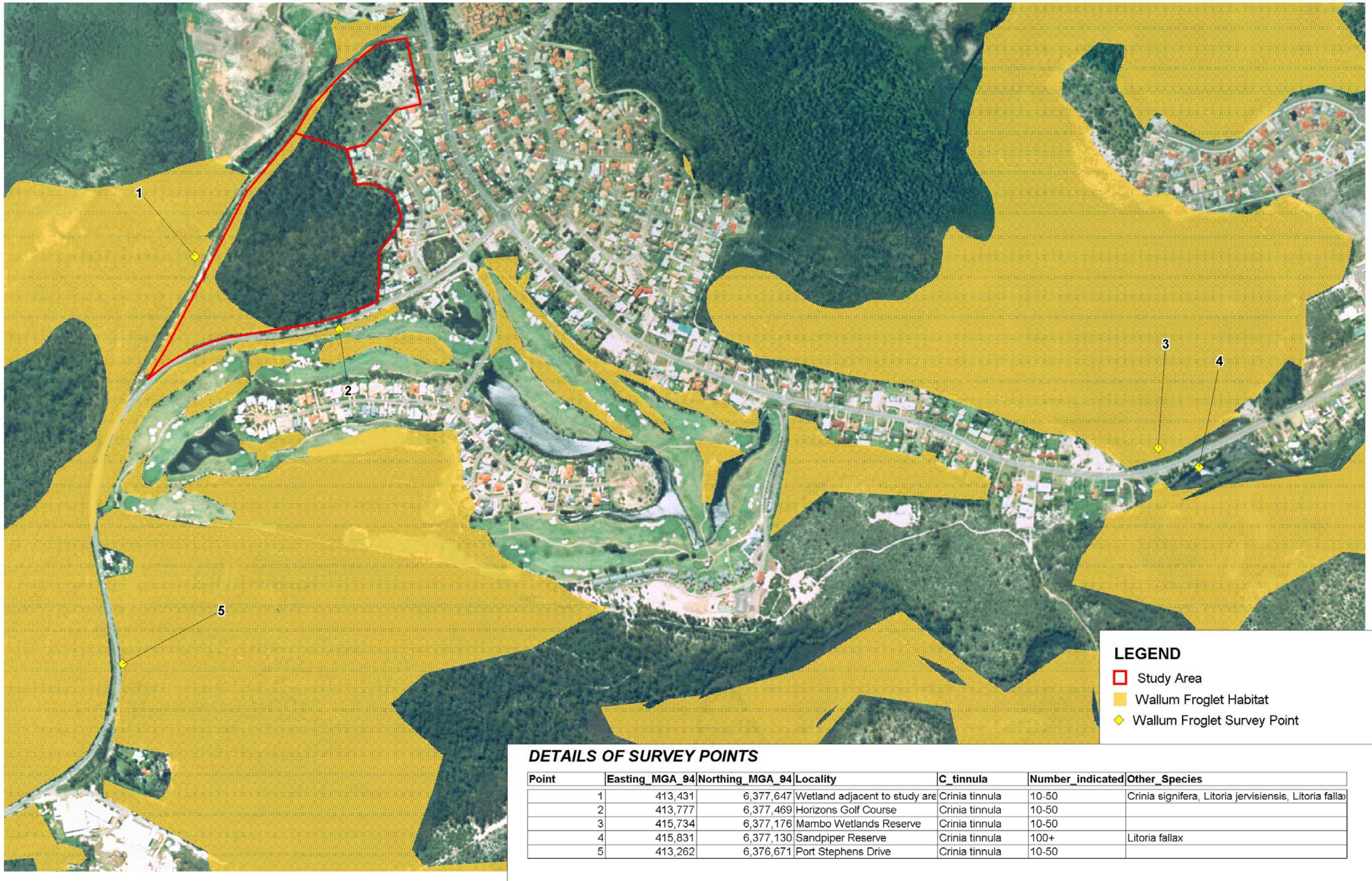
5.3.5 Herpetofauna

Amphibians:

6 amphibian species were recorded during the survey period. These were generally heard calling from the direction of the wetland within stage 1 and on the western side of Old Soldiers Point Road. Wallum Froglet *Crinia tinnula* (V TSC Act) was recorded adjacent to the study area and also in a number of other locations in the local area (Figure 5; Figure 6).

Reptiles:

1 reptile species, *Lampropholis delicata*, was recorded during the survey period. Previous ecological investigations (Conacher Travers 1998; ERM 2005a) also recorded Lace Monitor *Varanus varius*, Land Mullet *Egernia major* and Red-bellied Black Snake *Pseudechis porphyriacus*.



LEGEND

- Study Area
- Wallum Froglet Habitat
- Wallum Froglet Survey Point

DETAILS OF SURVEY POINTS

Point	Easting_MGA_94	Northing_MGA_94	Locality	C_tinnula	Number_indicated	Other_Species
1	413,431	6,377,647	Wetland adjacent to study are	Crinia tinnula	10-50	Crinia signifera, Litoria jervisiensis, Litoria fallax
2	413,777	6,377,469	Horizons Golf Course	Crinia tinnula	10-50	
3	415,734	6,377,176	Mambo Wetlands Reserve	Crinia tinnula	10-50	
4	415,831	6,377,130	Sandpiper Reserve	Crinia tinnula	100+	Litoria fallax
5	413,262	6,376,671	Port Stephens Drive	Crinia tinnula	10-50	

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DATE: 26/10/2006

SCALE - 1:8500

FIGURE 6: Wallum Froglet

PROJECT: Salamander Waters

CLIENT: Port Stephens Council

WORKSPACE: T:\04\04107 Hill PDA (PS Council) Salamander Waters\Map\03 wor\Ecology Figures\Final Figures\050707_Fiure_6.WOR

NOTE: All features are approximate only and subject to detailed survey.

6.0 DISCUSSION

6.1 Survey Limitations

Surveys were undertaken over 1 week in September 2006. This limits the possibility of recording cryptic species or species which utilise the site seasonally or periodically. The threatened terrestrial orchid *Cryptostylis hunteriana* has been recorded in close proximity to the study area in similar habitat (House 2003; DEC 2006). This species flowers from December to February and is not visible outside of this period (Bishop 1996). Therefore, this species was unlikely to be detected during the survey period if it does occur within the study area.

6.2 Flora

The habitat assessment presented in Appendix 2 concluded that the study area would provide potential habitat for 4 threatened flora species (Table 15).

TABLE 15 – THREATENED FLORA SPECIES WITH POTENTIAL HABITAT IN STUDY AREA

Scientific Name	Common Name	TSC Act	EPBC Act
Melaleuca groveana	Grove's Paperbark	V	
Tetratheca juncea	Black-eyed Susan	V	V
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V
Diuris praecox	Rough Double-tail	V	V

Assessment pursuant to s.5A of the EP&A Act (assessment of significance) is provided for these species in Appendix 7 and assessment pursuant to the EPBC Act is provided in Appendix 8.

Vegetation communities mapped within the study area by Andrews.Neil (2006) and ERM (2005a) are generally consistent with regional vegetation mapping by House (2003) (Figure 4). There are some small discrepancies in relation to the extent of swamp forest within the study area with House (2003) showing this vegetation type extending along the western boundary (Figure 4) which is not a true representation of the distribution. Further to this, the area mapped by ERM (2005a) as Lepironia Swamp is mapped as Coastal Sand Apple/Blackbutt Forest by House (2003).

The extent of Swamp Mahogany Paperbark Forest as indicated by House (2003) to the north west of the study area appears to be inaccurate (Figure 4). A brief walk-over in this area indicates that the Mangrove-Estuarine Complex is more extensive than indicated while Swamp Mahogany Paperbark Forest is less extensive. This vegetation has been identified as a Koala corridor previously (see ERM 2005a Figure 3.3), however this should be disregarded as it is considered unlikely that Koala would utilise this vegetation.

6.2.1 Endangered Ecological Communities

As indicated in Table 16, 2 Endangered Ecological Communities (EEC's) are considered to occur within the study area.

TABLE 16 – ENDANGERED ECOLOGICAL COMMUNITIES WITHIN STUDY AREA

Vegetation Community (ERM 2005a; Andrews.Neil 2006)		Regional Community (House 2003)	Inferred EEC	Area (ha)
1	Coastal Sand Apple/Blackbutt Forest	Map Unit 33 – Coastal Sand Apple Blackbutt Forest	-	15.76
2	Lepironia Swamp	Map Unit 46 – Freshwater Wetlands Complex	Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South-east Corner Bioregions	0.31
3	Disturbed Re-growth	-	-	2.65

Vegetation Community (ERM 2005a; Andrews.Neil 2006)		Regional Community (House 2003)	Inferred EEC	Area (ha)
4	Swamp Mahogany Paperbark Forest	Map Unit 37 – Swamp Mahogany Paperbark Forest	Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South-east Corner Bioregions	0.2
5	Swamp Forest	Map Unit 37 – Swamp Mahogany Paperbark Forest	Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South-east Corner Bioregions	1.8

As indicated in Table 16, 2 Endangered Ecological Communities listed pursuant to the TSC Act are considered to occur within the study area. Map Unit 4 and 5 are considered to be representative of "swamp sclerophyll forest" (SSF) while Map Unit 2 is considered to represent "freshwater wetlands" (FWW). Potential impacts on these communities are discussed below.

An analysis of vegetation mapping prepared by House (2003) was undertaken to determine the extent of distribution of these EEC's within Port Stephens LGA (Table 17; Figure 7).

TABLE 17 – ASSESSMENT OF DISTRIBUTION OF SSF AND FWW IN PORT STEPHENS LGA

Endangered Ecological Community (NSW Scientific Committee)	Map Unit (House 2003)	Area (ha)	Minimum Area (m^2)	Maximum Area (ha)	Average Area(ha)	Number of Patches
Swamp Sclerophyll Forest	MU 37 - Swamp Mahogany - Paperbark Forest	3007.39	<1	162.39	1.7156	1753
	MU 42 - Riparian Melaleuca Swamp Woodland	1274.72	<1	185.07	2.2054	578
	MU 43 - Wyong Paperbark Swamp Forest	0.54	17	0.51	0.18	3
	TOTAL	**4282.65**	**<1**	**185.07**	**1.8349**	**2334**
Freshwater Wetlands	MU 45 - Lepironia Swamp	35.9	336	25.22	2.7615	13
	MU 46 - Freshwater Wetland Complex	564.37	<1	196.82	2.5308	223
	TOTAL	**600.27**	**<1**	**196.82**	**2.5435**	**236**

Swamp Sclerophyll Forest:

Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions (NSW Scientific Committee 2004). It is characterised by an open to dense tree layer of eucalypts and paperbarks although some remnants now only have scattered trees as a result of partial clearing. The trees may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality where the tree stratum is low and dense (DEC 2005). For example, stands dominated by *Melaleuca ericifolia* typically do not exceed 8 m in height. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent (DEC 2005). The most widespread and abundant dominant trees include *Eucalyptus robusta* (swamp mahogany), *Melaleuca quinquenervia* (paperbark) and, south from Sydney, *Eucalyptus botryoides* (bangalay) and *Eucalyptus longifolia* (woollybut). A full description of this community is given in Appendix 9.

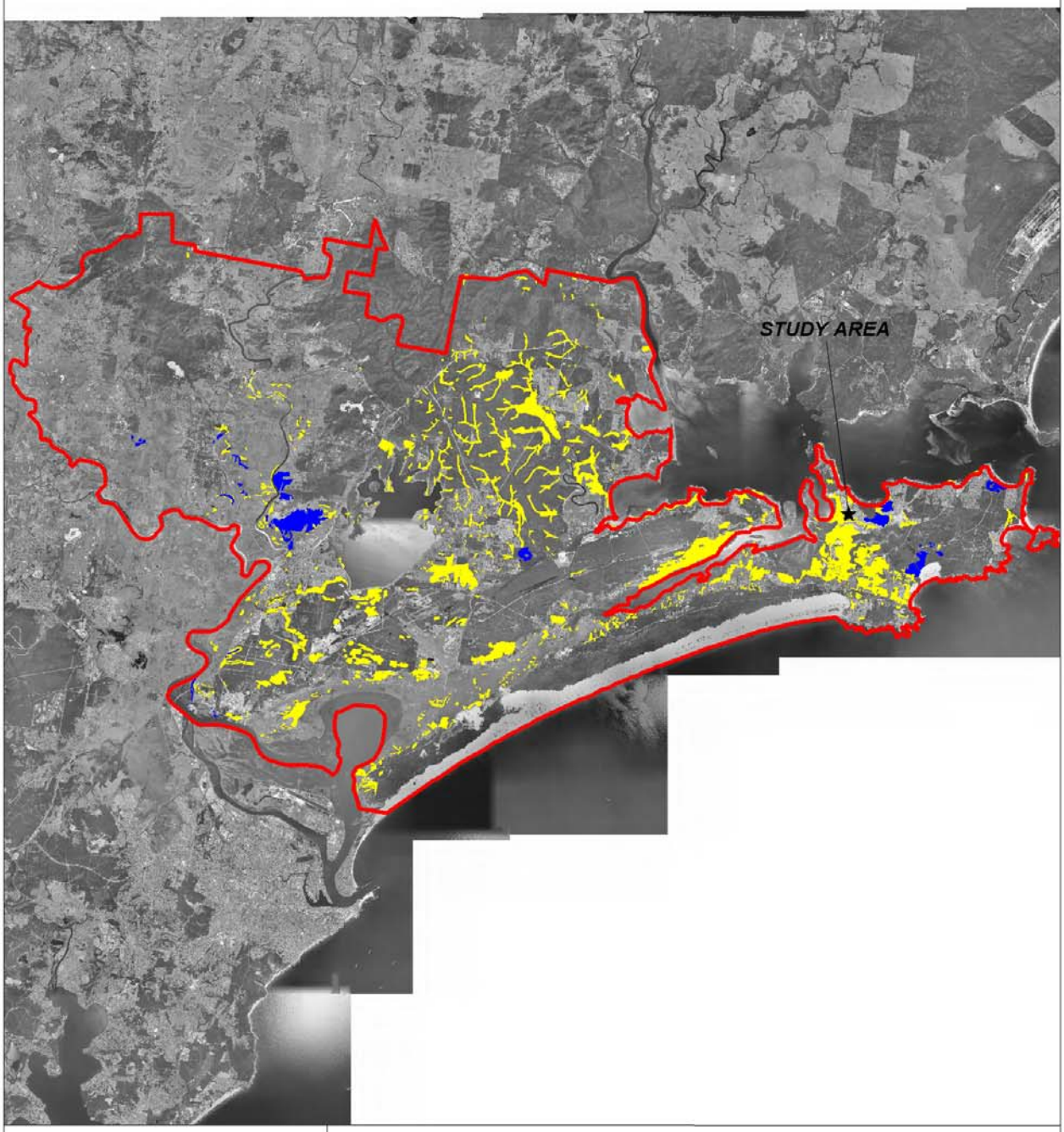
Vegetation within Map Unit 4 and 5 is considered to be representative of SSF. Therefore, approximately 2 hectares of SSF is considered to occur within the study area, which would represent approximately 0.05% of the extent of the community within the Port Stephens LGA (Table 17; Figure 7). The proposed development would result in the removal of approximately 0.2 hectares of this community which equates to approximately 10% of the extent of SSF within the study area and 0.005% of that within Port Stephens LGA.

The area that would be removed occurs as an isolated patch in stage 1 and it is considered that removal of this vegetation is unlikely to be significant. The area that would be retained occurs adjacent to the Lepironia swamp and also within the southern section of the study area. Management strategies need to consider indirect impacts such as weed invasion and modified hydrological regimes which could result from processes including urban runoff so that the integrity of the habitat within the community is not compromised.

Freshwater Wetlands:

Freshwater Wetlands are associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years (DEC 2005). Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas. They are dominated by herbaceous plants and have very few woody species. The structure and composition of the community varies both spatially and temporally depending on the water regime: Those that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including *Paspalum distichum* (water couch), *Leersia hexandra* (swamp rice-grass), *Pseudoraphis spinescens* (mud grass) and *Carex appressa* (tussock sedge). Where they are subject to regular inundation and drying the vegetation may include large emergent sedges over 1 metre tall, such as *Baumea articulata*, *Eleocharis equisetina* and *Lepironia articulata*, as well as emergent or floating herbs such as *Hydrocharis dubia* (frogbit), *Philydrum lanuginosum* (frogsmouth), *Ludwigia peploides* subsp. *montevidensis* (water primrose), *Marsilea mutica* (nardoo) and *Myriophyllum* spp. (milfoils). As standing water becomes deeper or more permanent, amphibious and emergent plants become less abundant, while floating and submerged aquatic herbs become more abundant. These latter species include *Azolla filiculoides* var. *rubra*, *Ceratophyllum demersum* (hornwort), *Hydrilla verticillata* (water thyme), *Lemna* spp. (duckweeds), *Nymphaea gigantea* (giant waterlily), *Nymphoides indica* (water snowflake), *Ottelia ovalifolia* (swamp lily) and *Potamageton* spp. (pondweeds). The threatened aquatic plants, *Aldrovanda vesiculosa* and *Najas marina*, also occur within this community (DEC 2005). A full description of this community is given in Appendix 9.

Vegetation within Map Unit 2 is considered to be representative of FWW. Therefore, approximately 0.31 hectares of FWW occurs within the study area which would represent approximately 0.05% of the extent of this community within Port Stephens LGA (Table 17; Figure 7). The proposed development is unlikely to result in direct impacts on this community as it is situated within the 100 metre wide corridor which would be retained. Notwithstanding, indirect impacts such as weed invasion and modified hydrological regimes which could result from processes including urban runoff need to be managed to ensure that the community is not compromised.



LEGEND

- Port Stephens
- Freshwater Wetlands
- Swamp Sclerophyll Forest

NOTE:

All features are approximate only and subject to detailed survey.

Distribution of EEC's based on LHCCREMS Mapping (House 2003).

FIGURE 7: Extent of SSF & FWW in Port Stephens

PROJECT: Salamander Waters

CLIENT: Port Stephens Council

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6.2.2 Noxious Weeds

The objectives of the *Noxious Weeds Act, 1993* (NW Act) are as follows (Part 1 Section 3):

(a) to reduce the negative impact of weeds on the economy, community and environment of this State by establishing control mechanisms to:

(i) prevent the establishment in this State of significant new weeds, and
(ii) restrict the spread in this State of existing significant weeds, and
(iii) reduce the area in this State of existing significant weeds,

(b) to provide for the monitoring of and reporting on the effectiveness of the management of weeds in this State.

The objectives of the act are achieved by a process of declaring a plant as a noxious weed by way of a weed control order (Part 2 Section 7(1)) and applying a weed control class or classes to the plant (Part 2 Section 7(2)). The weed control classes are listed in Part 2 Section 8, a summary of this section is given in Table 18 below:

TABLE 18 – WEED CONTROL CLASSES AND CHARACTERISTICS

Weed Control Class	Control Level	Characteristics
1	State Prohibited Weeds	Plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.
2	Regionally Prohibited Weeds	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.
3	Regionally Controlled Weeds	Plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.
4	Locally Controlled Weeds	Plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.
5	Restricted Plants	Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

Under Section 8(3), a weed which is classified as a class 1, 2 or 5 noxious weed is referred to in the NW Act as a "notifiable weed". Under Part 4, Division 2, Section 40 of the NW Act, the Department of Primary Industries has more power in relation to the control of notifiable weeds.

Table 19 identifies the noxious weeds recorded within the study area during the survey period and provides the control measures required pursuant to the NW Act.

TABLE 19 – NOXIOUS WEEDS OCCURING IN THE STUDY AREA

Scientific Name	Common Name	Weed Control Class	Control Measures
Lantana camara	Lantana	5	The requirements of the NW Act for a notifiable weed must be complied with. Port Stephens Council (2006) indicates that the trade of any species of Lantana is prohibited however there are no specific requirements to otherwise control Lantana.
Chrysanthemoides monilifera	Bitou Bush/Boneseed	4	The growth and spread of the plant must be controlled according to the measures identified in a management plan published by the local control authority (Appendix 10).

A Weed Management Strategy should be implemented within the study area to control the noxious weeds listed above and other exotic species that occur (see Appendix 4 for flora species list). A suitably qualified and experience bush regeneration contractor should be engaged to undertake the required works and a monitoring and maintenance period of 5 years following the completion of construction should be considered.

6.3 Fauna

6.3.1 Squirrel Glider

The Squirrel Glider is an intermediate size gliding marsupial, one of four species in the genus. It is listed as Vulnerable pursuant to the TSC Act, and was recorded within and adjacent to the survey area during the survey period (Table 10; Figure 5). Thus, this species needs to be considered in the overall planning process for the proposed development.

The Squirrel Glider is a hollow-dependant; mainly nectivorous species (also feeds on insect and plant exudates). Although a definitive model of its habitat is yet to be developed, the current knowledge suggests that Squirrel Glider occurs in mixed eucalypt forests with a high proportion of hollow-bearing trees, and winter-flowering nectiferous tree or shrub species (Smith & Murray, 2003).

The NSW Scientific Committee determined to list the Squirrel Glider as Vulnerable pursuant to the TSC Act for the following reasons:

- Its distribution has been reduced,
- Its population has been severely reduced,
- It faces severe threatening processes,
- It is an ecological specialist (it depends on particular types of diet or habitat), and
- It has poor recovery potential.

The following threats have been identified in relation to Squirrel Glider conservation (DEC 2005):

- Loss and fragmentation of habitat due to clearing and associated activities,
- Logging of old growth elements of forests resulting in a reduction of hollow bearing trees,
- Inappropriate fire regimes resulting in a depletion of foraging resources and isolation of populations making them susceptible to catastrophic events, and
- Predation by foxes and cats.

Habitat Requirements:

Throughout its range the Squirrel Glider is found in dry forest and woodland associations dominated by winter flowering eucalypts or with an understorey of winter flowering Banksias or gum producing Acacias (Smith 2002). These habitats may be broadly classified into the following types (Smith 2002):

- Type 1 Box-ironbark forests of the inland or western slopes of the Great Dividing Range;
- Type 2 Gum-ironbark forests of the inland rivers, western slopes and the coastal foothills and plains;
- Type 3 *Eucalyptus-Banksia* forests and woodlands of the coastal plains and tablelands;
- Type 4 Swamp forests of the coastal plains dominated by winter flowering *Eucalyptus robusta* and *Melaleuca* spp.
- Type 5 *Eucalyptus-Acacia* forests and woodlands with an understorey of winter gum producing *Acacia* spp.

With reference to Smith (2002), the study area contains both Type 3 and Type 4 vegetation communities with Type 4 communities dominating surrounding connected habitat (House 2003). Surveys targeting Squirrel Glider resulted in 8 captures (Table 10), the majority of which were within or directly adjacent to Swamp Forest.

The occurrence and abundance of Squirrel Glider in fragments in urban areas is influenced and limited by a number of factors, principally food resources, density of hollow-bearing trees, fragment size and connectivity between fragments (Smith 1998; Smith 2000; Winning & King 2001a; Winning & King 2001b; Winning & King 2001c). At some sites, the Squirrel Glider population size (and density) appears to be limited by the availability of food resources (Smith & Murray 2003), while at other sites the population is limited to the availability of tree hollows (Winning & King 2001a; Winning & King 2001b) or connectivity between fragments (Winning & King 2002).

Local Population:

Estimating the local population of Squirrel Glider is problematic. Population sizes can vary significantly in relation to several extrinsic factors, including floristic diversity and composition, fire history, management regimes such as underscrubbing and slashing, abundance of suitable hollows, competition with Sugar Gliders, size of vegetation fragment and distance to other fragments and predation pressure.

Squirrel Gliders are not a highly mobile species and can be limited by geographical and human-made barriers, including large areas of cleared land (>75 metres wide) and busy wide highways. The Squirrel Glider population occurring within the local area would cover, at least, the remnant bushland in the study area, and connected vegetation to the north, west and south. The study area is bounded to the south by Port Stephens Drive; it is considered that Squirrel Glider would be able to cross this road further to the south of the study area where large trees occur on either side of the road.

Vegetation mapping prepared by House (2003) was queried within the local area to gain an indication of the extent of Squirrel Glider habitat available to the local population. Table 20 provides a list of communities which are mapped as occurring within the local area that are considered to provide Squirrel Glider habitat. It should be noted that this is purely a desktop study and ground truthing would be required to accurately determine the extent and accessibility of habitat for Squirrel Glider within the local area.

TABLE 20 – SQUIRREL GLIDER HABITAT WITHIN THE LOCAL AREA

Vegetation Community (House 2003)	Total Area (ha)	Minimum Area (m^2)	Maximum Area (ha)	Average Area(ha)	Number of Patches
MU 5 - Alluvial Tall Moist Forest	24.6	0.5	10.7	1.1	22.0
MU 15 - Coastal Foothills Spotted Gum - Ironbark Forest	0.8	11.9	0.8	0.3	3.0
MU 30 - Coastal Plains Smooth-barked Apple Woodland	0.0	381.5	0.0	0.0	1.0
MU 32a - Scrub	268.2	9.3	90.3	8.9	30.0
MU 32 - Nerong Smooth Barked Apple Forest	233.7	0.5	35.8	3.7	63.0
MU 33 - Coastal Sand Apple - Blackbutt Forest	3365.3	<1	772.1	3.7	917.0
MU 34 - Coastal Sand Wallum Woodland - Heath	77.9	<1	50.4	3.7	21.0
MU 34a - Heath	506.6	<1	240.2	7.9	64.0
MU 36a - Heath	238.0	<1	83.9	4.2	56.0
MU 36 - Tomago Sand Swamp Woodland	235.6	<1	195.7	4.4	53.0
MU 37 - Swamp Mahogany - Paperbark Forest	1404.2	<1	145.0	2.3	611.0
MU 44 - Coastal Wet Sand Cyperoid Heath	286.2	<1	102.7	2.2	132.0
MU 48 - Coastal Clay Heath	61.5	<1	10.8	0.7	88.0
MU 49 - Wallum Clay Scrub Heath	49.3	983.9	28.1	9.9	5.0
MU 50 - Coastal Sand Scrub	12.5	<1	3.2	0.5	23.0
MU 52 - Rocky Headland Scrub	19.1	<1	3.5	0.3	67.0
TOTAL	**6783.5**	**<1**	**772.1**	**3.2**	**2156.0**

As indicated in Table 20, review of House (2003) indicates that there is extensive Squirrel Glider habitat within the local area (6783 hectares). However, the total area of habitat available to the local population is likely to be lower than the total area of habitat calculated by this analysis due to fragmentation within and between patches. Review of low resolution aerial photography at a scale of 1:100,000 indicates that habitat within the western section of the local area would be inaccessible to the local population assessed in this report (Figure 8) and as such there is approximately 4342 hectares of available habitat. The proposal would require the removal of approximately 13 hectares of known habitat for Squirrel Glider which equates to approximately 0.3% of available habitat within the local area. Removal of habitat at this scale is unlikely to significantly effect the local population.

An individual Squirrel Glider requires three essential elements during its life cycle; den trees, foraging habitat and accessibility to mating partners. These essential elements are discussed below.

Den trees:

Van der Ree (2002) found that up to 19 hollows may be used by a social group of Squirrel Gliders within their home range. This behaviour is known as "den swapping" and is thought to occur for a number of reasons including (Gibbons and Lindenmayer 2002; Lindenmayer 2002):

- Predator avoidance,
- avoidance of ectoparasites,
- Change in environmental conditions. Environmental conditions may vary between dens making them suitable at different times of the year,
- The distribution of foraging resources within a home range may influence the time of year a certain den is utilised. Den trees which are close to foraging resources may be used in order to reduce the energy requirements of commuting between resources, and
- Territoriality. A dominant male glider may mark a number of hollows within its home range to signify that they are occupied and to deter other males.

In some instances the distribution and density of hollows within a landscape can limit the "carrying capacity" of the landscape for a hollow obligate species. For example Lindenmayer *et al.* (1990) found that in the central highlands of Victoria, the abundance of the Mountain Brushtail Possum, *Trichosurus caninus*, and the Greater Glider, *Petauroides volans*, increased with an increase in the number of available tree hollows. Similarly, also in the Victorian central highlands, Smith and Lindenmayer (1988) found a linear relationship between the total possum and glider density and the number of potential nest trees until there were more than 12 potential nest trees per 3 hectares. At densities greater than 12 potential nest trees per 3 hectares, other factors (e.g. food) were possibly limiting the possum and glider density.

Hollow resources are not a limiting factor in the study area given that there could be as many as 61 hollows per hectare within Map Unit 1 and 20 hollows per hectare within Map Unit 5 (Table 8). During the survey period very little flowering was observed within the tree stratum or the middle stratum indicating that the availability of foraging resources may have influenced the abundance of Squirrel Glider.

Foraging habitat:

Squirrel Gliders feed on insect and plant exudates (such as honeydew, manna and sap) and nectar and pollen. High quality foraging habitat is thought to consist of mixed eucalypt woodland with high densities of nectar producing shrubs (such as *Banksia* spp.) in the understorey (Rowston 1998; Sharpe and Goldingay 1998; Smith and Murray 2003). Winter flowering tree species such as *Eucalyptus robusta* are also likely to be important. Table 21 provides a list of known food plants occurring within the study area (Menkhorst *et al*. 1988; Sharpe & Goldingay 1998; Smith & Murray 2003) and an indication of the dominant flowering period of each species.

As shown in Table 21, year round foraging resources are available for Squirrel Glider within the study area however nectar and pollen resources would be scarce between April and November. The most abundant nectar and pollen resources included *Eucalyptus pilularis*, *Angophora costata*, *Corymbia gummifera* and *Banksia serrata*. Given the flowering period of these resources it is likely that Squirrel Glider and other nectarivorous species would be more abundant within the study area during the summer and early autumn.

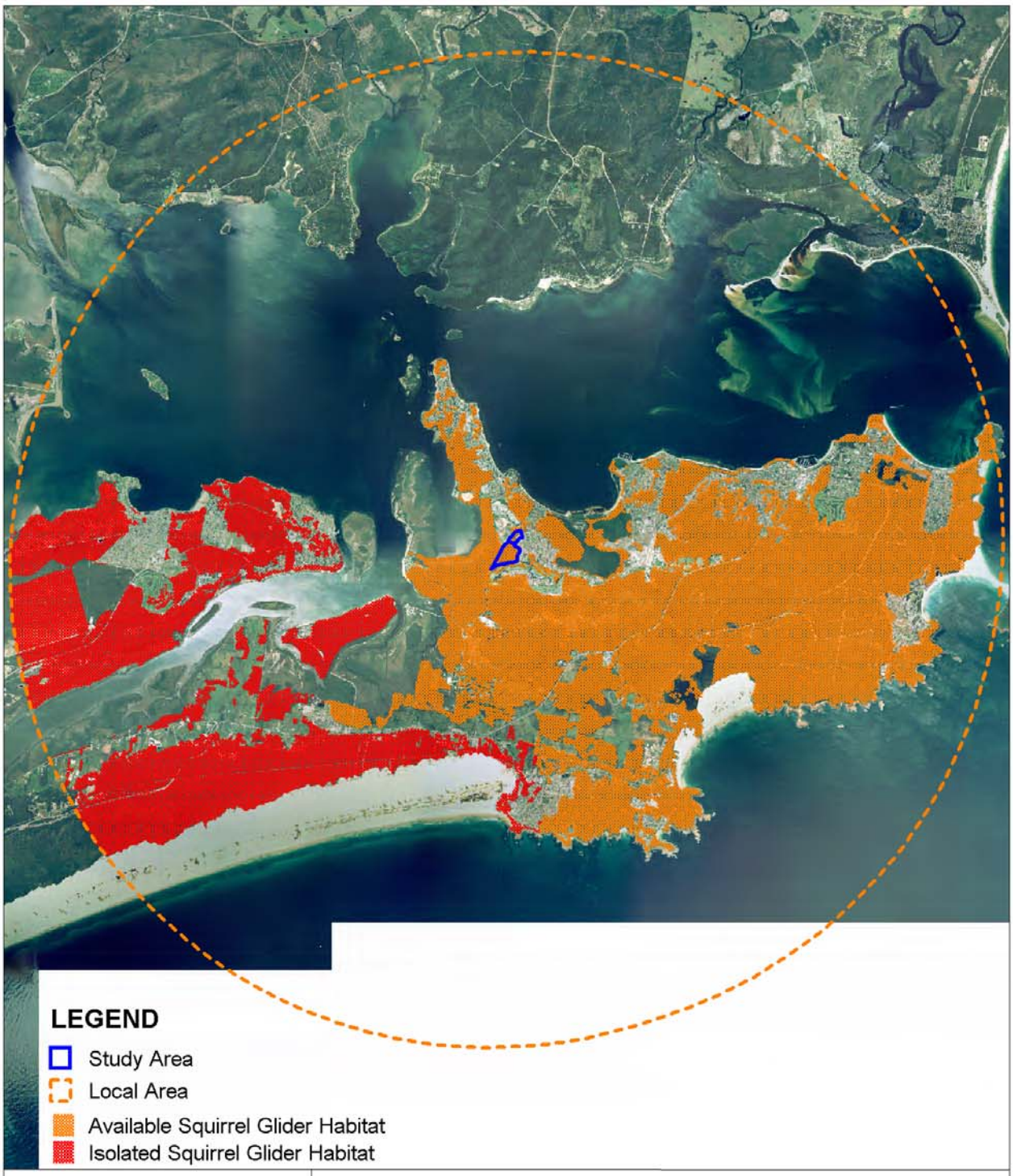
Gliders captured during the survey period were relatively young (an estimate of age was obtained following Quinn 1995) however the incisor teeth in most of these individuals were more worn than would normally be expected. This may be an indication that the gliders living within the study area are feeding more on “hard foods” such as plant and insect exudates including sap and mana rather than nectar and pollen.

Movement and access to breeding partners:

Squirrel Gliders will form family groups that occupy almost exclusive territories. Within these territories many den trees are used and communal denning is common. Dispersing individual males need to establish their own territory in order to acquire access to many females; alternatively males can become satellite males and mate with females from other parts or other family groups. With these factors in mind the major considerations for the local Squirrel Glider population within the habitat matrix of the region are:

- what habitat opportunities currently exist within the matrix?;
- what is the security of these habitats?;
- Are there spatial genetic barriers within the habitat matrix that constrain the spatial limits of the local population? and;
- What is the required habitat matrix threshold for the local population to remain viable?

It is considered that the local population would occur in a series of interconnecting fragments ranging in size from less than 1 hectare to approximately 770 hectares (Table 20; Figure 8). No detailed investigations are known to have been undertaken to determine population dynamics and demography of the local Squirrel Glider population and further to this potential movement corridors and barriers have not been investigated. In relation to the study area, the vegetation within the proposed corridor would function as a potentially important link between suitable habitat within Wanda Wetlands reserve, habitat within the study area and habitat to the south of the study area. It is considered that Squirrel Glider could cross Soldiers Point Road, a gap of approximately 35 metres (see Jackson 1999 for a review on glide angles and distance in *Petaurus* spp.); however to enhance this link it is recommended that additional *Eucalyptus robusta* be planted closer to the road to minimise the gap and thus make it easier for gliders to cross.



NOTE: All features are approximate only and subject to detailed survey.

Squirrel Glider habitat based on LHCCREMS Mapping (House 2003)

FIGURE 8: Squirrel Glider Habitat

PROJECT: Salamander Waters

CLIENT: Port Stephens Council

NORTH

DATE: 25/10/2006

SCALE - 1:127000

Our Ref: WB/04107/050707rpt_final

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TABLE 21 – SQUIRREL GLIDER FORAGING RESOURCES

Species	Common	Resource	Availability*											
Nectar and Pollen Resources			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Angophora costata	Smooth-barked Apple	Exudates, nectar, pollen	■									■	■	■
Corymbia gummifera	Red Bloodwood	Exudates, nectar, pollen	■	■	■	■	■							
Eucalyptus pilularis	Blackbutt	Exudates, nectar, pollen	■											■
Eucalyptus robusta	Swamp Mahogany	Exudates, nectar, pollen						■	■	■	■	■	■	
Melaleuca quinquenervia	Broad-leaved Paperbark	Nectar, pollen, insects			■	■	■	■	■	■				
Melaleuca sieberi	Sieber's Paperbark	Nectar, pollen, insects	■	■										■
Banksia serrata	Old-man Banksia	Nectar, pollen	■	■	■									■
Exudates														
Acacia elongata	Swamp Wattle	Gum	*Exudates are considered to be available throughout the year*											
Acacia irrorata	Green Wattle	Gum												
Acacia longifolia	Sydney Golden Wattle	Gum												
Acacia longissima	Narrow-leaved Wattle	Gum												
Acacia suaveolens	Sweet-scented Wattle	Gum												
Leptospermum polygalifolium	Lemon-scented Tea Tree	Insects												
Leptospermum trinervium	Flaky-barked Tea Tree	Insects												
Persoonia levis	Broad-leaved Geebung	Insects, fruit												
Persoonia lanceolata	Lance-leaved Geebung	Insects, fruit												

*Flowering times for nectar and pollen resources taken from PlantNet (2006).

6.3.2 Koala

The Koala is an arboreal marsupial with fur ranging from grey to brown above, and is white below. It has large furry ears, a prominent black nose and no tail. It spends most of its time in trees and has long, sharp claws, adapted for climbing. Adult males weigh 6 - 12 kg and adult females weigh 5 - 8 kg. During breeding, males advertise with loud snarling coughs and bellows (DEC 2005).

Notwithstanding the definitive appearance of this species, making observations of free-ranging Koalas can be difficult. This is in part due to the cryptic nature of the species and the large and complex home ranges that individuals occupy (100 hectares plus) (White 1990). The species is identified as a "species in decline" and there are many intricate factors that limit free-ranging Koala populations, including food tree preferences, history of disturbance, and Chlamydia infection, all of which make longer-term population trends of many populations difficult to predict (Phillips 2000).

The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the western region. It was historically abundant on the south coast of NSW, but now occurs in sparse and possibly disjunct populations. Koalas are also known from several sites on the southern tablelands (DEC 2005).

Foraging Requirements:

Koala is an obligate folivore that feeds primarily on the genus *Eucalyptus*. Throughout their range they have been recorded feeding on a wide variety of eucalypt and non-eucalypt species however within a particular area only a few of the *Eucalyptus* species will be preferentially utilised while others, including some non-eucalypt genera, appear to be browsed opportunistically or used for other behavioural purposes (Phillips *et al.* 2000; Moore and Foley 2000).

Phillips *et al.* (2000) studied the feeding preferences of Koala in the Port Stephens Local Government Area concluding that 2 species *Eucalyptus robusta* Swamp Mahogany and *Eucalyptus parramattensis* Drooping Red Gum are the most preferred feed species. Up to 10 additional eucalypt species and 17 non-eucalypt species were found to be utilised by Koala however it was concluded that the importance of supplementary feeding resources was related to the proximity of preferred foraging habitat. For example, the Coastal Sand Apple-Blackbutt community which is dominated by *Eucalyptus pilularis*, *Angophora costata* and *Corymbia gummifera* is considered to be of marginal importance to Koala in Port Stephens except where it occurs adjacent to areas containing either *Eucalyptus robusta* or *E. parramattensis* in which case it would provide supplementary Koala habitat (Phillips *et al.* 2000).

Results of spot surveys conducted within and adjacent to the study area during this survey support the conclusions of Phillips *et al.* (2000), the highest Koala activity was recorded for *Eucalyptus robusta*. Koala's were only noted to be active on the western side of the study area both within the Swamp Forest and the Coastal Sand Apple/Blackbutt Forest. It is likely that Koala only utilises the later community due to the dieback of *Eucalyptus robusta* on the western side of Old Soldiers Point Road, apparently as a result of changes in the hydrological regime. Notwithstanding, the western side of the study area is considered to be important habitat for Koala in providing supplementary foraging resources, refuge habitat and a movement corridor. As part of the proposed development a 100 metre wide corridor would be retained along the western edge of the study area. It is considered that retention of this corridor together with some supplementary planting of *Eucalyptus robusta* in the areas indicated in Figure 9 would successfully mitigate any potential impacts on Koala and would improve Koala dispersal opportunities in the vicinity of the study area.

Dispersal:

Studies of Koala ecology over the past 30 years have identified dispersal as playing an important role in the dynamics of localised Koala populations as many young male and female Koalas frequently disperse from their natal range soon after weaning (Dique *et al.* 2003). A number of reasons for dispersal have been postulated including competition for mates, competition for resources and the avoidance of inbreeding (Dique *et al.* 2003). These mechanisms would likely affect males and females in different ways depending on mating systems for instance in a polygynous system young males are more likely to disperse in response to aggression or in search of greater mating opportunities (Dique *et al.* 2003).

Koala populations become vulnerable to decline when habitat becomes fragmented and dispersal opportunities are reduced. Review of aerial photography indicates that habitat within the local area is highly fragmented and as such the importance of maintaining corridors within the landscape to facilitate dispersal is paramount. The retention and improvement of the corridor on the western side of the study area would improve koala dispersal opportunities in the vicinity of the study area. Further recommendations relating to Koala management are provided in section 8 of this report.

6.3.3 Flying Mammals

There are approximately 76 species of bat in Australia all of which occur in a diverse range of environments. Australian bats can be divided into two sub-orders: microchiroptera and megachiroptera. Microchiropteran bats are largely insectivorous and generally navigate using echolocation. There are six families represented in Australia with 63 different species (Hall and Richards 2000). Generally they are much smaller than megachiropteran bats. Megachiropeteran bats are phytophagous (they feed on plant products) and are generally much larger than microchiropteran species. In Australia, there are 13 species all occurring in one family, Pteropodidae (Hall and Richards 2000). Within Port Stephens LGA 21 species of microchiropteran bats from 4 families have been recorded (DEC 2006) while 2 species of megachiropteran bats have been recorded (Table 22).

Species Richness of Flying Mammal Assemblages:

Bats are recognised as an important fauna group in indicating forest health because they are often the most species-rich mammal group in a forest (Irvin *et al.* 2003). This suggests that high levels of bat diversity indicate a relatively healthy forest and a low diversity a relatively unhealthy forest. Up to 8 species were recorded within the survey area during the survey period while 2 additional species were recorded during previous surveys (Conacher Travers 1998) indicating that at least 10 microchiropteran bat species are known to utilise the study area. This represents 48% of the species known to occur within Port Stephens LGA indicating that the vegetation within the study area is relatively healthy.

Bat species which coexist avoid competition (e.g. Hutchinson 1959; McArthur & Levins 1967; Connell 1983; Schoener 1983). Specialized morphological, behavioural and dietary adaptations (e.g. Saunders & Barclay 1992; Kalko, Handley & Handley 1996) help minimise competition among bat species (e.g. Osche 1973). There is also likely to be temporal variation in bat diversity within the study area as many species utilise different areas at different times in their life cycles (Churchill 1998). Thus the diversity of flying mammals within the study area may not be limited to the species that were recorded during this snapshot survey. This is made evident by the fact that previous surveys detected the presence of 2 species that were not recorded during this survey (Appendix X). Further to this the habitat within the study area is considered to be suitable for 6 microchiropteran species and 1 megachiropteran species which have not been recorded to date (Table 22).

Bats which occur in the same area partition resources through different foraging habitat preferences, which correspond with their morphological and behavioural adaptations such as flight ability (a bat's manoeuvrability and flight speed), echolocation call design, hunting behaviour and body size (Findley 1993; Altringham 1996; Pavey and Burwell 2000). Degree of clutter within an environment is particularly important factor influencing microhabitat utilisation by different species (eg. Pavey 2003).

The study area is vegetated by open forest which is characterised by three distinctive strata providing high structural diversity. A number of fire trails occur within the study area creating open fly ways that provide good foraging habitat opportunities for many microchiropteran bat species. A high density of hollow bearing trees were recorded (Table 8) indicating that it is likely that hollow obligate species, such as *Mormopterus norfolkensis*, would be roosting within the study area.

TABLE 22 – CHIROPTERA KNOWN TO PORT STEPHENS LGA (DEC 2006)

Sub-order	Family	Scientific Name	Common Name	Legal Status	Recorded within Study Area	Potential Habitat if not recorded?
Microchiroptera	Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V	No	Yes
	Molossidae	*Mormopterus loriae*	Little Northern Freetail-bat	P	No	No
		Mormopterus norfolkensis	Eastern Freetail-bat	V	Yes	
		Tadarida australis	White-striped Freetail-bat	P	No	Yes
	Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	No	Yes
		Chalinolobus gouldii	Gould's Wattled Bat	P	Yes	
		Chalinolobus morio	Chocolate Wattled Bat	P	Yes	
		Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	No	Yes
		Kerivoula papuensis	Golden-tipped Bat	V	No	No
		Miniopterus australis	Little Bentwing-bat	V	Yes	
		Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	Yes	
		Myotis adversus	Large-footed Myotis	V	No*	No
		Nyctophilus geoffroyi	Lesser Long-eared Bat	P	Yes	
		Nyctophilus gouldi	Gould's Long-eared Bat	P	Yes	
		Scoteanax rueppellii	Greater Broad-nosed Bat	V	Yes	
		Scotorepens orion	Eastern Broad-nosed Bat	P	Yes	
		Vespadelus darlingtoni	Large Forest Bat	P	No	Yes
		Vespadelus pumilus	Eastern Forest Bat	P	No	Yes
		Vespadelus regulus	Southern Forest Bat	P	No	Yes
		Vespadelus vulturnus	Little Forest Bat	P	Yes	
Megachiroptera	Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	Yes	
		Pteropus scapulatus	Little Red Flying-fox	P	No	Yes

**Myotis adversus* was recorded over the wetland adjacent to the study area by Conacher Travers (1998). No habitat exists within the study area.

Habitat Selection:

It has been suggested that bat habitat preferences can be determined by analysing foraging and roosting habitats in terms of structure and floristics (Herr 1998; Pavey and Burwell 2000; Pavey and Burwell 2004). Habitat requirements of many species of microchiroptera are poorly known (Strahan 1995; Menkhorst 1995; Churchill 1998). This is problematic for the management of microchiropteran bats because determining which resources or suites of resources within a given landscape are important is difficult. The roosting habitat can be geographically and temporally different from the foraging areas (e.g. Menkhorst & Lumsden 1995a) however for many forest dwelling species these habitats may interact and overlap due to the connectivity of vegetation exhibited in forest landscapes (e.g. Tidemann & Flavel 1987; Taylor & Savva 1988; Lunney 1989).

The high degree of connectivity exhibited in forest landscapes and the subsequent interaction and overlapping between roosting and foraging habitats is advantageous for bat species in terms of energy efficiency. It reduces the amount of energy they use commuting between the roosting and foraging resources and directly influences the survival of young (e.g. Tuttle & Stevenson 1982; Altringham 1996).

While some microchiropteran bat species show a tendency to consistently use a particular roost site, increasing research is suggesting that many species establish and maintain familiarity with one or more alternate roosts (Kunz 1982; Herr 1998). For example, Large Bent-wing Bats (*Miniopterus schreibersii oceanensis*) show fidelity for a number of roost sites, each of which is used at different stages in the life cycle (eg. maternity roosts, over-wintering roosts and mating roosts) (Hoye and Spence 2004). Additionally, Irvin (1998) found that fidelity to a general area was exhibited by *Vespadelus darlingtoni* and *Nyctophilus geoffroyi*. Lunney *et al.* (1988) found that *N. geoffroyi* and *N. gouldii* both roost and forage in an area of less than 1 km from their cluster of roosts. Likewise *Chalinolobus morio* and *C. gouldii* confined their activity to an area within 5 km of their roosts (Lunney *et al.* 1985).

Radio tracking studies have found that many hollow dependant species preferentially select the largest available trees for roosting for example *Nyctophilus gouldii* (Lunney *et al.* 1988), *Chalinolobus morio* (Lunney *et al.* 1985), *C. gouldii* and *Nyctophilus geoffroyii* (Lumsden *et al.* 1994) and *Vespadelus pumilus* (Law and Anderson 2000) (cited in Parnaby and Hamilton-Smith 2004). Further to this, Campbell *et al.* (2005) found that female *Vespadelus vulturnus* on Philip Island preferentially selected trees that were dead or contained >30% dead timber. All the above mentioned species are considered to be common and have been presumed to be ecological generalists, however, their specialised roosting preferences would indicate that they are vulnerable to decline or elimination as such roosting resources are rare throughout most Australian landscapes (Parnaby and Hamilton-Smith 2004).

Roosting and Foraging Habitat Preferences:

***Mormopterus norfolkensis*:**

The Eastern Freetail-bat *Mormopterus norfolkensis* has dark brown to reddish brown fur on the back and is slightly paler below. Like other freetail-bats it has a long (3 - 4 cm) bare tail protruding from the tail membrane. Freetail-bats are also known as mastiff-bats, having hairless faces with wrinkled lips and triangular ears. They weigh up to 10 grams (DEC 2005).

During the current survey this species was positively identified throughout the survey area, 29 call sequences were recorded to varying degrees of accuracy during both transects and at all night stations (Table 14; Appendix 6; Figure 5). The results show that this species was active within the survey area throughout the night with calls recorded between 1918 hrs and 0501 hrs. The fact that this species was active within the survey area at 0501, approximately 1 hour before sunrise, indicates that it is likely to be roosting within the survey area.

The uncertainty surrounding the taxonomy and field identification of *Mormopterus* species in south-eastern Australia has resulted in problems regarding the validity of recent literature records of the species (Parnaby 1998). The known range of the species extends from central New South Wales along the coast and Great Dividing Range to south-east Queensland (Allison and Hoye 1995). In New South Wales, *M. norfolkensis* has been recorded in dry and wet sclerophyll forests and woodlands, with one record from rainforest (Parnaby 1998). Little is known about the roosting or feeding requirements of this species however it is thought to forage above the canopy and has been recorded roosting in tree hollows (Allison and Hoye 1995).

Duncan *et al.* (1999) suggest that threats to this species are likely to include habitat modification, such as clearing for development and logging. This is based largely on the fact that the known distribution of this species is limited to coastal NSW and SE Qld where population growth is concentrated.

***Miniopterus australis*:**

Little Bent-wing Bat *Miniopterus australis* are small chocolate brown insectivorous bats with a body length of about 45 mm. The fur is long and thick, especially over the crown and around the neck. The tip of the wing is formed by a particularly long joint of the third finger (DEC 2005).

Little Bent-wing Bat was positively recorded within the survey area during the survey period, 37 call sequences were recorded to varying degrees of accuracy during both transect surveys and at all night stations (Table 14; Figure 5; Appendix 6). This species preferentially roosts in caves however tunnels, old mines and sometimes tree hollows are also used (DEC 2005). It often shares roosts sites with Large Bent-wing Bats and it is thought that large mixed-species colonies are required to provide the high temperatures needed for the species to rear its young (Churchill 1998; DEC 2005).

Little Bent-wing Bats show a preference for well-timbered habitats including rainforest, wet and dry sclerophyll forests, *Melaleuca* swamps and coastal forests (Churchill 1998). They generally forage below the canopy for a variety of flying insects including crane flies, ants, moths and wasps flying rapidly with considerable manoeuvrability (Churchill 1998).

No roosting habitat was found within the survey area however the species was recorded foraging intermittently throughout the night from approximately 1930 hrs until approximately 0400 hrs (Appendix 6).

Fragmentation and Degradation of Habitat:

Richards and Tiedmann (1988) suggest that the main threatening process faced by bats is the anthropogenic alteration of habitats which adversely affects bat communities. However, without detailed information on the habitat requirements and preferences conservation management issues cannot be addressed adequately on a species by species basis (Irvin *et al*. 2003). Therefore further research on habitat requirements is urgently required to allow for the conservation of Australia's bat fauna.

Human activity often results in the fragmentation of habitats thus increasing the degree of separation between foraging and roosting habitats. While bats are capable of bridging these distances through flight their mobility makes them appear less sensitive to habitat fragmentation. However, with large scale clearing and fragmentation between patches of vegetation it is likely that in terms of their energetics, commuting costs would increase between foraging and roosting locations which would affect survival rates, especially in juveniles (Tuttle & Stevenson 1982, Altringham 1996).

Pavey (1998) suggests that "clutter tolerant"[1] species such as *Rhinolophus megaphyllus* (Eastern Horseshoe Bat) are particularly susceptible to fragmentation because their commuting routes between roosts and foraging areas usually follow linear landscape elements such as riparian vegetation, hedgerows and tree lines. Open areas are crossed by such species only if protected flight paths are not available (Pavey 1998). Tree clearance would thus result in a reduction in the availability of preferred habitat which in turn reduces the carrying capacity of a fragmented landscape for clutter tolerant species (Pavey 1998).

Large scale changes through logging and broad-scale clearing are also likely to result in a reduced structural density of the habitat (Irvin *et al*. 2003). This loss often results in the reduction of insect availability (Tuttle & Stevenson 1982; Kunz 1987) through the loss of protective vegetation which results in higher wind speed (e.g. Alexander 1964; Miller, Lin & Lu 1991; Esseen 1994), rain and more extreme temperature changes (Irvin *et al*. 2003).

[1] Insectivorous bats which are adapted to forage in habitats with high levels of clutter (example high tree density) are termed "clutter tolerant species" after Brigham *et al.* (1997).

Fire and its impact on bat communities is another factor which needs to be considered in the management of any development which has a threat of bushfire. Irvin *et al.* (2003) acknowledged that bats are likely to be affected by fire because they forage in the middle and overstorey vegetation and would be susceptible to changes in forest structure. Irvin *et al*. (2003) examined the impact of low intensity fuel reduction burns in sclerophyll forests in Victoria and determined that bat activity was significantly affected by air temperature (which was correlated with airborne insect activity) with bat activity ceasing below 9ºC.

Tree cavities, varying from hollows to fissures, were found to be important as roost sites for bats (Irvin *et al.* 2003). Fire is thought to contribute to the formation of hollows for instance high-intensity fire would significantly reduce the amount of time required before hollows form. Low-intensity burns however, remove most of the loose bark on the lower parts of eucalypt species thus reducing this type of roost habitat. This suggests the management of fire regimes may play an important role in the regulation of bat assemblages through the adding and removal of roost habitat features.

Management:

Management of bat species would mainly focus upon maintaining the connectivity between foraging and roost sites. Clearing and fragmentation of habitats resulting from development leads to an increase in commuting costs for bats to and from foraging and roost sites and is also responsible for decreases in the survival rates for juvenile bats. Further to this, clutter tolerant species are adversely affected due to the direct loss of preferred foraging habitat and commuting avenues.

Forests with trees from a range of age classes would have greater bat diversity than single aged forests (Herr 1998). Thus, in order to maintain bat diversity retention of trees from varying age classes is required. In addition to this, any potential bat roosting trees should be retained. If it is necessary to remove such trees, they should be inspected for evidence of occupancy prior to consent being granted for their removal.

In cases of development, a lack of general and species specific knowledge of roost selection often results in the loss of important roost habitat and a simplification in the age structure of trees in the remaining fragment. As a result, supplementary habitat (nest boxes) is often utilised to ameliorate hollow loss. It is suggested that the impact of clearing on resident bats can be minimised through appropriate timing of the clearing by identifying non-breeding periods. In south-eastern Australia, the period between February and April is generally the time when juvenile bats have gained independence and bats are not hibernating (Herr 1998).

The proposed development includes provisions for a 100 metre wide corridor (approx. 7.5 hectares) adjacent to Old Soldiers Point Road (Figure 2). The primary purposes of this corridor are to facilitate fauna movement between extensive swamp forest to the south west and Wanda Wetland Reserve to the North and to provide permanent habitat for local fauna populations to offset the loss of habitat in the eastern section of the subject site. Thus, this corridor will be managed in perpetuity purely for conservation purposes.

A high density of hollow bearing trees was recorded within the survey area during the survey period (Table 8). A Wildlife Management Strategy would need to be prepared and implemented for the construction phase of the development. This strategy would include a tree removal protocol which would be designed to ensure that no hollow obligate fauna species, including microchiropteran bats, are injured during tree removal. Supplementary habitat in the form of nest boxes should be installed within the corridor and adjacent connected vegetation to help mitigate the loss of natural hollows from the survey area.

Appropriate fire regimes should also be adopted in the management of bat assemblages given that these activities influence the availability of potential roost habitat within an area. A mosaic pattern of fire regulation should be adopted in order to allow for both the formation and protection of important habitat elements. Although it must be noted that severe fire events would likely influence insect availability which in turn would be likely to influence bat assemblages.

6.3.4 Avifauna

As indicated in Table 7, 4 migratory bird species were identified within the wetland adjacent to the study area during the survey period. Further to this the protected matters database search indicated that 6 terrestrial migratory birds known to occur in the local area would also have potential habitat within the study area.

6.3.5 Wallum Froglet

Wallum Froglet *Crinia tinnula* are small frogs, usually no more than 15 mm long. They are extremely variable in colour and pattern, from light grey or brown to dark grey above and cream to dark grey below. A distinctive feature of the species is a fine white line on the underside from the tip of the snout to the base of the abdomen. The call is a short high-pitched ringing 'tching..tching..', heard throughout the year, particularly following rain (DEC 2005).

Wallum Froglet has specific habitat requirements being restricted to Paperbark and heath swamps with a pH reading between 4.3 and 5.2 (Barker *et al.* 1995). The species is a late winter breeder. Males call in choruses from within sedge tussocks or at the water edge (DEC 2005).

Wallum Froglet was recorded within the wetland in stage 1 by ERM (2005a). 5 Listening points were established throughout the local area during the current survey period to establish an understanding of the local distribution of the species (Table 23; Figure 6).

TABLE 23 – LISTENING POINTS FOR WALLUM FROGLETS

Point	Easting (MGA 94)	Northing	Locality	Frog Species Heard	Number of *C. tinnula* Indicated
1	413431	6377647	Wetland adjacent to study area	*Crinia tinnula, Crinia signifera, Litoria jervisiensis, Litoria fallax*	10-50
2	413777	6377469	Horizons Golf Course	*Crinia tinnula*	10-50
3	415734	6377176	Mambo Wetlands Reserve	*Crinia tinnula*	10-50
4	415831	6377130	Sandpiper Reserve	*Crinia tinnula, Litoria fallax*	100+
5	413262	6376671	Port Stephens Drive	*Crinia tinnula*	10-50

As indicated in Table 23 and Figure 6 Wallum Froglet frequently occur throughout the local area. This highlights the importance of maintaining hydrological regimes within local wetlands to ensure that the habitat within these wetlands remains suitable to the species. In relation to the proposed development, urban runoff should be directed away from Wallum Froglet habitat so that the viability of populations within the immediate vicinity of the study area is not compromised.

7.0 ASSESSMENT

Table 24 lists the species and communities that require assessment due to the existence of known or potential habitat within the study area.

TABLE 24 – SUBJECT SPECIES AND COMMUNITIES REQUIRING ASSESSMENT

Scientific Name	Common Name	Assessment Required[2]		
		s.5A EP&A Act	EPBC Act	CKPoM
Amphibians				
Crinia tinnula	Wallum Froglet	✓		
Avifauna				
Callocephalon fimbriatum	Gang-gang Cockatoo	✓		
Lathamus discolor	Swift Parrot	✓	✓	
Ninox connivens	Barking Owl	✓		
Ninox strenua	Powerful Owl	✓		
Tyto novaehollandiae	Masked Owl	✓		
Xanthomyza phrygia	Regent Honeyeater	✓	✓	
Mammals				
Dasyurus maculatus	Spotted-tailed Quoll	✓	✓	
Phascogale tapoatafa	Brush-tailed Phascogale	✓		
Mormopterus norfolkensis	Eastern Freetail-bat	✓		
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	✓		
Petaurus norfolcensis	Squirrel Glider	✓		
Phascolarctos cinereus	Koala	✓		✓
Pteropus poliocephalus	Grey-headed Flying-fox	✓	✓	
Chalinolobus dwyeri	Large-eared Pied Bat	✓	✓	
Miniopterus australis	Little Bentwing-bat	✓		
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	✓		
Scoteanax rueppellii	Greater Broad-nosed Bat	✓		
Flora				
*Cryptostylis hunteriana**	Leafless Tongue Orchid	✓	✓	
Diuris praecox	Rough Double Tail	✓	✓	
Tetratheca juncea	Black-eyed Susan	✓	✓	
Endangered Ecological Communities				
Freshwater Wetlands		✓		
Swamp Sclerophyll Forest		✓		

*Surveys took place outside the flowering period for *Cryptostylis hunteriana* and as such assessment cannot be undertaken until its presence/absence can be more accurately determined.

[2] S.5A Assessment EP&A Act is commonly referred to as the "test of significance" and is undertaken to determine if the proposed development would have any potentially significant impacts on threatened species, endangered populations or endangered ecological communities listed pursuant to the NSW *Threatened Species Conservation Act, 1995* (TSC Act).
EPBC Act Assessment is undertaken to determine if a proposed development would have any potentially significant impacts on Matters of National Environmental Significance (MNES) listed pursuant to the Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act) and in turn whether the proposal needs to be referred to the Commonwealth Minister for the Environment for approval.
CKPoM refers to assessment pursuant to the Port Stephens Comprehensive Koala Plan of Management.

7.1 Assumptions

The following assumptions identify the extent of the proposal for the purpose of assessment under s.5A of the EP&A Act and the EPBC Act.

- A wildlife corridor would be retained along the northern side of the study area. This would be managed for conservation purposes in perpetuity. The primary purpose of this corridor is to facilitate fauna movement (specifically Koala and Squirrel Glider) between Wanda Wetlands Reserve, the study area and habitat to the south of the study area. Retention of the corridor will also offset vegetation removal from the development area and provide an area for installing supplementary habitat to offset removal of hollow resources,
- Stormwater and nutrient runoff would be managed in accordance with the water cycle management plan (Cardno Willing 2007) ensuring that the Lepironia wetland would not be affected by the proposed development.

7.2 Port Stephens CKPoM

The Port Stephens Comprehensive Koala Plan of Management (CKPoM) was prepared in accordance with regulation 11 of part 3 of *State Environmental Planning Policy Number 44 – Koala Habitat Protection* (SEPP 44). The principle aim of the CKPoM is:

> *"…to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline."*

Effectively, compliance with the CKPoM constitutes compliance with SEPP 44 and as such the CKPoM supersedes the requirements of SEPP 44 for development applications occurring within the Port Stephens LGA (PSC 2001).

The objectives of performance criteria for development applications are set out below. All developments (excluding developments proposing agricultural activities) must demonstrate that they are consistent with these objectives.

i. To ensure that the Koala population in the Port Stephens LGA is sustainable over the long-term.
ii. To protect Koala habitat areas from any development which would compromise habitat quality or integrity.
iii. To ensure that any development within or adjacent to Koala habitat areas occurs in an environmentally sensitive manner.
iv. To ensure that acceptable levels of investigation are undertaken, considered and accepted prior to any development in or adjacent to Koala habitat areas.
v. To encourage Koala habitat rehabilitation and restoration.
vi. Maintain interconnection between areas of Preferred and Supplementary Koala Habitat and minimise threats to safe Koala movements between such areas.
vii. To ensure that development does not further fragment habitat areas either through the removal of habitat or habitat links or through the imposition of significant threats to Koalas.
viii. To provide guidelines and standards to minimise impacts on Koalas during and after development, including any monitoring requirements.
ix. To provide readily understandable advice to proponents preparing development applications and for Council officers involved in the assessment of those applications.

Koala habitat assessment in Port Stephens LGA requires the following steps as the minimum acceptable approach (PSC 2002):

1. Preliminary Assessment,
2. Vegetation Mapping,
3. Koala Habitat Identification, and
4. Assessment of the Proposal.

An assessment of Koala habitat within the study area has been undertaken in accordance with the CKPoM.

7.2.1 Preliminary Assessment

Review of the Koala Habitat Planning Map was undertaken to determine if the study area is mapped as containing Koala habitat. As indicated in Figure 9, the study area is mapped as containing both preferred and supplementary Koala habitat. Field survey has verified that both preferred and supplementary Koala habitat occurs within the study area however the extent mapped on the Koala Habitat Planning Map is considered to be inaccurate as is the extent of preferred Koala habitat extending further north. As a result, vegetation mapping prepared for this report was used to accurately identify Koala habitat within and directly adjacent to the study area.

Table 25 provides a list of known Koala feed trees recorded within the study area.

TABLE 25 – KOALA FEED TREES OCCURING WITHIN STUDY AREA

Scientific Name	Common Name	Koala Food Status*	Vegetation Community
Eucalyptus robusta	Swamp Mahogany	Preferred	Map Unit 4; Map Unit 5
Eucalyptus pilularis	Blackbutt	Supplementary	Map Unit 1; Map Unit 2
Angophora costata	Smooth-barked Apple	Supplementary	Map Unit 1; Map Unit 2; Map Unit 5
Corymbia gummifera	Red Bloodwood	Supplementary	Map Unit 1; Map Unit 2
Melaleuca quinquenervia	Broad-leaved Paperbark	Supplementary	Map Unit 4; Map Unit 5

*Following Phillips *et al.* (2000)

As indicated in Table 25, 1 preferred Koala feed species *Eucalyptus robusta* was recorded within the study area in Map Unit 4 and 5.

7.2.2 Koala Habitat Identification

Vegetation was surveyed throughout the study area (Stage 1 – ERM 2005a; Stage 2 – Andrews.Neil 2006) using both quadrats and random meander techniques (refer to section 5.2 of this report). Table 26 identifies the Koala habitat classification (following PSC 2002) assigned to each of the vegetation communities occurring in the study area (Figure 9).

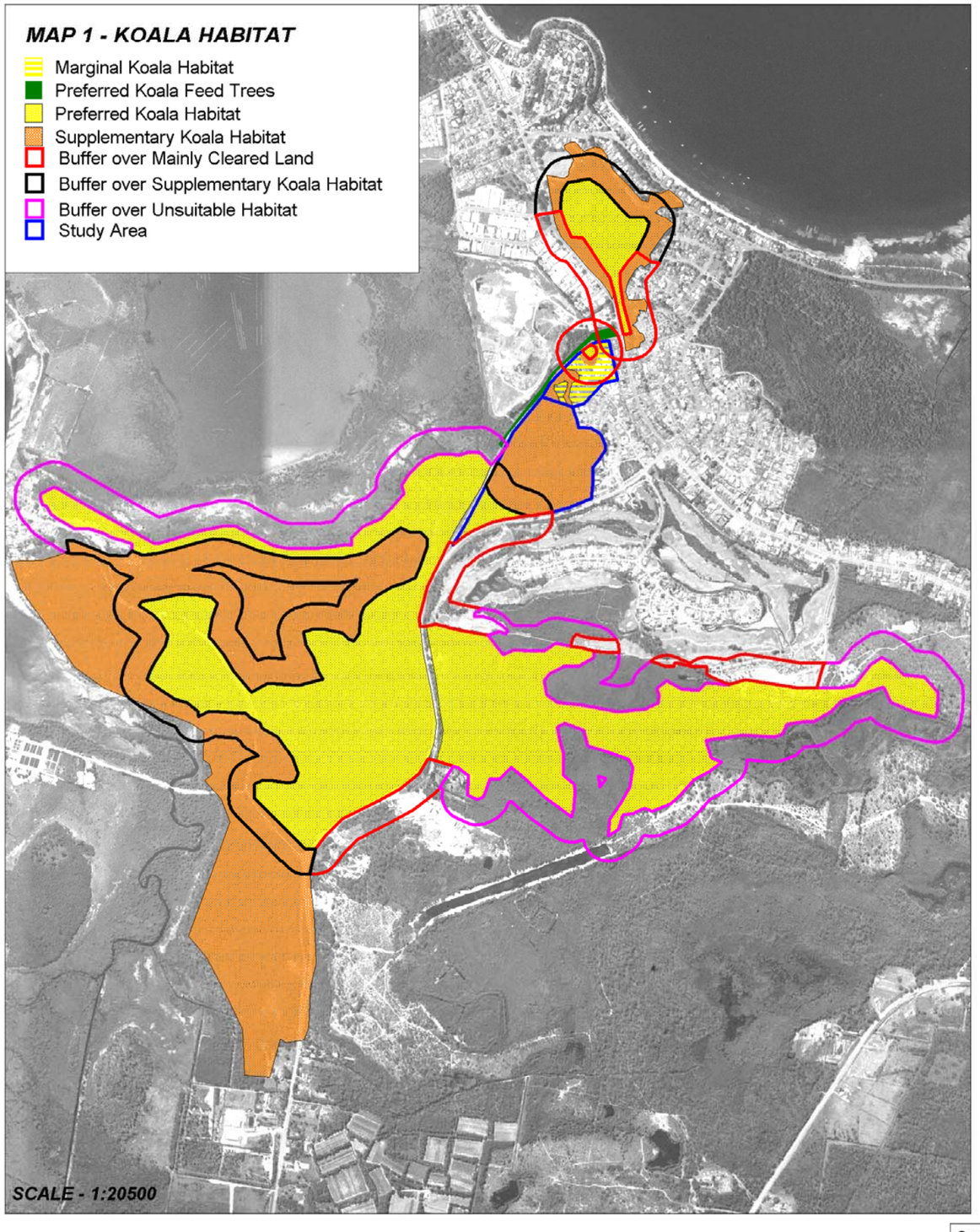
TABLE 26 – KOALA HABITAT IDENTIFICATION

Map Unit	Description	Dominant Upper Stratum Species	Koala Habitat Classification	Area (ha)
1	Coastal Sand Apple/Blackbutt Forest	*Eucalyptus pilularis, Angophora costata, Corymbia gummifera*	Supplementary	15.76
2	Lepironia Swamp	Occasional *Melaleuca quinquenervia*	Marginal	0.31
3	Disturbed Re-growth	Scattered *E. pilularis*, *A. costata* and *C. gummifera*	Marginal	2.65
4	Swamp Mahogany Paperbark Forest	*Eucalyptus robusta, Melaleuca quinquenervia*	Preferred	0.2
5	Swamp Forest	*Melaleuca quinquenervia, Angophora costata, Eucalyptus robusta*	Preferred	1.8

As indicated in Table 26 and Figure 9, approximately 2 hectares of preferred Koala habitat and 16 hectares of supplementary Koala habitat occur within the study area.

MAP 1 - KOALA HABITAT

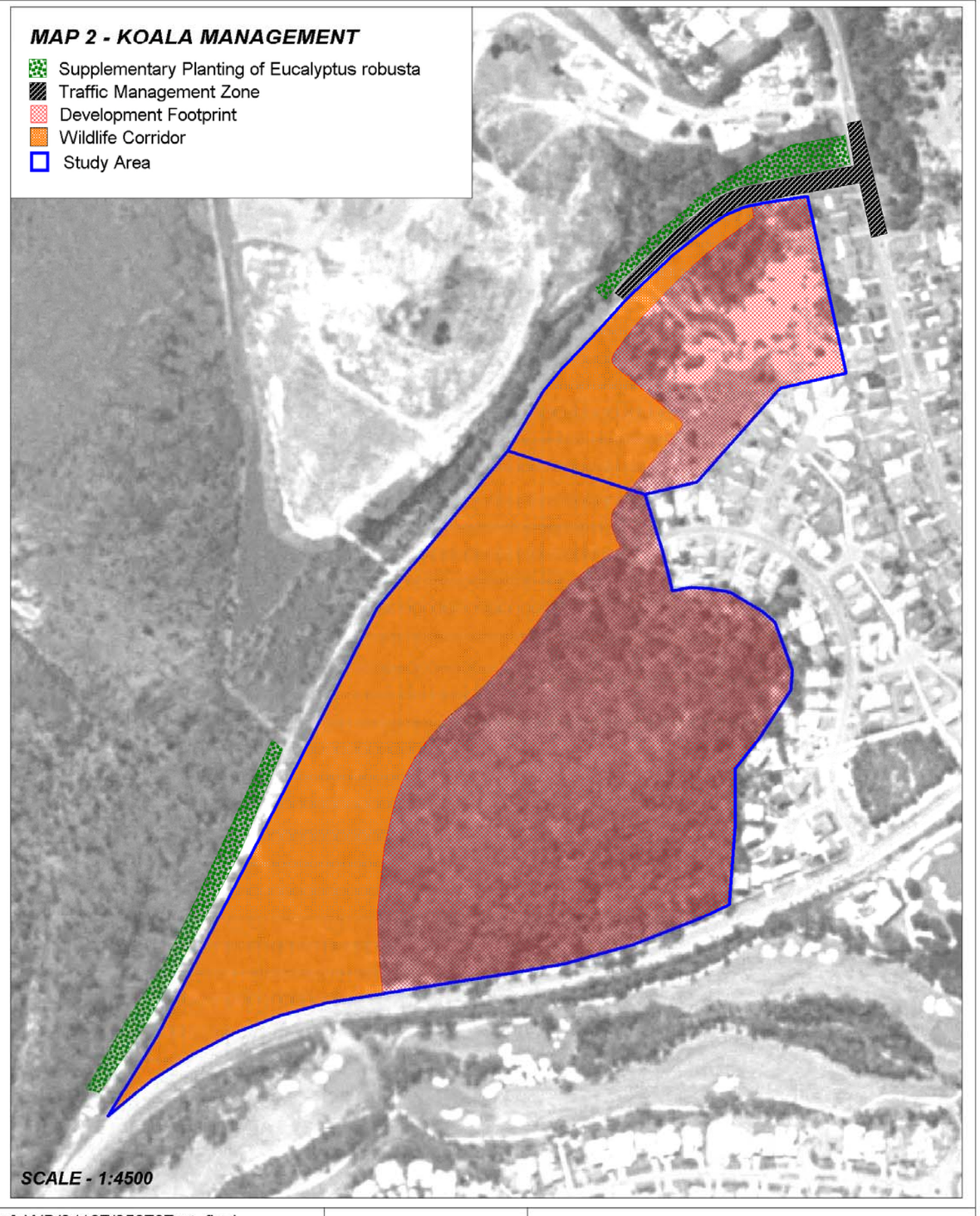
- Marginal Koala Habitat
- Preferred Koala Feed Trees
- Preferred Koala Habitat
- Supplementary Koala Habitat
- Buffer over Mainly Cleared Land
- Buffer over Supplementary Koala Habitat
- Buffer over Unsuitable Habitat
- Study Area



SCALE - 1:20500

MAP 2 - KOALA MANAGEMENT

- Supplementary Planting of Eucalyptus robusta
- Traffic Management Zone
- Development Footprint
- Wildlife Corridor
- Study Area



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NORTH

DATE: 30/10/2006

FIGURE 9: Koala Habitat & Management

PROJECT: Salamander Waters

CLIENT: Port Stephens Council

WORKSPACE: T:\04\04107 Hill PDA (PS Council) Salamander Waters\Map\03 wor\Ecology Figures\Final Figures\050707_Figure_9.WOR

NOTE: All features are approximate only and subject to detailed survey.

The vegetation adjacent to the study area to the north is mapped by House (2003) as Map Unit 37 – Swamp Mahogany Paperbark Forest and as such has been assigned the classification "preferred Koala habitat" on the Port Stephens Koala Habitat Planning Map. Field survey indicates that the extent of MU 37 is less than that depicted by House (2003) and as such the area of "preferred Koala habitat" is also inaccurate; a more accurate representation is shown in Figure 9. This vegetation was identified as a fauna corridor by ERM (2005a) however given that it consists of Mangrove-estuarine forest it is considered unlikely that non-flying mammals such as Koala and Squirrel Glider would utilise this link. Therefore, for the purpose of this assessment it is considered that there is approximately 146 hectares of preferred Koala habitat connected to the study area (Figure 9).

The proposed development would result in the removal of approximately 0.2 hectares of preferred Koala habitat in the north eastern section of the study area. This equates to approximately 0.1% of preferred Koala habitat within and connected to the study area which is considered to be a negligible impact. The loss of this habitat could be successfully mitigated by supplementary planting of *Eucalyptus robusta* adjacent to the study area (Figure 9).

Implication of Koala Survey Results:

9 spot surveys were undertaken within and adjacent to the study area (Table 11; Figure 3) with Koala activity confined to the western side of the study area within the proposed wildlife corridor. Additionally, 2 Koala's were observed within the study area and 1 was observed within a *Eucalyptus robusta* adjacent to the study area, all within the proposed corridor (Figure 5). This corridor provides a link between preferred Koala habitat within Wanda Wetlands Reserve and preferred Koala habitat within and adjacent to the southern section of the study area (Figure 9). Results of Koala surveys conducted during this assessment support the retention of this corridor and demonstrate that Koala utilises this corridor. The proposed development could result in an improvement to this link if supplementary planting of *Eucalyptus robusta* occurs adjacent to the Swamp Mahogany Paperbark forest adjacent to the south western section of the study area (Figure 9) and traffic controls are implemented at the point that the corridor crosses Soldiers Point Road to reduce the likelihood of road related Koala fatalities.

7.2.3 Assessment of Performance Criteria Objectives

Table 27 demonstrates that the proposed development is consistent with the performance criteria objectives set out in Appendix 4 of the CKPoM.

TABLE 27 – ASSESSMENT OF PERFORMANCE CRITERIA OBJECTIVES

Performance Criteria Objective	Response
To ensure that the Koala population in the Port Stephens LGA is sustainable over the long-term.	The proposed development would result in the removal of approximately 0.2 hectares of preferred Koala habitat (PKH) which equates to approximately 0.1% of the PKH connected to the study area. This impact is considered to be negligible due to: i. The small area being impacted, ii. The retention of a 100 metre wide corridor which would facilitate Koala movement and provide foraging habitat, and iii. Supplementary planting of *Eucalyptus robusta* within the corridor where suitable habitat exists. Therefore, the proposed development would not compromise the long-term viability of the Port Stephens Koala population and as such is consistent with this objective.
To protect Koala habitat areas from any development which would compromise habitat quality or integrity.	The section of the study area which would be cleared to accommodate the proposed development (the development area) consists of 0.2 hectares of PKH, 10 hectares of Supplementary Koala Habitat (SKH) and 2.6 hectares of Marginal Koala Habitat (MKH). Spot surveys indicated that there was no Koala Activity in the SKH within the development area. Previous assessments have identified Koala within the small area of PKH within the development area (ERM 2005a). This impact is considered to be negligible due to: i. The small area of Koala habitat being impacted, ii. The retention of a 100 metre wide corridor which would facilitate Koala movement and provide foraging habitat, iii. Supplementary planting of *Eucalyptus robusta* within the corridor where suitable habitat exists, and iv. Implementation of a Vegetation Management Plan to ensure that the integrity of habitat within the corridor is maintained. Therefore, the proposed development would not compromise habitat quality or integrity.
To ensure that any development within or adjacent to Koala habitat areas occurs in an environmentally sensitive manner.	The impact of the proposed development on Koala is considered to be negligible due to: i. The small area of preferred Koala habitat being impacted, ii. The retention of a 100 metre wide corridor which would facilitate Koala movement and provide foraging habitat, iii. Supplementary planting of *Eucalyptus robusta* within the corridor where suitable habitat exists, and iv. Implementation of a Vegetation Management Plan to ensure that the integrity of habitat within the corridor is maintained. It is considered that the management protocols implemented as part of the proposed development would ensure that potential impacts on Koala are successfully mitigated. As such, it is considered that the proposed development is occurring in an environmentally sensitive manner.
To ensure that acceptable levels of investigation are undertaken, considered and accepted prior to any development in or adjacent to Koala habitat areas.	Koala surveys undertaken as part of this assessment adequately address the requirements of the Port Stephens CKPoM.
To encourage Koala habitat rehabilitation and restoration.	The proposed corridor would be managed to ensure that habitat integrity is maintained and improved. Management of the corridor would be subject to a Weed Management Strategy and a Wildlife Management Strategy which would include supplementary planting of *E. robusta*, a preferred Koala feed species, with the objective of improving foraging resources adjacent to the development.

Performance Criteria Objective	Response
Maintain interconnection between areas of Preferred and Supplementary Koala Habitat and minimise threats to safe Koala movements between such areas.	The primary purpose of the 100 metre wide corridor is to maintain connectivity between PKH in Wanda Wetlands Reserve and PKH within and adjacent to the study area. Traffic controls would be implemented at the point that the corridor crosses Soldiers Point Road to reduce the likelihood of road related Koala fatalities. Therefore, the proposed development would maintain interconnection between areas of Koala habitat and would improve Koala safety during movements between these areas.
To ensure that development does not further fragment habitat areas either through the removal of habitat or habitat links or through the imposition of significant threats to Koalas.	The proposed development would result in improved connection between PKH within Wanda Wetlands Reserve and PKH within and adjacent to the study area by: i. The retention of a 100 metre wide corridor which would facilitate Koala movement and provide foraging habitat, ii. Providing traffic control at the point that the corridor crosses Soldiers Point Road to reduce the likelihood of road related Koala fatalities, iii. Supplementary planting of *Eucalyptus robusta* within the corridor where suitable habitat exists, and iv. Implementation of a Vegetation Management Plan to ensure that the integrity of habitat within the corridor is maintained. Therefore, the proposed development would not result in further fragmentation of Koala habitat through the removal of habitat or habitat links.
To provide guidelines and standards to minimise impacts on Koalas during and after development, including any monitoring requirements.	A Wildlife Management Strategy would be implemented to ensure that habitat integrity within the corridor is maintained. This would be prepared with reference to Council requirements and guidelines for Koala management.
To provide readily understandable advice to proponents preparing development applications and for Council officers involved in the assessment of those applications.	Liaison with relevant Council officers would be undertaken to ensure that all parties are satisfied with the Koala management strategies implemented as a result of the proposed development.

7.3 Consideration of s.5A of the EP&A Act

Section 5A of the NSW EP&A Act sets out seven factors that need to be considered in determining whether a proposed action will or is likely to have a significant impact on a threatened species, endangered population or endangered ecological community listed pursuant to the TSC Act or the *Fisheries Management Act, 1994*. If a significant impact is found to be likely, the proposed action may require concurrent consent from the Director General of the Department of the Environment and Conservation (DEC) and the preparation of a Species Impact Statement may be required.

Under Section 5A(2) of the EP&A Act, the following factors must be taken into account in making a determination:

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

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

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

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

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

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

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

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

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

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

Section 5A assessments are provided in Appendix 7. No potentially significant impacts were identified for any of the species assessed pursuant to s.5A of the EP&A Act. This was largely due to the retention of habitat within the corridor in the northern section of the study area.

7.4 Consideration of the EPBC Act

The Commonwealth EPBC Act provides for the need for the approval of the Commonwealth Environment Minister for all actions that will or are likely to have a significant impact on a matter of national environmental significance (MNES). Matters of national environmental significance are:

- World Heritage properties,
- Ramsar wetlands of international importance,
- listed threatened species and communities,
- migratory species protected under international agreements,
- nuclear actions, and
- the Commonwealth marine environment.

The process established under the EPBC Act compels the person proposing the action to refer that action to the Commonwealth Environment Minister where that person thinks that the proposed action will or is likely to have a significant impact on a MNES.

According to the EPBC Act in order to decide whether an action is likely to have a significant impact, it is necessary to take into account the nature and magnitude of potential impacts.

In determining the nature and magnitude of an action's impact, it is important to consider matters such as:

- all on-site and off-site impacts,
- all direct and indirect impacts,
- the frequency and duration of the action,
- the total impact which can be attributed to that action over the entire geographic area over time,
- the sensitivity of the receiving environment, and
- the degree of confidence with which the impacts of the action are known and understood.

An action does not require approval from the Environment Minister under the Act if:

- the action is approved under, and taken in accordance with, a State management plan that is accredited by the Commonwealth for the purposes of a bilateral agreement (see section 46 of the Act), or
- the action is approved under, and taken in accordance with, a Commonwealth management plan that is accredited by the Environment Minister for the purposes of a Ministerial declaration (see section 33 of the Act), or
- the action is a forestry operation taken in a Regional Forest Agreement region (see Part 4, Division 2 of the Act), or
- the action is taken in the Great Barrier Reef Marine Park and is authorised by certain instruments issued under the *Great Barrier Reef Marine Park Act 1975* (see section 43 of the Act), or
- the action has been authorised by a Government decision on which the Minister's advice has been sought (see section 160 of the Act).

In addition, an approval is not required for an action if:

- the action was authorised by the Commonwealth, a State or a Territory prior to the EPBC Act commencing (16 July 2000), and
- at the time the EPBC Act commences, no further authorisation is required to allow the action to be lawfully taken.

Finally, the EPBC Act provides that approval is not required for an action that is a lawful continuation of a use of land, sea or seabed that was occurring immediately before the commencement of the Act. (This exception does not apply to an enlargement, intensification or expansion of an existing use).

Review of the habitat requirements of threatened species recorded within the local area indicates that 6 listed threatened fauna species, 5 listed threatened flora species and 6 terrestrial migratory birds have potential habitat within the subject site. No other MNES are relevant to the subject site. Under the EPBC Act the following factors need to be considered in determining whether an action is likely to have a significant impact on listed threatened species:

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

Assessment of the impact on the 9 listed species considered to have potential habitat within the study area is shown in Appendix 8. The proposal will not have an impact on species listed as Critically Endangered, Endangered, Vulnerable or Migratory under the EPBC Act. Therefore, the proposal does not require referral to the Commonwealth Minister for the Environment.

8.0 RECOMMENDATIONS

The following recommendations are designed to mitigate the overall ecological impacts of the proposal and should be considered in the determination of the application (Table 28).

TABLE 28 - RECOMMENDATIONS

	Recommendation	Justification
1	Implement a traffic control strategy at the point that the corridor crosses Soldiers Point Road including a 40kph speed limit and sign posting.	Reducing the speed limit in places where Koala is known or likely to cross the road will reduce the likelihood of road related Koala fatalities (see PSC 2001).
2	Semi-mature *Eucalyptus robusta* should be planted closer to Soldiers Point Road and adjacent to Swamp Mahogany Paperbark forest adjacent to Old Soldiers Point Road in the area indicated in Figure 9.	This would strengthen the link across Soldiers Point Road for Squirrel Glider and would provide additional foraging resources for Koala.
3	A Habitat Restoration Plan should be prepared and implemented for the study area. This would include measures for the management of exotic species, in particular *Crysanthemoides monilifera* and *Lantana camara* which are listed pursuant to the WM Act. The plan should be prepared and implement prior to commencement of construction. A 5 year monitoring and maintenance period following the completion of all infrastructure associated with the sub-division should be considered.	The habitat restoration plan is required to manage the interface between the development area adjacent native vegetation in the wildlife corridor. A 5 year monitoring and maintenance period is considered necessary to enable native vegetation to properly establish within the interface. Following this period native vegetation within the interface should be established to a point that exotic species are unable to proliferate.
4	A Wildlife Management Strategy should be implemented for the study area. This would include a tree removal protocol and habitat augmentation strategy including nestbox installation. A 5 year monitoring and maintenance period following the completion of all infrastructure associated with the sub-division should be considered.	The Wildlife Management Strategy is required to manage fauna habitat attributes within the study area. The WMS includes strategies to manage fauna during the construction phase of the development such as during tree felling; provides a supplementary habitat plan (including a nest box program), and; a monitoring program to determine the effectiveness of the strategy. As with the HRP, a 5 year monitoring period is recommended. The WMS should be prepared in consultation with Council.
5	Stormwater should be directed away from the Lepironia swamp within stage 1.	The Lepironia swamp is considered to represent the EEC Freshwater Wetlands and as such directing stormwater away from this community is necessary to maintain the integrity of the habitat. Further to this, Wallum Froglet *Crinia tinnula* was recorded within this community. This species has a narrow pH tolerance (see Barker *et al.* 1995) and as such changes in the hydrological regime within its habitat could be detrimental to the survival of the species.
6	External night lighting needs to be designed to ensure that there is no significant light wash into adjacent bushland.	Artificial night lighting has been shown to negatively affect the behaviour of some nocturnal species (see Rich and Longcore 2006). Therefore, minimising light wash into remnant bushland is considered to be important in the management of remnant bushland which provides habitat for nocturnal species.

9.0 CONCLUSIONS

This report provides an assessment of potential impacts on flora and fauna arising from a proposed residential development on land at part lot 59 DP 831253 360 Soldiers Point Road Salamander Bay. Field surveys were conducted within the survey area (stage 2) between 11 and 14 September 2006 which resulted in the identification of 5 threatened fauna species (*Phascolarctos cinereus* Koala, *Petaurus norfolcensis* Squirrel Glider, *Crinia tinnula* Wallum Froglet, *Mormopterus norfolkensis* Eastern Free-tail Bat and *Miniopterus australis* Little Bent-wing Bat) and 1 Endangered Ecological Community (swamp sclerophyll forest) listed pursuant to the NSW *Threatened Species Conservation Act, 1995* (TSC Act). 4 migratory species listed pursuant to the *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act) were recorded adjacent to the study area within an artificial wetland (*Cygnus atratus* Black Swan, *Chenonetta jubata* Australian Wood Duck, *Elseyornis melanops* Black-fronted Dotterel and *Acrocephalus stentoreus* Clamorous Reed-Warbler). Previous surveys undertaken within the study area by Conacher Travers (1998) and ERM (2005) resulted in the identification of 1 additional Endangered Ecological Community (Freshwater wetlands) within stage 1 (outside of the survey area for this assessment) and 1 additional threatened species (*Miniopterus schreibersii oceanensis* Large Bent-wing Bat). Additionally, *Pteropus poliocephalus* Grey-headed Flying Fox was recorded flying over the study area (Conacher Travers 1998) and *Ninox strenua* Powerful Owl was recorded within 1-2km of the study area (ERM 2005).

Assessment pursuant to section 5A of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) did not identify any potentially significant impacts on the threatened species and EEC's assessed. This is largely due to the proposed retention and enhancement of habitat within a wildlife corridor along the western boundary of the study area.

Assessment pursuant to the EPBC Act did not identify any impacts on Matters of National Environmental Significance and as such referral to the Commonwealth Minister for the Environment is not considered to be necessary.

The Port Stephens Comprehensive Koala Plan of Management (CKPoM) was addressed. The proposed development would result in the removal of a small area (0.2 ha) of Preferred Koala Habitat (PKH) however this impact would be successfully mitigated by supplementary planting of *Eucalyptus robusta* within the corridor and retention of 1.8 ha of PKH within the southern corner of the study area. The corridor would facilitate movement of Koala between PKH within Wanda Wetlands Reserve to the north east and PKH within and adjacent to the southern section of the study area. It is recommended that a traffic control strategy including sign posting and a 40kph speed limit be implemented at the point where the corridor crosses Soldiers Point Road to minimise the potential for road related Koala fatalities.

Recommendations designed to reduce the overall ecological impacts of the proposed development are provided in section 8.0.

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APPENDIX 1 – FIELD SURVEY METHODS

FLORA SURVEY METHODS

The flora survey involved random meander searches of the entire study area and community composition analysis within 9 20 x 20 metre quadrats following McDonald *et al.* 1990). All recorded species are listed in Appendix 4.

Random Meander

Equipment:

- Standardised field survey sheet.
- Plastic sample bags.
- Reference books (eg. Robinson 2003).

Method:

The Random Meander (Cropper 1993) search involved traversing the entire survey area and recording all encountered species. Any species that could not be identified on the study area were sampled and identified later using appropriate keys (Harden 1992; Harden 2000; Harden 2002).

Quadrats

Equipment:

- Standardised field survey sheet.
- Plastic sample bags.
- Reference books (Robinson 2003).
- Tape measure.
- Compass.
- Plastic surveyors flagging tape.

Method:

Community composition analysis was undertaken within nine 20 x 20 metre quadrats using a standard procedure adapted by Andrews.Neil Pty Ltd from McDonald *et al*. (1990). The quadrat is characteristic of the community being sampled. This analysis involves three steps:

Tallest Stratum

Percentage cover abundance (%) for each identified species taller than three metres within the 20 x 20 metre quadrat was estimated for the total area within the quadrat. Height, cover abundance and vegetation formation of the stratum was estimated.

Middle and Lower Strata

Percentage cover abundance and form of the lower strata species is estimated (%) within ten 1 x 1 metre quadrats placed randomly throughout the 20 x 20 metre quadrat. Each species is placed into one of 15 formation classes (McDonald *et al.* 1990):

T	Tree	D	Sod Grass
M	Mallee tree	V	Sedge
S	Shrub	R	Rush
Z	Heath shrub	F	Forb
Y	Mallee shrub	E	Fern
C	Chenopod shrub	O	Moss
G	Tussock Grass	L	Vine
H	Hummock Grass		

Height Class is determined by estimating the height of flora within each stratum based on the following scoring from 1 to 9:

1 = <0.25m
2 = 0.25 - 0.5m
3 = 0.5 – 1m
4 = 1 – 3m
5 = 3 – 6m
6 = 6 – 12m
7 = 12 – 20m
8 = 20 – 35m
9 > 35m

Percentage foliage cover of each stratum is categorised using the following:

D = Closed >70%
M = Mid-dense 30-70%
S = Sparse 10-30%
V = Very Sparse 1-10%
I = Isolated Plants<1%
L = Isolated Clumps <1%

APPENDIX 2 – HABITAT ASSESSMENT

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
MYOBATRACHIDAE					
Crinia tinnula Wallum Froglet (18)	V		Wallum Froglets are only found in acid paperbark swamps and sedge swamps of the coastal 'wallum' country.	Wallum Froglets are confined to acid swamps of the 'Wallum' (sand plain swamp) country (Cogger 1992) swamps with a pH reading between 4.3 and 5.2 (Barker *et al.* 1995). Characteristic vegetation of these areas includes paperbark forests and woodlands, swamp heaths and sedgelands. A few frog species, including Wallum Froglet, appear to be able to tolerate the acid conditions, whereas other more common species are excluded from these areas because of their intolerance of the acid conditions. These areas generally derive their acidity from humic acids leached by groundwater passing through organic layers on and below the sand. The acidic groundwater 'breaks out' in swales and other depressions. These Wallum species do not appear to readily compete with other frog species in neutral water conditions. Breeding occurs in late winter; information is limited for wild populations however studies that have been undertaken indicate that single eggs are attached to fine submerged stems of grasses or reeds with tadpoles appearing approximately 6 days thereafter (Anstis 2002).	Potential habitat within swamp forest vegetation in the south western section of the study area. It was recorded within swamp forest adjacent to the study area and within the Golf Course on the southern side of Port Stephens Drive. This species is widely distributed throughout the local area (Figure 6).
ACCIPITRIDAE					
Pandion haliaetus Osprey (9)	V	M	Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas.	Osprey are often located in coastal areas, especially along lagoons, rivers, and watercourses where it perches in prominent locations overlooking foraging areas. Ospreys forage mainly for fish, but occasionally take crustaceans, reptiles, small mammals, or birds (Debus 1998). Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees,	No Habitat Present.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
				usually within one kilometre of the sea (DEC 2005)..	
BURHINIDAE					
Burhinus grallarius Bush Stone-curlew (7)	E		Throughout Australia, mainly in inland areas in open forest or woodland where it is sparsely grassed or lightly timbered. They are often associated with woodlands of *Casuarina* (Marchant and Higgins 1993).	Bush Stone-curlews inhabit mainly inland areas in open forest or woodland where it is sparsely grassed or lightly timbered. In coastal areas they are often associated with woodlands of *Casuarina* (Marchant and Higgins 1993). On the Central Coast Bush Stone-curlews require areas of Saltmarsh fringed with Mangrove and/or Swamp Oak forests that are at least 10 hectares in area. These areas generally adjoin cleared, grazed or mown areas of an open nature which are greater than 1 hectare in area (Morris 2002). Bush Stone-curlews are sedentary and form life-long breeding pairs that occupy the same territory throughout their lives (Morris 2002; DEC 2005). They live for between 10-30 years and due to the limited amount of habitat young birds may be unable to establish new territories. Breeding pairs defend territories of between 10-25 hectares but may forage over an area of 250-600 hectares. The nest site consists of a scrape on the ground typically near the edge of open grassy woodland where there is good visibility (Morris 2002). Sites may be used in successive years and some sites are known to have been used for 30 years (Morris 2002).	No habitat present.
CACATUIDAE					
Calyptorhynchus lathami Glossy Black-cockatoo (16)	V		Coastal regions to tablelands Qld and NSW.	This species inhabits woodlands and open forests on low nutrient soils with a middle stratum with abundant *Allocasuarina* spp. which they are dependent upon for food. They breed in either dead or alive hollow within woodlands	No habitat present.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
				or remnant woodlands. Roosts are in the canopy of leafy eucalypts less than one (1) kilometre from the feed site and within thirty (30) metres of the nesting tree (Higgins 1999).	
Callocephalon fimbriatum Gang Gang Cockatoo (2)	V		From southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee (DEC 2005).	In summer, Gang-gang Cockatoo are generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. They may also occur in sub-alpine Snow Gum *Eucalyptus pauciflora* woodland and occasionally in temperate rainforests. Move to lower altitudes in winter, preferring more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. This species favours old growth attributes for nesting and roosting (DEC 2005).	Potential habitat present.
CHARADRIIDAE					
Charadrius mongolus Lesser Sand-plover (1)	V	M	The Lesser Sand Plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records (DEC 2005).	Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge (DEC 2005).	No habitat present.
CICONIIDAE					
Ephippiorhynchus asiaticus Black-necked Stork (3)	E1		Coastal areas north of Newcastle.	The Black-necked Stork inhabits wetlands, such as floodplains, large shallow swamps, pools, mangroves and	No habitat present.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
				deeper permanent bodies of water. Mainly forages over open fresh waters; or extensive sheets of shallow water over grassland or sedgeland; shallow swamps with short emergent vegetation and abundant aquatic flora; and permanent billabongs and pools on floodplains (Marchant and Higgins 1990). Also use freshwater meadows, wet heathland, seepage from springs, semi-permanent swamps with tall emergent vegetation (eg. *Eleocharis, Typha*) *Melaleuca* swamps, watercourses and reservoirs (Marchant and Higgins 1990). Builds a large, bulky stick platform often within a large tree offering a commanding view of the surrounding area (Frith 1976; Marchant and Higgins 1990).	
COLUMBIDAE					
Ptilinopus superbus Superb Fruit-dove (1)	V		Littoral and subtropical rainforest. In NSW it is regularly observed in the northern rivers and irregular in the mid-north coast. It is a frequent visitor to the Hunter, Sydney, Illawarra and south coast region (Higgins & Davies 1996).	This species forages high within the canopy of fruiting rainforests tress but can be seen in a variety of habitats including lantana thickets and mangrove. However for foraging it requires vegetation that bears fruit. Old littoral rainforests provide the majority of the habitat for the species in Australia. These habitats are greatly reduced in NSW where the species is endangered.	Sub-optimal habitat within Mangrove forest adjacent to study area.
Ptilinopus magnificus Wompoo Fruit-dove (1)	V		Littoral and subtropical rainforest. In NSW they are widespread east of the Great Divide from the northern rivers south to Illawarra, but are rare and vagrant south of Coffs Harbour (Higgins & Davies 1996). Incidental records only in local area (Barrett *et al.* 2003).	This species is found mainly in dense foliage in undisturbed patches of tall tropical/subtropical rainforest, in south of range in temperate rainforest dominated by Nothofagus (Higgins & Davies 1996). They are obligate frugivores which forage on fruits from rainforest trees, palms, and vines.	No habitat present.
HAEMATOPODIDAE					

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
Haematopus fuliginosus Sooty Oystercatcher (13)	V		Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small numbers of the species are evenly distributed along the NSW coast. The availability of suitable nesting sites may limit populations (DEC 2005).	Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels (DEC 2005). Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories. The nest is a shallow scrape on the ground, or small mounds of pebbles, shells or seaweed when nesting among rocks (DEC 2005).	No habitat present.
Haematopus longirostris Pied Oystercatcher (8)	V		Pied Oystercatcher is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast (DEC 2005).	Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish (DEC 2005). Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones (DEC 2005).	No habitat present.
LARIDAE					
Sterna albifrons Little Tern (1)	E	M	Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire east coast from Tasmania to	Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records) (DEC 2005). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands (DEC 2005). Often seen feeding in flocks, foraging for small fish, crustaceans, insects, annelids and molluscs by plunging in	No habitat present.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
			northern Queensland, and is seen until May, with only occasional birds seen in winter months (DEC 2005).	the shallow water of channels and estuaries, and in the surf on beaches, or skipping over the water surface with a swallow-like flight (DEC 2005).	
PROCELLARIIDAE					
Macronectes giganteus Southern Giant Petrel (1)	E		The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the entire length of the New South Wales coast (Blakers et al. 1984). Over summer, the species nests in small colonies amongst open vegetation on Antarctic and subantarctic islands (DEC 2004).	The Southern Giant Petrel is an opportunistic scavenger and predator. The species regularly follows fishing vessels and scavenges animal carcasses. They are also an active predator of cephalopods, euphausiids, as well as smaller birds, particularly penguins. Although representing a small proportion of its total foraging area, potential forage in NSW waters during the winter is nonetheless considered significant for the species (DEC 2004). Breeding pairs raise a single chick annually (DEC 2005).	No habitat present.
Pterodroma leucoptera leucoptera Goulds Petrel (1)	E		Breeds on both Cabbage Tree Island, 1.4 km offshore from Port Stephens and on nearby Boondelbah island. The range and feeding areas of non-breeding Petrels are unknown (DEC 2005).	Gould's Petrels begin arrival to Cabbage Tree Island from mid to late September. Nesting habitat is located within two gullies which are characterised by steeply, sloping rock scree with a canopy of Cabbage Tree Palms. They nest predominantly in rock crevices and also in hollow fallen palm trunks, under mats of fallen palm fronds and in cavities among the buttresses of fig trees. They breed colonially and the nests are clumped and often less than 1 m apart. Egg laying takes place over a six week period commencing in early November (DEC 2005).	No habitat present.
PSITTACIDAE					
Lathamus discolour Swift Parrot (80)	E	E	Throughout NSW. In the southeast mainly between March & November. Breeding occurs in Tasmania and is restricted to a range correlating with the distribution of Tasmania Blue Gum.	This species migrates to mainland Australia in autumn. During winter it is semi-nomadic foraging on nectar and lerps in Eucalypt forest and woodland (Swift Parrot Recovery Team 2001; DEC 2005). *Eucalyptus robusta* is an important foraging resource in the local area.	Limited potential foraging habitat within remnant swamp forest in study area.
STRIGIDAE					

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
Ninox strenua Powerful Owl (16)	V		Coast and ranges from Eden in the south to the Border Ranges in the north.	Powerful Owl inhabit wet or dry sclerophyll forest with mature trees. They roost and breed in trees in densely vegetated gullies. They require a large home range (800-1000 ha). Powerful Owl is the largest of Australia's owls (Debus & Chafer 1994). It feeds on larger arboreal mammals, megabats, and other fauna captured in trees. It forages mostly in open forests and typically roosts in tall trees in moist gullies. It nests in a very large hollow, typically in large tree in a moist gully. Pairs maintain and hunt throughout a home range that may be up to 1000 ha. (Garnett 1992; Fleay 1979).	Potential foraging habitat.
Ninox connivens Barking Owl (2)	V		Throughout most of New South Wales (Debus 1997), Victoria (Silveira 1997) and South Australia (Parker 1988; Higgins 1999).	The southern subspecies of Barking Owl occur primarily in dry sclerophyll woodland. Nesting is in large hollows in live eucalypts, often near open country (Kavanagh *et al.* 1997). Diet is primarily insects in non-breeding season with birds and mammals, particularly small gliders and rabbits, taken when the owls are breeding (Higgins 1999).	Potential foraging habitat.
TYTONIDAE					
Tyto novaehollandiae Masked Owl (9)	V		Coast and ranges. In NSW they are recorded in most regions but occur predominantly east of the Great Divide from Murwillumbah to Ben Boyd National Park in the south (Higgins 1999).	These owls inhabit a diverse range of dry eucalypt forest and woodland, especially adjacent to grassland or clearings. They require a large home range (1000 ha). Key roosting and nesting habitat must contain tall or dense mature trees with suitable hollows. Favoured nesting hollows are near-vertical spouts or large hollows in trunks of large eucalypts (Higgins 1999). They forage mainly upon terrestrial prey in adjoining open habitat, occasionally preying upon arboreal or scansorial mammals (Higgins 1999). Rats forma large part of their diet (DEC 2005).	Potential foraging habitat.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
Tyto capensis Grass Owl	V		Grass Owls have been recorded occasionally in all mainland states of Australia but appear to be more commonly recorded in northern and north-eastern Australia. In NSW they are more likely to be found in the north-east. Grass Owl numbers often increase when rodent numbers increase.	Grass Owls are mainly found in tussock-grasslands, but also inhabit heaths, swamps, coastal dunes, treelined creeks, treeless plains, grassy gaps between trees, and crops. They nest on the ground, usually under tussocks, with both timing and density of nesting responsive to food abundance. The clutch size is 6-8 (Schodde and Mason, 1980, Higgins, 1999). They feed on rodents, notably Long-haired Rat *Rattus villosissimus*, Dusky Field Rat *R. sordidus*, Grassland Melomys *Melomys burtoni* and House Mouse *Mus domesticus*, but also take insects when their preferred food is scarce (Cox, 1976, Parker, 1977, Maciejewski, 1997, Debus *et al*., 1998, Higgins, 1999).	No habitat present.
MELIPHAGIDAE					
Xanthomyza phrygia Regent Honeyeater (0)	E	E,M	Temperate woodlands and open forests of the inland slopes of south-east Australia, also found in drier coastal woodlands and forests in some years. Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years non-breeding flocks converge on flowering coastal woodlands and forests.	This species occurs in forest and woodlands dominated by winter-flowering eucalypts like ironbark and box species. Found especially in moist fertile sites along creeks, river valleys and lower slopes of foothills (Higgins *et al*. 2001). Forage in canopy among foliage and flowers on nectar and invertebrates.	Limited potential foraging habitat within remnant swamp forest in study area.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
DASYURIDAE					
Phascogale tapoatafa Brush-tailed Phascogale (23)	V		The Brush-tailed Phascogale has a patchy distribution around the coast of Australia up to 1500m (Soderquist, 1995). In NSW it is more frequently found in forest on the Great Dividing Range in the north-east and south-east of the State. There are also a few records from central NSW. Maxwell *et al* (1996) reported that within NSW they are most commonly recorded from Taree to Port Macquarie as well as some parts of the Hunter Valley. The distribution of Phascogale populations is correlated to the richness and abundance of arthropods which is positively related to soil and foliar nutrient levels (Recher *et al*. 1996).	Brush-tailed Phascogale are agile climbers which forage arboreally in dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. They are often found at low densities as they have large home ranges, male home ranges are up to 100ha (Soderquist 1995) in continuous habitat and overlap with female intrasexually exclusive home ranges (30-60 ha). They are a hollow dwelling species which require large numbers of hollows (>30) within their home range (DSE 1997). They show a preference for utilising dead or senescent trees with suitable hollows, 25-40mm wide, lined with leaves and pungent faeces (DSE, 1997; Rhind 2004). Prey generally consists of large invertebrates including insects, spiders and centipedes (Triall & Coates 1993; Soderquist 1995; Scarff et al. 1998).	Sub-optimal potential habitat.
Dasyurus maculatus Spotted-tailed Quoll (14)	V	E	The range has contracted considerably since European settlement. It is now found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common.	Spotted-tailed Quoll have been recorded across a broad range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites include hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Nocturnal hunters preying upon a range of arboreal and ground dwelling mammals such as gliders, rats, birds, bandicoots etc. Use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky cliff faces as den sites. Occupy extremely large territories with female home ranges up to about 750 hectares and males up to 3500 hectares.	Potential habitat present.
PHASCOLARCTIDAE					

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
Phascolarctos cinereus cinereus Koala (2622)	V		Patchily distributed throughout coast, ranges and western slopes, but concentrated on north coast.	Koalas inhabit Eucalypt forest and woodland on higher nutrient soils. Although the Koala feeds on a range of tree species, a small number of eucalypt species provide its staple diet. One known feed species *Eucalyptus robusta* was recorded within the subject site in low numbers.	Known habitat, recorded during field surveys.
PETAURIDAE					
Petaurus norfolcensis Squirrel Glider (40)	V		Patchily distributed along ranges, western slopes, and the coast north of Sydney.	Eucalypt forest or woodland with mature or mixed-age trees, with a variety of species. The presence of winter-flowering species appears to be important.	Known habitat, recorded during field surveys.
MURIDAE					
Pseudomys gracilicaudatus Eastern Chestnut Mouse (0)	V		The Eastern Chestnut Mouse is scattered along the east coast from Townsville to Brisbane Water National Park; in the south-east region it is found at Jervis Bay. Its presence in NSW has only relatively recently been recognised (DEC 2005).	In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands (DEC 2005). Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again (DEC 2005). Feeds at night via runways through the grassy and sedge understorey, within an area of less than half a hectare. It has a broad diet of grass stems, invertebrates, fungi and seeds, with the relative significance of each component varying seasonally (DEC 2005).	Potential habitat occurs adjacent to wetlands.
PTEROPODIDAE					

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
Pteropus poliocephalus Grey-headed Flying Fox (21)	V	V	Within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.	This species occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, birth and the rearing of young. Site fidelity to camps is high with some caps being used for over a century. Grey-headed Flying-fox travel up to 50 km to forage. They feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. They may also forage in cultivated gardens and fruit crops and can inflict severe crop damage.	Known habitat, recorded within study area by ERM (2004).
MOLOSSIDAE					
Mormopterus norfolkensis Eastern Free-tail Bat (4)	V		East of the Great Dividing range to the coastline, and ranging in latitude from Picton (New South Wales) in the south, as far north as south-east Queensland (DEH, 1999). Most recent records come from north-eastern New South Wales (Parnaby 1992; Gilmore and Parnaby 1994 cited in DEH 1999).	*Mormopterus norfolkensis* is a tree-dwelling (Allison & Hoye 1995) insectivorous bat which is often located in dry eucalypt forest and coastal woodlands, although individuals have also been captured within riparian zones, wet sclerophyll and rainforest (Allison & Hoye 1995). They forage above the canopy or in unobstructed corridors in open areas (Strahan 1995) on either winged or wingless ants (Allison 1989). Roost together in small colonies in hollows or under loose bark (Australian Museum 2004).	Known habitat. Recorded during field surveys.
VESPERTILIONIDAE					
Miniopterus australis Little Bent-wing Bat (20)	V		Coastal north-eastern NSW and eastern Queensland.	Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites (Law 1996; Wilson	Known foraging habitat.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
				1982). Little Bent-wing Bat has a preferences for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects (DEC 2005).	
Miniopterus schreibersii oceanensis Eastern Bent-wing Bat (39)	V		East and north-west coasts of Australia.	Eastern Bent-wing Bat forage above dry and moist forest, and can be found on edges of urban areas. Roost in caves, in old mines, in tunnels, under bridges, or in similar structures. Specific maternity caves are used by females during summer to give birth.	Known foraging habitat, recorded during previous surveys (Conacher Travers 1998).
Chalinolobus dwyeri Large-eared Pied Bat (1)	V	V	In areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. They are generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes (DEC 2005).	These bats roost in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features (DEC 2005). Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.	Potential foraging habitat.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
Falsistrellus tasmaniensis Eastern False Pipistrelle (8)	V		South-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania.	The Eastern False Pipistrelle is an insectivorous bat which is often located in wet temperate forests with tall trees with a dense canopy and sub-canopy, foraging on beetles, moths and ants (Herr 1998; Australian Museum 2004). Herr (1998) identified that their preferred roost habitat was mature forests which contained a low density of trees, with a high density of older trees with a large dbh (>100cm). The trees utilised are often older smooth-barks with large hollows with a large crown canopy (Herr 1998). Radio tracking analysis of *Falsistrellus tasmaniensis* revealed a variable home range of between 6 ha and 336 ha, and that they had a high roost fidelity to a group of trees rather than singular trees (Herr 1998).	Potential habitat present.
Myotis adversus Large-footed Myotis (3)	V		East coast of Australia, along the top of Queensland, the Northern Territory and north-western Australia. Sites inhabited are usually far between, and as such it is regarded as sparse in Australia (State Forests of NSW 1995).	Large-footed Myotis are small bats that live in caves, tunnels, under bridges and in trees in eastern and northern Australia. They are about 5 cm long with a grey-brown back and grey belly. They have very large feet to help them catch insects from the water and narrow wings to help them fly fast. Large-footed Myotis hunt for food at night. They fly over creeks and rake their clawed hind feet through the water to catch fish and insects. Lives in harems, usually with 8 females for every male (Dwyer 1970).	Potential foraging habitat adjacent to study area. Recorded over wetland adjacent to study area (General Flora and Fauna 2004).
Scoteanax rueppellii Greater Broad-nosed Bat (12)	V		Coastal (altitudes under 500 metres), occurring less than 100km inland (Hoye & Richards 1995).	The Greater Broad-nosed bat is found in a variety of habitats ranging from woodlands, to moist and dry eucalypt forest and rainforest (Hoye & Richards 1995). They prefer open habitats in which they can fly straight and direct and are known to utilise artificial openings in forests, with their favoured habitats being river and creek corridors (Hoye & Richards 1995). Individuals have been recorded roosting in tree hollows, cracks and fissures in the trunk and boughs of stags, and under exfoliating bark. A recent study on the north coast of NSW by Campbell (2001) found roost habitat occurred in a Melaleuca swamp woodland habitat (Wallum)	Potential habitat present. Possibly recorded within study area previously (Conacher Travers 1998).

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
				in areas of low relief.	
EUPHORBIACEAE					
Chamaesyce psammogeton Sand Spurge (3)	E		Sand Spurge is found sparsely along the coast from south of Jervis Bay (at Currarong, Culburra and Seven Mile Beach National Park) to Queensland (and Lord Howe Island). Populations have been recorded in Wamberal Lagoon Nature Reserve, Myall Lakes National Park and Bundjalung National Park (DEC 2005).	Grows on fore-dunes and exposed headlands, often with Spinifex (*Spinifex sericeus*) (DEC 2005). Flowering occurs in summer, Plant growth occurs in spring and summer (DEC 2005). *C. psammogeton* seeds float, so some dispersal between beaches may occur (DEC 2005). Longevity of the species is approximately 5 – 30 years with a primary juvenile period of less than 1 year (DEC 2005).	No habitat present.
MYRTACEAE					
Eucalyptus parramattensis subsp. *decadens* (2)	V	V	There are two separate meta-populations of *E. parramattensis* subsp. *decadens*. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the sub-species are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south.	Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. In the Kurri Kurri area, E. parramattensis subsp. decadens is a characteristic species of 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion', an endangered ecological community under the TSC Act. In the Tomago Sandbeds area, the species is usually associated with the 'Tomago Swamp Woodland' as defined by NSW NPWS (2000).	No habitat present.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
				Very little is known about the biology or ecology of this species. Flowers from November to January. Propagation mechanisms are currently poorly known. Seed dispersal is likely to be effected by wind and animals. Likely to be sensitive to over-frequent fire, however there is evidence (i.e. coppicing, epicormic shoots) that the species may be tolerant of low intensity fires. The species has a canopy stored seed bank for dispersal after fire events.	
Melaleuca groveana Grove's Paperbark (9)	V		Widespread, scattered populations in coastal districts north of Port Stephens to southeast Queensland.	Grove's Paperbark grows in heath and shrubland, often in exposed sites, at high elevations, on rocky outcrops and cliffs. It also occurs in dry woodlands (DEC 2005).	No habitat present.
RUBIACEAE					
Asperula asthenes Trailing Woodruff (1)	V		This small herb occurs only in NSW. It is found in scattered locations from Bulahdelah north to near Kempsey, with several records from the Port Stephens/Wallis Lakes area.	Damp sites, often along river banks (DEC 2005).	No habitat present.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
TREMANDRACEAE					
Tetratheca juncea (19)	V	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock.	It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies (DEC 2005).	Potential habitat present, not recorded.
LAMIACEAE					
Prostanthera densa Villous Mint-bush (13)	V	V	This species has been recorded from the Currarong area in Jervis Bay, Royal National Park, Cronulla and Port Stephens (Gan Gan Hill, Nelson Bay). The Sydney and Royal NP populations have not been seen in recent times.	Villous Mint-bush is generally found on sandstone in sclerophyll forest and shrubland on coastal headlands (DEC 2005). Plants regenerate from rootstock after fire and flower within the first year or two (DEC 2005).	No habitat present.
ORCHIDACEAE					
Cryptostylis hunteriana Leafless Tongue Orchid (2)	V	V	The Leafless Tongue Orchid has been recorded from the Gibraltar Range National Park, south into Victoria around the coast. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Also recorded at Nelson Bay, Wyee, Washpool National Park, Nowendoc State Forest, Ku-Ring-Gai Chase National Park, Ben Boyd National	In NSW it occupies habitats from scrubby swamp fringes to steep bare hillsides in tall eucalypt forest. Recorded from only a few locations (Bishop 1996). In previous years it has been found in the Wyong Shire at sites with open woodland (*Eucalyptus haemastoma, Angophora costata, E. capitellata* and *Angophora inopina*), or *Eucalyptus capitellata, E. umbra, Corymbia gummifera* and *Angophora costata* open grassland (*Themeda australis*, *Austrodanthonia* species and *Patersonia sericea*), open forest (*Corymbia maculata, Eucalyptus haemastoma, Angophora costata* and *Melaleuca nodosa* and mid-canopy heathland with *Themeda australis* and *Austrodanthonia*	Potential habitat present.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
			Park (DEC 2005).	species present (Bell 2003). *C. hunteriana* is a leafless, saprophytic herb, independent of fire but dependent on the availability of decaying matter and mycorrhizal fungi (Bell 2001; Perkins 2001). It lacks chlorophyll and survives by a symbiotic relationship with a mycorrhizal fungus at its roots. It relies entirely upon the symbiotic fungus to digest and transport substances into the roots. These materials are from organic matter decaying in the soil (Jones 1988). Bell (2001) recorded the sole pollinating agent of this species as the ichneumonid wasp *Lissopimpla excelsa*, which is also the pollinating agent of the other five species of *Cryptostylis* which occur in Australia.	
Diuris praecox Rough Double Tail (13)	V	V	Known to occur in coastal areas between Ourimbah and Nelson Bay, growing in eucalypt forest, often on hilltops or slopes (Bishop 1996). In the Wyong Shire populations have been recorded within coastal habitat in: • open woodland dominated by *Eucalyptus haemastoma, Angophora costata* and *Allocasuarina littoralis*; • open grassland and sedgeland dominated by *Patersonia sericea*, *Themeda australis* and *Austrodanthonia* species; and • forests dominated by *Angophora costata*, *Melaleuca nodosa* and *Allocasuarina littoralis*. Bell (2001) recorded a population of 200-300 plants near Crackneck lookout in	Species of *Diuris* are widespread in grassy habitats, but easily overlooked because their flowering seasons are usually no more than 2 weeks. Many species are associated with *Themeda australis*. Their colourful flowers appear to be pollinated by small bees, but syrphiid flies and beetles may also be pollinators. The flowers offer no nectar reward to pollinators, but often appear to mimic other plants growing nearby which do offer nectar as a reward to the pollinator, thereby tricking pollinators into visiting them. Most of the *Diuris* species mimic flowers in the genera *Daviesia* and *Pultenaea* (Beardsell et al. 1986). Many populations of *Diuris* species show a wide range of floral forms, perhaps the result of natural selection favouring rarer flower types that the pollinators have less chance to learn to recognise as being unrewarding (Bishop 1996). This explanation may explain why the flowers on a single stem can vary dramatically from each other. They are terrestrial herbs, sympodial (produce a new shoot each year) and have tubers. *Diuris* species exist as subterranean tubers during most of the year. *D. praecox* produces leaves and flowering stems in winter	Potential habitat present.

Family/Species (No. of Records)	TSC Act	EPBC Act	Distribution	Habitat and Ecology	Habitat within Study Area
			Wyrrabalong National Park. In the Wyong Shire *D. praecox* has been recorded on Patonga claystone, indurated sand and Munmorah conglomerate. An individual plant has also been recorded behind the Council depot in Arizona Rd (Branwhite 1999).	to mid winter. *D. praecox* uses floral mimicry to achieve the pollination of its flowers.	
Diuris arenaria Sand Doubletail (1)	E		Sand Doubletail is known from the Tomaree Peninsula near Newcastle. It is currently known from three locations, two of which are in reserves.	This species occurs in coastal heath and dry grassy eucalypt forest on sandy flats (DEC 2005). Grows in gently undulating country in eucalypt forest with a grassy understorey on clay soil (DEC 2005).	No habitat present.

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APPENDIX 3 – EPBC PROTECTED MATTERS REPORT

Australian Government
Department of the Environment and Heritage

Protected Matters Search Tool

You are here: DEH Home > EPBC Act > Search

22 September 2006 14:31

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at http://www.environment.gov.au/atlas may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.deh.gov.au/epbc/assessmentsapprovals/index.html

Search Type: Point
Buffer: 10 km
Coordinates: -32.73466,152.079328

Report Contents:

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.deh.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance: (Ramsar Sites)	1
Commonwealth Marine Areas:	Relevant
Threatened Ecological Communities:	None
Threatened Species:	37
Migratory Species:	37

Other Matters Protected by the EPBC Act

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

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

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.deh.gov.au/epbc/permits/index.html.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Places on the RNE:	5
Listed Marine Species:	58
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

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

State and Territory Reserves:	6
Other Commonwealth Reserves:	None
Regional Forest Agreements:	1

Details

Matters of National Environmental Significance

Wetlands of International Significance [Dataset Information]
(Ramsar Sites)

MYALL LAKES

Commonwealth Marine Areas [Dataset Information]

Approval may be required for a proposed activity that is likely to have a significant impact on the environment in a Commonwealth Marine Area, when the action is outside the Commonwealth Marine Area, or the environment anywhere when the action is taken within the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Within 3 Nautical Mile Limit

Threatened Species [Dataset Information]	Status	Type of Presence
Birds		
Diomedea amsterdamensis * Amsterdam Albatross	Endangered	Species or species habitat may occur within area
Diomedea antipodensis * Antipodean Albatross	Vulnerable	Species or species habitat may occur within area
Diomedea dabbenena * Tristan Albatross	Endangered	Foraging may occur within area
Diomedea exulans * Wandering Albatross	Vulnerable	Species or species habitat may occur within area
Diomedea gibsoni * Gibson's Albatross	Vulnerable	Species or species habitat may occur within area
Lathamus discolor * Swift Parrot	Endangered	Species or species habitat may occur within area
Macronectes giganteus * Southern Giant-Petrel	Endangered	Species or species habitat may occur within area
Macronectes halli * Northern Giant-Petrel	Vulnerable	Species or species habitat may occur within area
*Pterodroma leucoptera leucoptera** Gould's Petrel	Endangered	Species or species habitat may occur within area
*Pterodroma neglecta neglecta** Kermadec Petrel (western)	Vulnerable	Species or species habitat may occur within area
Rostratula australis * Australian Painted Snipe	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri * Buller's Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta * Shy Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche impavida * Campbell Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris * Black-browed Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini * Salvin's Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi * White-capped Albatross	Vulnerable	Species or species habitat may occur within area
Xanthomyza phrygia * Regent Honeyeater	Endangered	Species or species habitat may occur within area
Frogs		
Litoria aurea * Green and Golden Bell Frog	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus * Stuttering Frog, Southern Barred Frog (in Victoria)	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Balaenoptera musculus * Blue Whale	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri * Large-eared Pied Bat, Large Pied Bat	Vulnerable	Species or species habitat may occur within area
*Dasyurus maculatus maculatus (SE mainland population)** Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered	Species or species habitat may occur within area
Eubalaena australis * Southern Right Whale	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae * Humpback Whale	Vulnerable	Species or species habitat may occur within area
*Potorous tridactylus tridactylus** Long-nosed Potoroo (SE mainland)	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus * Grey-headed Flying-fox	Vulnerable	Roosting known to occur within area
Reptiles		
Chelonia mydas * Green Turtle	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea * Leathery Turtle, Leatherback Turtle, Luth	Vulnerable	Species or species habitat may occur within area
Sharks		
*Carcharias taurus (east coast population)** Grey Nurse Shark (east coast population)	Critically Endangered	Species or species habitat may occur within area
Carcharodon carcharias * Great White Shark	Vulnerable	Species or species habitat may occur within area
Rhincodon typus * Whale Shark	Vulnerable	Species or species habitat may occur within area
Plants		
Cryptostylis hunteriana * Leafless Tongue-orchid	Vulnerable	Species or species habitat may occur within area
Diuris praecox * Newcastle Doubletail	Vulnerable	Species or species habitat likely to occur within area
*Eucalyptus parramattensis subsp. decadens** Earp's Gum, Earp's Dirty Gum	Vulnerable	Species or species habitat likely to occur within area
Prostanthera densa * Villous Mintbush	Vulnerable	Species or species habitat likely to occur within area
Tetratheca juncea *	Vulnerable	Species or species habitat likely to occur within area

Migratory Species [Dataset Information]	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Migratory	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Migratory	Breeding may occur within area
Monarcha trivirgatus Spectacled Monarch	Migratory	Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher	Migratory	Breeding likely to occur within area
Rhipidura rufifrons Rufous Fantail	Migratory	Breeding may occur within area
Xanthomyza phrygia	Migratory	Species or species habitat may occur within area

Regent Honeyeater		
Migratory Wetland Species		
Birds		
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew	Migratory	Species or species habitat likely to occur within area
Numenius phaeopus Whimbrel	Migratory	Species or species habitat likely to occur within area
Rostratula benghalensis s. lat. Painted Snipe	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
Diomedea amsterdamensis Amsterdam Albatross	Migratory	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross	Migratory	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross	Migratory	Foraging may occur within area
Diomedea exulans Wandering Albatross	Migratory	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross	Migratory	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel	Migratory	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel	Migratory	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel	Migratory	Species or species habitat may occur within area
Puffinus leucomelas Streaked Shearwater	Migratory	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross	Migratory	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross	Migratory	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross	Migratory	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross	Migratory	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross	Migratory	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross	Migratory	Species or species habitat may occur within area
Migratory Marine Species		
Mammals		
Balaenoptera edeni Bryde's Whale	Migratory	Species or species habitat may occur within area
Balaenoptera musculus ***** Blue Whale	Migratory	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale	Migratory	Species or species habitat may occur within area
Eubalaena australis ***** Southern Right Whale	Migratory	Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin	Migratory	Species or species habitat may occur within area
Megaptera novaeangliae ***** Humpback Whale	Migratory	Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca	Migratory	Species or species habitat may occur within area
Reptiles		
Chelonia mydas ***** Green Turtle	Migratory	Species or species habitat may occur within area
Dermochelys coriacea ***** Leathery Turtle, Leatherback Turtle, Luth	Migratory	Species or species habitat may occur within area
Sharks		
Carcharodon carcharias Great White Shark	Migratory	Species or species habitat may occur within area
Rhincodon typus Whale Shark	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Dataset Information]	Status	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater	Listed	Species or species habitat may occur within area
Catharacta skua Great Skua	Listed	Species or species habitat may occur within area
Diomedea amsterdamensis Amsterdam Albatross	Listed	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross	Listed	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross	Listed	Foraging may occur within area
Diomedea exulans Wandering Albatross	Listed	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross	Listed	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
Lathamus discolor Swift Parrot	Listed - overfly marine area	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel	Listed	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel	Listed	Species or species habitat may occur within area

Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
Monarcha trivirgatus Spectacled Monarch	Listed - overfly marine area	Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
Numenius madagascariensis Eastern Curlew	Listed	Species or species habitat likely to occur within area
Numenius phaeopus Whimbrel	Listed	Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail	Listed - overfly marine area	Breeding may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Sterna albifrons Little Tern	Listed	Breeding may occur within area
Thalassarche bulleri Buller's Albatross	Listed	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross	Listed	Species or species habitat may occur within area
Thalassarche chlororhynchos Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross	Listed	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross	Listed	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross	Listed	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross	Listed	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross	Listed	Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri New Zealand Fur-seal	Listed	Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal	Listed	Species or species habitat may occur within area
Ray-finned fishes		
Acentronura tentaculata Hairy Pygmy Pipehorse	Listed	Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish	Listed	Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish	Listed	Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish	Listed	Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish	Listed	Species or species habitat may occur within area
Hippocampus abdominalis Eastern Potbelly Seahorse, New Zealand Potbelly, Seahorse, Bigbelly Seahorse	Listed	Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse	Listed	Species or species habitat may occur within area
Histiogamphelus briggsii Briggs' Crested Pipefish, Briggs' Pipefish	Listed	Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish	Listed	Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish	Listed	Species or species habitat may occur within area
Notiocampus ruber Red Pipefish	Listed	Species or species habitat may occur within area
Phyllopteryx taeniolatus Weedy Seadragon, Common Seadragon	Listed	Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse	Listed	Species or species habitat may occur within area
Solenostomus cyanopterus Blue-finned Ghost Pipefish, Robust Ghost Pipefish	Listed	Species or species habitat may occur within area
Solenostomus paradoxus Harlequin Ghost Pipefish, Ornate Ghost Pipefish	Listed	Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish	Listed	Species or species habitat may occur within area
Stigmatopora nigra Wide-bodied Pipefish, Black Pipefish	Listed	Species or species habitat may occur within area
Syngnathoides biaculeatus Double-ended Pipehorse, Alligator Pipefish	Listed	Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bend Stick Pipefish, Short-tailed Pipefish	Listed	Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish	Listed	Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish	Listed	Species or species habitat may occur within area
Reptiles		
Chelonia mydas ***** Green Turtle	Listed	Species or species habitat may occur within area
Dermochelys coriacea ***** Leathery Turtle, Leatherback Turtle, Luth	Listed	Species or species habitat may occur within area
Pelamis platurus Yellow-bellied Seasnake	Listed	Species or species habitat may occur within area
Whales and Other Cetaceans [Dataset Information]	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera musculus ***** Blue Whale	Cetacean	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale	Cetacean	Species or species habitat may occur within area
Delphinus delphis Common Dolphin	Cetacean	Species or species habitat may occur within area
Eubalaena australis ***** Southern Right Whale	Cetacean	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus	Cetacean	Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin	Cetacean	Species or species habitat may occur within area

Megaptera novaeangliae * Humpback Whale	Cetacean	Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca	Cetacean	Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin	Cetacean	Species or species habitat may occur within area
Tursiops aduncus Spotted Bottlenose Dolphin	Cetacean	Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin	Cetacean	Species or species habitat may occur within area

Commonwealth Lands [Dataset Information]

Places on the RNE [Dataset Information]
Note that not all Indigenous sites may be listed.

Natural

Corrie Island NSW

Fly Point, Halifax Park Aquatic Reserve NSW

Port Stephens Estuary NSW

Snapper Island Nature Reserve NSW

Tomaree National Park NSW

Extra Information

State and Territory Reserves [Dataset Information]

Corrie Island Nature Reserve, NSW

Fly Point Aquatic Reserve, NSW

Myall Lakes National Park, NSW

Snapper Island Nature Reserve, NSW

Tilligerry Nature Reserve, NSW

Tomaree National Park, NSW

Regional Forest Agreements [Dataset Information]
Note that all RFA areas including those still under consideration have been included.

Lower North East NSW RFA, New South Wales

Caveat

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

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

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

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

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

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

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

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

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

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

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

Acknowledgments

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

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCLIM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Last updated:

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APPENDIX 4 – FLORA SPECIES LIST

Family	Species	Common Name	Legal Status		
			TSC	EPBC	Exotic
SCHIZAEACEAE					
	Schizaea dichotoma	Branched Comb Fern			-
GLEICHENIACEAE					
	Gleichenia dicarpa				-
DICKSONIACEAE					
	Calochlaena dubia	Common Ground Fern			-
DENNSTAEDTIACEAE					
	Histiopteris incisa	Bats Wing Fern			-
	Hypolepis muelleri	Harsh Ground Fern			-
	Pteridium esculentum	Bracken			-
DAVALLIACEAE					
	Nephrolepis cordifolia	Fishbone Fern			-
BLECHNACEAE					
	Blechnum camfieldii				-
	Blechnum indicum	Swamp Water Fern			-
LAURACEAE					
	Cassytha glabella				-
	Cassytha pubescens				-
MENISPERMACEAE					
	Stephania japonica	Snake Vine			-
DILLENIACEAE					
	Hibbertia obtusifolia				-
	Hibbertia pedunculata				-
	Hibbertia vestita	Hairy Guinea Flower			
	Hibbertia linearis				-
ELAEOCARPACEAE					
	Elaeocarpus reticulatus	Blueberry Ash			-
THYMELAEACEAE					
	Pimelea linifolia	Slender Rice Flower			-
EUPHORBIACEAE					
	Glochidion ferdinandi	Cheese Tree			-
	Ricinocarpos pinifolius	Wedding Bush			-
VIOLACEAE					
	Hybanthus monopetalus	Slender Violet-bush			-
DROSERACEAE					
	Drosera peltata				-
CASUARINACEAE					
	Allocasuarina littoralis	Black Sheoak			-
	Casuarina glauca	Swamp Oak			-
CUNONIACEAE					
	Ceratopetalum gummiferum	Christmas Bush			-
PROTEACEAE					
	Banksia serrata	Old-man Banksia			
	Hakea salicifolia subsp. salicifolia	Willow-leaved Hakea			-

Family	Species	Common Name	Legal Status		
			TSC	EPBC	Exotic
	Persoonia lanceolata				-
	Persoonia levis	Broad-leaved Geebung			-
	Xylomelum pyriforme	Woody Pear			-
MYRTACEAE					
	Angophora costata	Smooth-barked Apple			
	Callistemon rigidus	Stiff Bottlebrush			-
	Corymbia gummifera	Red Bloodwood			-
	Eucalyptus pilularis	Blackbutt			-
	Eucalyptus robusta	Swamp Mahogany			-
	Leptospermum polygalifolium subsp. polygalifolium				-
	Leptospermum trinervium				-
	Melaleuca quinquenervia	Paperbark			-
	Melaleuca sieberi				-
HALORAGACEAE					
	Gonocarpus micranthus subsp. micranthus				-
RUTACEAE					
	Eriostemon australasius	Waxflower			
	Philotheca salsolifolia				-
SAPINDACEAE					
	Dodonaea triquetra				-
FABACEAE					
Caesalpinioideae					
	Senna pendula var. glabrata				X
Mimosoidae					
	Acacia elongata	Swamp Wattle			-
	Acacia irrorata subsp. irrorata	Green Wattle			-
	Acacia longifolia subsp. longifolia	Sydney Golden Wattle (subsp. longifolia)			-
	Acacia longissima	Narrow-leaved Wattle			-
	Acacia ulicifolia	Prickly Moses			-
	Acacia suaveolens	Sweet Wattle			
Faboideae					
	Bossiaea rhombifolia subsp. rhombifolia				-
	Daviesia corymbosa				-
	Dillwynia floribunda				
	Dillwynia retorta				-
	Erythrina x sykesii	Coral Tree			X
	Glycine tabacina				-
	Gompholobium latifolium	Golden Glory Pea			-
	Hardenbergia violacea	False Sarsaparilla			-
	Hovea linearis				-
	Indigofera australis				-
	Kennedia rubicunda	Red Kennedy Pea			-

Family	Species	Common Name	Legal Status		
			TSC	EPBC	Exotic
	Platylobium formosum subsp. formosum				-
	Pultenaea paleacea				-
	Pultenaea rosmarinifolia				-
POLYGALACEAE					
	Comesperma ericinum				-
OXALIDACEAE					
	Oxalis sp.				-
VITACEAE					
	Cissus hypoglauca	Giant Water Vine			-
SANTALACEAE					
	Exocarpos cupressiformis	Native Cherry			-
	Exocarpos strictus	Dwarf Cherry			-
	Leptomeria acida	Sour Currant Bush			-
PITTOSPORACEAE					
	Billardiera scandens var. scandends	Appleberry			-
	Pittosporum undulatum	Pittosporum			-
TREMANDRACEAE					
	Tetratheca ericifolia				-
APIACEAE					
	Actinotus helianthi	Flannel Flower			-
	Hydrocotyle bonariensis				X
	Trachymene incisa subsp. incisa				-
	Xanthosia pilosa				-
LOBELIACEAE					
	Pratia purpurascens	Whiteroot			-
ASTERACEAE					
	Chrysanthemoides monilifera subsp. monilifera	Bitou Bush			X
	Coreopsis lanceolata	Coreopsis			X
	Hypochaeris microcephala var. albiflora	White Flatweed			X
	Hypochaeris radicata	Catsear			X
	Senecio madagascariensis	Fireweed			X
EPACRIDACEAE					
	Epacris pulchella				
	Leucopogon lanceolatus				-
	Leucopogon juniperinus				-
	Monotoca elliptica				-
RUBIACEAE					
	Pomax umbellata				-
APOCYNACEAE					
	Parsonsia straminea	Common Silkpod			-
BIGNONIACEAE					

Family	Species	Common Name	Legal Status		
			TSC	EPBC	Exotic
	Pandorea pandorana	Wonga Wonga Vine			-
VERBENACEAE					
	Lantana camara	Lantana			X
SMILACACEAE					
	Smilax glyciphylla	Sweet Sarsaparilla			-
ASPARAGACEAE					
	Protasparagus aethiopicus	Sprengeri Fern			X
LOMANDRACEAE					
	Lomandra filiformis subsp. filiformis	Wattle Mat-rush			-
	Lomandra longifolia	Spiny-headed Mat-rush			-
XANTHORRHOEACEAE					
	Xanthorrhoea media				-
PHORMIACEAE					
	Dianella caerulea var. caerulea				-
	Dianella caerulea var. producta				-
IRIDACEAE					
	Patersonia sericea				-
	Watsonia meriana	Wild Watsonia			X
ORCHIDACEAE					
	Acianthus sp.				-
	Acianthus fornicatus	Pixie Caps			-
	Caladenia carnea	Pink Fairy			-
	Caladenia quadrifaria				-
	Calochilus robertsonii	Purplish Beard Orchid			-
	Corybas sp.	Helmet Orchid			-
	Cymbidium suave	Snake Orchid			-
	Pterlstylis curta				
	Pterostylis longifolia	Tall Greenhood			-
	Pterostylis obtusa				-
	Thelymitra sp.	Sun Orchid			-
CYPERACEAE					
	Caustis flexuosa	Curly Wig			-
	Gahnia clarkei				-
RESTIONACEAE					
	Baloskion tetraphyllum				
	Leptocarpus tenax				-
POACEAE					
	Andropogon virginicus	Whisky Grass			X
	Briza maxima	Quaking Grass			X
	Chloris gayana	Rhodes Grass			X
	Cynodon dactylon	Couch			-
	Imperata cylindrica var. major	Blady Grass			-
	Pennisetum clandestinum	Kikuyu Grass			X
	Themeda australis	Kangaroo Grass			-
	Setaria gracilis	Pigeon Grass			X

Family	Species	Common Name	Legal Status		
			TSC	EPBC	Exotic
ARECACEAE					
	Archontophoenix cunninghamiana	Bangalow Palm			-

APPENDIX 5 – FAUNA SPECIES LIST

Family	Species	Common Name	Legal Status		
			TSC	EPBC	Exotic
AMPHIBIANS					
HYLIDAE					
	Litoria fallax	Green Reed Frog			-
	Litoria jervisiensis	Jervis Bay Tree Frog			-
MYOBATRACHIDAE					
	Crinia signifera	Brown Froglet			-
	Crinia tinnula	Wallum Froglet	V		-
	Limnodynastes peronii	Stripe Marsh Frog			-
	Limnodynastes tasmaniensis	Spotted Marsh Frog			-
AVIFAUNA					
ANATIDAE					
	Cygnus atratus	Black Swan		M	-
	Chenonetta jubata	Australian Wood Duck		M	-
	Anas platyrhynchos	Mallard			X
	Anas superciliosa	Pacific Black Duck		M	-
PODICIPEDIDAE					
	Tachybaptus novaehollandiae	Australasian Grebe			-
PHALACROCORACIDAE					
	Phalacrocorax sulcirostris	Little Black Cormorant			-
ARDEIDAE					
	Egretta novaehollandiae	White-faced Heron			-
THRESKIORNITHIDAE					
	Threskiornis molucca	Australian White Ibis			-
	Threskiornis spinicollis	Straw-necked Ibis			-
	Platalea regia	Royal Spoonbill			-
RALLIDAE					
	Gallinula tenebrosa	Dusky Moorhen			-
	Fulica atra	Eurasian Coot			-
CHARADRIIDAE					
	Elseyornis melanops	Black-fronted Dotterel		M	-
COLUMBIDAE					
	Ocyphaps lophotes	Crested Pigeon			-
CACATUIDAE					
	Eolophus roseicapillus	Galah			-
	Cacatua sanguinea	Little Corella			-
	Cacatua galerita	Sulphur-crested Cockatoo			-
PSITTACIDAE					
	Trichoglossus haematodus	Rainbow Lorikeet			-
	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet			-
	Glossopsitta pusilla	Little Lorikeet			-
	Platycercus eximius	Eastern Rosella			-
PODARGIDAE					
	Podargus strigoides	Tawny Frogmouth			-

Family	Species	Common Name	Legal Status		
			TSC	EPBC	Exotic
HALCYONIDAE					
	Dacelo novaeguineae	Laughing Kookaburra			-
	Todirhamphus macleayii	Forest Kingfisher			-
MALURIDAE					
	Malurus cyaneus	Superb Fairy-wren			-
PARDALOTIDAE					
	Sericornis frontalis	White-browed Scrubwren			-
	Acanthiza pusilla	Brown Thornbill			-
MELIPHAGIDAE					
	Anthochaera carunculata	Red Wattlebird			-
	Anthochaera chrysoptera	Little Wattlebird			-
	Entomyzon cyanotis	Blue-faced Honeyeater			-
	Manorina melanocephala	Noisy Miner			-
	Meliphaga lewinii	Lewin's Honeyeater			-
	Lichenostomus chrysops	Yellow-faced Honeyeater			-
	Phylidonyris nigra	White-cheeked Honeyeater			-
	Acanthorhynchus tenuirostris	Eastern Spinebill			-
PACHYCEPHALIDAE					
	Pachycephala pectoralis	Golden Whistler			-
	Pachycephala rufiventris	Rufous Whistler			-
DICRURIDAE					
	Grallina cyanoleuca	Magpie-lark			-
	Rhipidura fuliginosa	Grey Fantail			-
	Rhipidura leucophrys	Willie Wagtail			-
CAMPEPHAGIDAE					
	Coracina novaehollandiae	Black-faced Cuckoo-shrike			-
ORIOLIDAE					
	Oriolus sagittatus	Olive-backed Oriole			-
ARTAMIDAE					
	Artamus leucorhynchus	White-breasted Woodswallow			-
	Cracticus torquatus	Grey Butcherbird			-
	Gymnorhina tibicen	Australian Magpie			-
CORVIDAE					
	Corvus coronoides	Australian Raven			-
PASSERIDAE					
	Neochmia temporalis	Red-browed Finch			-
SYLVIIDAE					
	Acrocephalus stentoreus	Clamorous Reed-Warbler		M	-
ZOSTEROPIDAE					
	Zosterops lateralis	Silvereye			-
STURNIDAE					
	Acridotheres tristis	Common Myna			X
MAMMALS					
PERAMELIDAE					
	Isoodon macrourus macrourus	Northern Brown Bandicoot			-

Family	Species	Common Name	Legal Status		
			TSC	EPBC	Exotic
					-
PHASCOLARCTIDAE					
	Phascolarctos cinereus cinereus	Koala	V		-
PETAURIDAE					
	Petaurus norfolcensis	Squirrel Glider	V		-
PSEUDOCHEIRIDAE					
	Pseudocheirus peregrinus peregrinus	Common Ringtail Possum			-
ACROBATIDAE					
	Acrobates pygmaeus	Feathertail Glider			-
PHALANGERIDAE					
	Trichosurus vulpecula vulpecula	Common Brushtail Possum			-
MACROPODIDAE					
	Wallabia bicolor	Swamp Wallaby			-
MOLOSSIDAE					
	Mormopterus norfolkensis	Eastern Freetail-bat	V		-
	Mormopterus sp. 2	East Coast Freetail- bat			-
VESPERTILIONIDAE					
	Miniopterus australis	Little Bentwing-bat	V		-
	Nyctophilus geoffroyi	Lesser Long-eared Bat			-
	Nyctophilus gouldi	Gould's Long-eared Bat			-
	Chalinolobus gouldii	Gould's Wattled Bat			-
	Chalinolobus morio	Chocolate Wattled Bat			-
	Vespadelus vulturnus	Little Forest Bat			-
MURIDAE					
	Rattus rattus	Black Rat			X
CANIDAE					
	Vulpes vulpes	Fox			X
LEPORIDAE					
	Oryctolagus cuniculus	Rabbit			X

APPENDIX 6 – BAT CALL ANALYSIS

Date	Time (24hr)	File Name*	Characteristic Frequency	Species	Accuracy	Comments / Distinguishing Features
11/09/2006	1930	G9111930.42	~60	*Miniopterus australis*	Definite	prominent downsweeping tail
11/09/2006	1941	G9111941.29	~50	*Chalinolobus morio*	Definite	prominent downsweeping tail
11/09/2006	2106	G9112106.11	32-34	*Mormopterus norfolkensis*	Definite	
11/09/2006	2107	G9112107.04	~60	*Miniopterus australis*	Definite	
11/09/2006	2109	G9112109.24	~60	*Miniopterus australis*	Definite	
11/09/2006	2112	G9112112.33	~60	*Miniopterus australis*	Probable	
11/09/2006	2112	G9112112.40	~60	*Miniopterus australis*	Definite	
11/09/2006	2116	G9112116.20	~60	*Miniopterus australis*	Probable	
11/09/2006	2123	G9112123.30	~50	*Chalinolobus morio OR Vespadelus vulturnus*	Both Possible	No distinguishing characteristics
12/09/2006	1918	G9121218.15	32-36	*Mormopterus norfolkensis*	Possible	poor quality call sequence
12/09/2006	1925	G9121925.41	32-34	*Mormopterus norfolkensis*	Probable	Some pulses have downsweeping tail; pulses alternate by about 2kHz in frequency.
12/09/2006	1928	G9121928.36	33	*Mormopterus norfolkensis*	Probable	
12/09/2006	1929	G9121929.35	33-36	*Mormopterus norfolkensis*	Probable	
12/09/2006	1929	G9121929.50	32-35	*Mormopterus norfolkensis*	Definite	Pulses have well defined shape.
12/09/2006	1930	G9121930.29	33-37	*Mormopterus norfolkensis*	Probable	Short call sequence
12/09/2006	1930	G9121930.55	32-35	*Mormopterus norfolkensis*	Definite	
12/09/2006	1931	G9121931.30	~32	*Mormopterus norfolkensis*	Probable	Short call sequence
12/09/2006	1944	G9121944.35	~31	*Chalinolobus gouldii*	Probable	Short call sequence
12/09/2006	1947	G9121947.10	~60	*Miniopterus australis*	Probable	Short call sequence
12/09/2006	1948	G9121948.23	~60	*Miniopterus australis*	Definite	prominent downsweeping tail
12/09/2006	1951	G9121951.22	~53	*Chalinolobus morio*	Probable	
12/09/2006	1953	G9121953.10	60	*Miniopterus australis*	Probable	poor quality call sequence
12/09/2006	1953	G9121953.17	60	*Miniopterus australis*	Probable	poor quality call sequence
12/09/2006	1953	G9121953.42	60	*Miniopterus australis*	Definite	
12/09/2006	1953	G9121953.53	60	*Miniopterus australis*	Definite	prominent downsweeping tail
12/09/2006	1956	G9121956.36	60	*Miniopterus australis*	Definite	prominent downsweeping tail
12/09/2006	2007	G9122007.23	~32	*Mormopterus norfolkensis*	Probable	poor quality call sequence
12/09/2006	2010	G9122010.05	30-32	*Chalinolobus gouldii*	Probable	poor quality call sequence

Date	Time (24hr)	File Name*	Characteristic Frequency	Species	Accuracy	Comments / Distinguishing Features
12/09/2006	2011	G9122011.03	30-32	*Chalinolobus gouldii*	Probable	poor quality call sequence
12/09/2006	2011	G9122011.15	30-32	*Chalinolobus gouldii*	Definite	
12/09/2006	2011	G9122011.28	28-30	*Chalinolobus gouldii*	Definite	
12/09/2006	2012	G9122012.07	~50	*Chalinolobus morio*	Probable	downsweeping tail on some pulses
12/09/2006	2013	G9122013.59	~34	*Mormopterus norfolkensis*	Probable	
12/09/2006	2014	G9122014.07	~32-34	*Mormopterus norfolkensis*	Probable	Short call sequence
12/09/2006	2014	G9122014.22	~31-34	*Mormopterus norfolkensis*	Definite	Prominent pulse shape
12/09/2006	2014	G9122014.41	~32	*Mormopterus norfolkensis*	Possible	Possible feeding buzz
12/09/2006	2015	G9122015.54	~31-34	*Mormopterus norfolkensis*	Definite	Prominent pulse shape
12/09/2006	2017	G9122017.23	~31-34	*Mormopterus norfolkensis*	Definite	Prominent pulse shape
12/09/2006	2017	G9122017.48	~31-34	*Mormopterus norfolkensis*	Definite	Prominent pulse shape
12/09/2006	2018	G9122018.30	~31-34	*Mormopterus norfolkensis*	Definite	Prominent pulse shape
12/09/2006	2018	G9122018.50	~31-34	*Mormopterus norfolkensis*	Definite	Prominent pulse shape
12/09/2006	2023	G9122023.02	~58	*Miniopterus australis*	Definite	Promintent downsweeping tail
12/09/2006	2030	G9122030.08		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
12/09/2006	2038	G9122038.03	~55	*Chalinolobus morio OR Vespadelus vulturnus*	Both possible	Short call sequence
12/09/2006	2043	G9122043.11		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
12/09/2006	2053	G9122053.10		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
12/09/2006	2054	G9122054.23		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
12/09/2006	2100	G9122100.52	~55	*Chalinolobus morio OR Vespadelus vulturnus*	Both possible	Short call sequence; probably V. vulturnus due to apparent up-sweeping tail
12/09/2006	2127	G9122127.06	~55	*Chalinolobus morio OR Vespadelus vulturnus*	Both possible	Short call sequence; probably V. vulturnus due to apparent up-sweeping tail
12/09/2006	2204	G9122204.04		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
12/09/2006	2212	G9122212.24		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting

Date	Time (24hr)	File Name*	Characteristic Frequency	Species	Accuracy	Comments / Distinguishing Features
12/09/2006	2256	G9122256.09		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
12/09/2006	2314	G9122314.22		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
12/09/2006	2320	G9122320.39		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
12/09/2006	2346	G9122346.32		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
12/09/2006	2350	G9122350.06		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0006	G9130006.14	~32	*Mormopterus norfolkensis*	Probable	Short sequence however apparent downsweeping tail
13/09/2006	0007	G9130007.53	~32	*Mormopterus norfolkensis*	Probable	Short sequence however apparent downsweeping tail
13/09/2006	0022	G9130022.59		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0031	G9130031.20		*Miniopterus australis AND Mormopterus norfolkensis*	Both definite	
13/09/2006	0044	G9130044.01		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0055	G9130055.42		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2003	133	G9130133.01	~60	*Miniopterus australis*	Definite	Short sequence however prominent pulse shape
13/09/2003	134	G9130134.19	~60	*Miniopterus australis*	Definite	Short sequence however prominent pulse shape
13/09/2006	0138	G9130138.55		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0139	G9130139.55		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0142	G9130142.05		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0142	G9130142.31		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0146	G9130146.04		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting

Date	Time (24hr)	File Name*	Characteristic Frequency	Species	Accuracy	Comments / Distinguishing Features
13/09/2006	0151	G9130151.32		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0201	G9130201.00		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0215	G9130215.55		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0216	G9130216.37		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0228	G9130228.14		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0232	G9130232.23		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0236	G9130236.36		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0237	G9130237.02		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2003	240	G9130240.26	~60	*Miniopterus australis*	Possible	Short call sequence
13/09/2006	0244	G9130244.20		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0249	G9130249.17		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0252	G9130252.27		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0253	G9130253.17		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0256	G9130256.56		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0301	G9130301.11		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0305	G9130305.50	~50	*Chalinolobus morio OR Vespadelus vulturnus*	Both Possible	poor quality call sequence
13/09/2006	0314	G9130314.48		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting

Date	Time (24hr)	File Name*	Characteristic Frequency	Species	Accuracy	Comments / Distinguishing Features
13/09/2006	0325	G9130325.33		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0326	G9130326.10		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0341	G9130341.10		*Nyctophilus gouldii OR Nyctophilus geoffroyii AND Mormopterus norfolkensis*	Nyctophilus possible; Mormopterus definite	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0342	G9130342.29		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0352	G9130352.55		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2003	0359	G9130359.19	~60	*Miniopterus australis*	Possible	Short call sequence
13/09/2006	0402	G9130402.09		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0413	G9130413.10		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0419	G9130419.53		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0458	G9130458.20		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0459	G9130459.31		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0501	G9130501.43	~30	*Mormopterus norfolkensis*	Probable	Short sequence however apparent down-sweeping tail
13/09/2006	0507	G9130507.18		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0514	G9130514.14		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0515	G9130515.07		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0515	G9130515.23		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting

Date	Time (24hr)	File Name*	Characteristic Frequency	Species	Accuracy	Comments / Distinguishing Features
13/09/2006	0516	G9130516.11		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0517	G9130517.04		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	0517	G9130517.30		*Nyctophilus gouldii; Nyctophilus geoffroyii*	Both Possible	Nyctophilus geoffroyi observed during spotlighting
13/09/2006	1801	G9131801.46	~30	*Chalinolobus gouldii*	Probable	short call sequence
13/09/2006	1813	G9131813.06	~30	*Mormopterus sp. 2*	Definite	
13/09/2006	1821	G9131821.52	~30	*Mormopterus sp. 2*	Probable	Feeding buzz
13/09/2006	1906	G9131906.52	33-35	*Mormopterus norfolkensis*	Definite	
13/09/2006	1916	G9131916.09	30-32	*Chalinolobus gouldii*	Definite	
13/09/2006	1918	G9131918.34	30	*Chalinolobus gouldii*	Probable	
13/09/2006	1929	G9131929.35	30	*Chalinolobus gouldii*	Probable	
13/09/2006	1945	G9131945.49	60	*Miniopterus australis*	Probable	Short call suquence, downsweeping tail apparent.
13/09/2006	2109	G9132109.18	60	*Miniopterus australis*	Definite	
13/09/2006	2109	G9132109.36	60	*Miniopterus australis*	Definite	
13/09/2006	2110	G9132110.00	60	*Miniopterus australis*	Definite	
13/09/2006	2110	G9132110.19	50	*Vespadelus vulturnus*	Definite	Prominent up-sweeping tail
13/09/2006	2111	G9132111.12	60	*Miniopterus australis*	Definite	
13/09/2006	2115	G9132115.41	60	*Miniopterus australis*	Definite	
13/09/2006	2118	G9132118.11	60	*Miniopterus australis*	Definite	
13/09/2006	2126	G9132126.54	50	*Vespadelus vulturnus OR Chalinolobus morio*	Both Possible	poor quality call sequence
13/09/2006	2155	G9132155.13	30	*Chalinolobus gouldii*	Probable	poor quality call sequence
13/09/2006	2230	G9132230.14	60	*Miniopterus australis*	Probable	Short call sequence, down-sweeping tail apparent.
14/09/2006	0057	G9140057.03	60	*Miniopterus australis*	Probable	Short call sequence, down-sweeping tail apparent.
14/09/2006	0057	G9140057.29	60	*Miniopterus australis*	Definite	
14/09/2006	0107	G9140107.53	60	*Miniopterus australis*	Probable	
14/09/2006	0207	G9140207.34	33-35	*Mormopterus norfolkensis*	Probable	
14/09/2006	0207	G9140207.57	33-35	*Mormopterus norfolkensis*	Definite	
14/09/2006	0208	G9140208.03	60	*Miniopterus australis*	Probable	Short call sequence, down-sweeping tail apparent.
14/09/2006	0209	G9140209.01	33-35	*Mormopterus norfolkensis*	Probable	

Date	Time (24hr)	File Name*	Characteristic Frequency	Species	Accuracy	Comments / Distinguishing Features
14/09/2006	0209	G9140209.09	60	*Miniopterus australis AND Mormopterus norfolkensis*	Minopterus Definite; Mormopterus probable	
14/09/2006	0210	G9140210.44	60	*Miniopterus australis*	Probable	Short call sequence, down-sweeping tail apparent.
14/09/2006	0247	G9140247.11	60	*Miniopterus australis*	Definite	
14/09/2006	0258	G9140258.53	60	*Miniopterus australis*	Definite	
14/09/2006	0304	G9140304.49	60	*Miniopterus australis*	Definite	
14/09/2006	0305	G9140305.55	60	*Miniopterus australis*	Definite	
14/09/2006	0307	G9140307.06	60	*Miniopterus australis*	Definite	
14/09/2006	0318	G9140318.48	60	*Miniopterus australis*	Definite	
14/09/2006	0322	G9140322.36	60	*Miniopterus australis*	Definite	
14/09/2006	0323	G9140323.24	60	*Miniopterus australis*	Definite	

APPENDIX 7 – S.5A ASSESSMENT

A4-1 *Crinia tinnula* Wallum Froglet

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

Wallum Froglets are found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country. The species is a late winter breeder. Males call in choruses from within sedge tussocks or at the water edge. Wallum Froglet was recorded within the Study Area by ERM (2005a) within the Lepironia swamp. Further to this, field work undertaken for this assessment indicates that Wallum Froglet is widely distributed in the immediate vicinity of the study area (Figure X). There is little information relating to population size, dynamics or genetics, non-breeding habitat requirements or factors limiting distribution (Hines *et al.* 1999) and as such determining the extent of the local population is difficult. For the purpose of this assessment the local population is considered to consist of individuals found within the Lepironia swamp within the study area and those distributed throughout wetland areas adjacent to the study area.

Little is known of the life cycle of this species (Hines *et al.* 1999) however threats to its habitat, which would in turn affect its life cycle, include (Hazell 2003):

- Land clearing,
- Altered hydrological regime, and
- Increased nutrient and/or sediment loads.

Land Clearing:

Wallum Froglet habitat would not be cleared as a result of the proposed development.

Altered Hydrological Regime:

Urban runoff would be directed away from Wallum Froglet habitat towards the artificial wetland adjacent to the sporting fields (Cardno Willing 2007). Therefore, the current hydrological regime would be retained following the development.

Increased Nutrient and/or Sediment Loads:

A vegetated buffer zone is proposed around the wetland areas providing Wallum Froglet habitat within the study area. Further to this, urban runoff associated within the development would be directed away from potential Wallum Froglet habitat (Cardno Willing 2007). These measures have been adopted to reduce the likelihood of increased nutrient and/or sediment loads within wetland areas.

Given that the proposed development is unlikely to contribute to the processes threatening this species it is considered unlikely that the life cycle of the species would be disrupted such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development is unlikely to result in the removal or modification of habitat for this species.

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

The proposed development is unlikely to result in fragmentation or isolation of habitat for this species.

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

Habitat for this species is unlikely to be modified or removed or fragmented or isolated as a result of the proposed development.

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

Critical habitat has not been declared for this species.

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

At the time of compilation of this report there was no recovery plan prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Wallum Froglet is considered to be negligible.

The spread of the Cane Toad *Bufo marinus* in NSW has recently been listed as a Key Threatening Process. Predation by adult Cane Toad's and tadpoles is expected to reduce population viability for a number of species including Wallum Froglet. Currently this species does not occur in the Port Stephens area and as such this process is unlikely to occur within the study area.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Other threats to this species include (DEC 2005):

- Destruction and degradation of coastal wetlands as a result of roadworks, coastal developments and sandmining.
- Reduction of water quality and modification to acidity in coastal wetlands.
- Grazing and associated frequent burning of coastal wetlands.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-2 *Callocephalon fimbriatum* Gang-gang Cockatoo

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

In summer, Gang-gang Cockatoo are generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Move to lower altitudes in winter, preferring more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. Gang-gang Cockatoo is known to forage on the flowers of *Corymbia gummifera* (Higgins 1999) and as such the study area would provide potential foraging habitat for this species and given the presence of large hollows it is also considered to provide potential breeding habitat.

This species favours old growth attributes for nesting and roosting (DEC 2005b) requiring hollows in the trunks or large limbs of large trees in which to breed (Gibbons 1999, Gibbons and Lindenmayer 2000). Breeding usually occurs in tall mature sclerophyll forests that have a dense understorey, and occasionally in coastal forests. Nests are most commonly recorded in eucalypt hollows in live trees close to water (Beruldsen 1980). Breeding usually occurs between October and January, and individuals are likely to breed from around four years of age (Chambers 1995).

The proposed development would result in the removal or modification of approximately 13 hectares of potential habitat for this species however it was not recorded during the survey period. Further to this only 2 records exist within the Port Stephens LGA from 1985 and 1992 (DEC 2006). Therefore, it is considered unlikely that this species would utilise the subject site and as such the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

Only 2 records of this species exist within the local area dating from 1985-1992. Therefore, it is considered unlikely that this species would utilise the study area and as such the potential habitat within the study area is unlikely to be important to the long-term survival of the species in the locality.

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

Critical habitat has not been declared for this species.

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

At the time of compilation of this report there was no recovery plan prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Gang-gang Cockatoo is considered to be negligible.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

DEC (2005b) identifies the following specific threats for this species:

- Clearing of vegetation and degradation of habitat may reduce the abundance of optimal foraging and roosting habitat.
- Individual pairs show high fidelity to selected nesting trees (choosing nesting hollows of particular shape, position and structure), with clearing and frequent fire posing a threat to continued successful breeding.
- Climate change may alter the extent and nature of its preferred habitat (cool temperate vegetation).
- Susceptible to *Psittacine cirovirus* disease (PCD) which is spread through contaminated nest chambers. PCD is known to have increased near Bowral in the southern highlands of New South Wales over the past decade and constitutes a further threat to the species.

The proposed development is unlikely to significantly contribute to any of these processes given that this species is unlikely to utilise the section of the subject site which would be developed.

A4-3 *Lathamus discolor* Swift Parrot

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

Swift Parrots migrate to mainland Australia in autumn. During winter it is semi-nomadic foraging on nectar and lerps in Eucalypt forest and woodland (Swift Parrot Recovery Team 2001; DEC 2005). *Eucalyptus robusta* is known to provide a seasonal foraging resource for this species and as such the study area would provide approximately 2 hectares of potential foraging habitat for this species. Approximately 0.2 hectares would be removed as a result of the proposed development however this would be mitigated by supplementary planting of *E. robusta* where suitable habitat exists within the 100 metre wide corridor. Removal of habitat at this scale is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 0.2 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 0.2 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

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

The proposed development would not affect the objectives or actions of the national recovery plan for Swift Parrot. This is due to the small area and low quality of potential habitat likely to be removed.

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

The proposed development is likely to contribute to the Key Threatening Process known as “clearing of native vegetation”. The extent to which it would contribute to this process in relation to Swift Parrot is considered to be negligible.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The following specific threats have been identified for this species (DEC 2005):

- On the mainland the main threat is loss of habitat through clearing for agriculture, and urban and industrial development.
- Collisions with wire netting fences, windows and cars, during the breeding season and winter migration (especially where such obstacles are in close proximity to suitable habitat).

The proposed development is unlikely to significantly contribute to any of these processes.

A4-4 *Ninox connivens* Barking Owl

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

Barking Owls *Ninox connivens* live alone or in pairs. Territories range from 30 to 200 hectares and birds are present all year. Breeding occurs during late winter and early spring with three eggs laid in nests in hollows of large, old eucalypts or paperbarks near watercourses. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as *Acacia, Angophora* and *Casuarina* species.

One potential nest tree was located within the study area during the survey period. A search around the base of this tree did not locate and owl pellets. Further to this, only two records of this species exist within the local area indicating that the likelihood of it roosting within the study area is low. Therefore, it is considered unlikely that the proposed development would disrupt the breeding aspects of this species life cycle.

Barking Owls feed nocturnally on invertebrates, birds and mammals. Some important prey species such as native arboreal mammals and rosellas require tree-hollows for denning and nesting. These larger prey species are preferred during winter, whereas many insects are eaten during the warmer months. Barking Owls tend to eat more birds than other large forest owl species (NSW NPWS 2003; Garnett & Crowley 2000).

The proposed development would result in the removal of approximately 13 hectares of potential foraging habitat for this species. This equates to between 6.5 and 43 % of the home range requirements. Given the scarcity of records within the local area it is considered unlikely that this species would utilise the study area and as such the proposed development is unlikely to disrupt the foraging aspects of this species life cycle.

Therefore, the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

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

A draft recovery plan has also been prepared for the Barking Owl (NPWS 2003). The proposed development would not obstruct the objectives or actions of this plan.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Barking Owl is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Barking Owl are (DEC 2005):

- Clearing and degradation of habitat, mostly through cultivation, intense grazing and the establishment of exotic pastures.
- Inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees.
- Firewood harvesting resulting in the removal of old trees.
- Too-frequent fire which causes degradation of understorey vegetation which provides habitat and foraging substrate for prey species.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-5 *Ninox strenua* Powerful Owl

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

Powerful Owls *Ninox strenua* are the largest of Australia's owls and, accordingly, require a large amount of land for foraging. As stated in SFNSW (1995) the home range of this species can be from 400 to 1,450 hectares. The size of the range is likely to be dependent on prey density (Debus and Chafer 1994). The most common food source is arboreal mammals; however the prey may depend on local availability and the preferences of a particular pair of owls (SFNSW 1995).

The proposed development would result in the removal or modification of 13 hectares of potential foraging habitat for this species. This equates to between 0.9% and 3% of the home range requirements. Removal or modification of habitat at this scale is unlikely to disrupt the foraging aspects of this species life cycle.

Kavanagh (1997) (cited Higgins 1999) suggested that the breeding roost, essentially several different trees, was used for many months of the year. Before nesting a pair may be seen on one of their roost sites between 10-20m apart from one another, the female will then move into the nesting hollow alone and the male take up roost nearby (generally within a 50m radius of the nest but can be much more) (Higgins 1999).

No potential nest trees were observed during the survey period within the area likely to be modified as a result of the proposed development. Thus, the proposed development is unlikely to disrupt the breeding aspects of this species life cycle.

Thus, the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

A4-5 *Ninox strenua* Powerful Owl

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

Critical habitat has not been declared for this species.

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

A draft recovery plan for large forest owls has been prepared by DEC (2005c). This plan refers to the three species Powerful Owl, Masked Owl and Sooty Owl. The action proposed does not involve any removal of nesting or roosting habitat for the large forest owls. This is consistent with Management Objective 1 – "To minimise further loss and fragmentation of habitat outside conservation reserves and State forests by protection and management of significant owl habitat, including protection of individual nest sites".

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Powerful Owl is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Powerful Owl are (DEC 2005):

- Historical loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development. This loss also affects the populations of arboreal prey species, particularly the Greater Glider which reduces food availability for the Powerful Owl.
- Inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees. Loss of hollow-bearing trees reduces the availability of suitable nest sites and prey habitat.
- Can be extremely sensitive to disturbance around the nest site, particularly during pre-laying, laying and downy chick stages. Disturbance during the breeding period may affect breeding success.
- High frequency hazard reduction burning may also reduce the longevity of individuals by affecting prey availability.
- Road kills.
- Secondary poisoning.
- Predation of fledglings by foxes, dogs and cats.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-6 *Tyto novaehollandiae* Masked Owl

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

Masked Owls *Tyto novaehollandiae* occupy a wide range of habitats, ranging from tall, wet eucalypt forest to dry woodland. They are occasionally found in ecotones between forests and cleared areas (NPWS & SFNSW 1994, SFNSW 1995). Pairs have a home range of around 500-1000 hectares (Debus & Rose 1994). They require hollows in large, old trees for nesting and will roost during the day, either in tree hollows or in the dense foliage of some rainforest tree species. Nest and roosting sites are generally in or near gullies and there are also records of the species nesting and roosting in caves (NPWS & SFNSW 1994). The typical diet consists of tree-dwelling and ground mammals up to the size of rabbits, especially rats (Garnett 1993; DEC 2005b).

The proposed development would result in the removal or modification of approximately 13 hectares of potential foraging habitat for this species. This equates to between 1.3 and 2.6 % of the home range requirements of a pair. Removal of habitat at this scale is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

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

A draft recovery plan for large forest owls has been prepared by DEC (2005c). This plan refers to the three species Powerful Owl, Masked Owl and Sooty Owl. The action proposed does not involve any removal of nesting or roosting habitat for the large forest owls. This is consistent with Management Objective 1 – "To minimise further loss and fragmentation of habitat outside conservation reserves and State forests by protection and management of significant owl habitat, including protection of individual nest sites".

A4-6 *Tyto novaehollandiae* Masked Owl

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Masked Owl is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Masked Owl are (DEC 2005):

- Loss of mature hollow-bearing trees and changes to forest and woodland structure, which leads to fewer such trees in the future.
- Clearing of habitat for grazing, agriculture, forestry or other development.
- A combination of grazing and regular burning is a threat, through the effects on the quality of ground cover for mammal prey, particularly in open, grassy forests.
- Secondary poisoning from rodenticides.
- Being hit by vehicles.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-7 *Xanthomyza phrygia* Regent Honeyeater

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

This species occurs in forest and woodlands dominated by winter-flowering eucalypts like ironbark and box species. Found especially in moist fertile sites along creeks, river valleys and lower slopes of foothills (Higgins *et al*. 2001). Forage in canopy among foliage and flowers on nectar and invertebrates. *Eucalyptus robusta* is known to provide a seasonal foraging resource for this species in the greater Sydney region (Franklin *et al.* 1989) and as such the study area would provide approximately 2 hectares of potential foraging habitat for this species. The proposed development would result in the removal of approximately 0.2 hectares of potential foraging habitat however given that supplementary planting of *Eucalyptus robusta* would take place in the 100 metre wide corridor it is unlikely to disrupt the foraging aspects of this species life cycle.

Therefore, the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 2 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 2 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

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

A recovery plan has not been prepared for this species.

A4-7 *Xanthomyza phrygia* Regent Honeyeater

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Regent Honeyeater is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The following specific threats have been identified for this species (DEC 2005):

- Historical loss, fragmentation and degradation of habitat from clearing for agricultural and residential development, particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands.
- Continuing loss of key habitat tree species and remnant woodlands from strategic agricultural developments, timber gathering and residential developments.
- Suppression of natural regeneration of overstorey tree species and shrub species from overgrazing. Riparian gallery forests have been particularly impacted by overgrazing.
- Inappropriate forestry management practices that remove large mature resource-abundant trees. Firewood harvesting in Box-Ironbark woodlands can also remove important habitat components.
- Competition from larger aggressive honeyeaters, particularly Noisy Miners, Noisy Friarbirds and Red Wattlebirds.
- Egg and nest predation by native birds.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-8 *Dasyurus maculatus* Spotted-tailed Quoll

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

Spotted-tailed Quoll *Dasyurus maculatus maculatus* have a minimum home range of 580 to 875 hectares with a total home range up to 2,000 hectares for males and slightly smaller for females (Jones & Rose 1996). They make dens in hollow logs, caves or trees with large hollows and are considered to exist in areas in excess of 800 hectares of continuous, undisturbed forest.

Their diet consists of medium-sized mammals, in particular arboreal prey species such as possums. They also eat gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects, carrion and domestic fowl. The Spotted-tailed Quoll hunt mostly at night and rest during the day. Young are reared in underground burrows or hollow logs, often in steep, inaccessible places within forest (Jones & Rose 1996).

The study area is connected to approximately 6800 hectares of potential habitat which exhibits varying levels of fragmentation and disturbance. A number of large hollow logs were recorded within the study area and as such potential denning habitat is present. Potential prey species were also recorded during the survey period. Further to this, review of the Atlas of NSW Wildlife (DEC 2007) indicates that there are records of this species as recent as 2006 in close proximity suggesting that it is likely that *D. maculatus* could periodically utilise the study area.

Thus, the proposed development would result in the removal of approximately 13 hectares of potential habitat for this species. This equates to approximately 0.2% of the habitat available to a local population and is unlikely to disrupt the life cycle such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

A4-8 *Dasyurus maculatus* Spotted-tailed Quoll

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

A recovery plan has not been prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Spotted-tailed Quoll is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Spotted-tailed Quoll are (DEC 2005):

- Loss, fragmentation and degradation of habitat.
- Accidental poisoning during wild dog and fox control programs. Deliberate poisoning, shooting and trapping may also be an issue.
- Competition with introduced predators such as cats and foxes.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-9 *Phascogale tapoatafa* Brush-tailed Phascogale

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

Brush-tailed Phascogale are agile climbers which forage arboreally in dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. They are often found at low densities as they have large home ranges, male home ranges are up to 100ha (Soderquist 1995) in continuous habitat and overlap with female intrasexually exclusive home ranges (30-60 ha). They are a hollow dwelling species which require large numbers of hollows (>30) within their home range (DSE 1997). They show a preference for utilising dead or senescent trees with suitable hollows, 25-40mm wide, lined with leaves and pungent faeces (DSE, 1997; Rhind 2004). Prey generally consists of large invertebrates including insects, spiders and centipedes (Triall & Coates 1993; Soderquist 1995; Scarff *et al.* 1998).

Given the cryptic nature of this species it is possible that it would be overlooked during a snap-shot ecological survey. However, the study area is surrounded by large areas of swamp forest which is considered to be sub-optimal habitat for this species. Therefore, the likelihood of occurrence is considered to be low and as such the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

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

A recovery plan has not been prepared for this species.

A4-9 *Phascogale tapoatafa* Brush-tailed Phascogale

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Brush-tailed Phascogale is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Brush-tailed Phascogale are (DEC 2005):

- Loss and fragmentation of habitat.
- Loss of hollow-bearing trees.
- Predation by foxes and cats.
- Competition for nesting hollows with the introduced honeybee.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-10 *Mormopterus norfolkensis* Eastern Free-tail Bat

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

The diet of Eastern Freetail Bats *Mormopterus norfolkensis* consists of small insects (Churchill 1998). They are known to roost in loose bark, tree hollows, roof spaces and other human structures (SFNSW 1995). Little is known of the life cycle of the Eastern Free tail Bat (Churchill 1998).

This species was positively recorded within the study area via ultrasonic detection during the survey period. Given that some of the passes were recorded close to dawn it is considered highly likely that it would be roosting within the study area. The proposed development would require the removal of hollow bearing trees some of which may contain suitable roosting habitat for this species. A wildlife management strategy including a strict tree removal protocol and a habitat augmentation plan would be implemented to ensure that hollow dependant species such as Eastern Free-tail Bat are not adversely affected by the proposed development. Hollow inspections and stag watches are required prior to tree felling and any trees containing bat roosts would be sectionally dismantled to reduce the possibility of injuries. With these management protocols in place it is considered unlikely that the proposed development would disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of known habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

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

A recovery plan has not been prepared for this species.

A4-10 *Mormopterus norfolkensis* Eastern Free-tail Bat

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Eastern Free-tail Bat is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Eastern Free-tail Bat are (DEC 2005):

- Loss of foraging habitat.
- Loss of hollow-bearing trees.
- Application of pesticides in or adjacent to foraging areas.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-11 *Scoteanax rueppellii* Greater Broad-nosed Bat

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

Greater Broad-nosed Bats *Scoteanax rueppellii* utilise a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though they are most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Foraging occurs after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young (DEC 2005b).

This species was possibly recorded within the study area via ultrasonic detection by Conacher Travers (1998). The proposed development would require the removal of hollow bearing trees some of which may contain suitable roosting habitat for this species. A wildlife management strategy including a strict tree removal protocol and a habitat augmentation plan would be implemented to ensure that hollow dependant species such as Greater Broad-nosed Bat are not adversely affected by the proposed development. Hollow inspections and stag watches are required prior to tree felling and any trees containing bat roosts would be sectionally dismantled to reduce the possibility of injuries. With these management protocols in place it is considered unlikely that the proposed development would disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

A4-11 *Scoteanax rueppellii* Greater Broad-nosed Bat

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

A recovery plan has not been prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Greater Broad-nosed Bat is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Greater Broad-nosed Bat are (DEC 2005):

- Disturbance to roosting and summer breeding sites.
- Foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions.
- Loss of hollow-bearing trees.
- Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores.
- Changes to water regimes are likely to impact food resources, as is the use of pesticides and herbicides near waterways.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-12 *Falsistrellus tasmaniensis* Eastern False Pipistrelle

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

Eastern False Pipistrelles *Falsistrellus tasmaniensis* roost in hollow eucalypt trunks in colonies of up to 36 individuals. They hibernate in winter and breed in late spring to early summer. Single offspring are born in December. Young are nursed through January and February (Churchill 1998). Diet consists of moths, beetles, chafers, weevils, plant bugs, flies and ants. Foraging takes place in and just below the canopy (Churchill 1998). They can travel several kilometres between roosting and foraging sites.

The proposed development would require the removal of hollow bearing trees some of which may contain suitable roosting habitat for this species. A wildlife management strategy including a strict tree removal protocol and a habitat augmentation plan would be implemented to ensure that hollow dependant species such as Eastern False Pipistrelle are not adversely affected by the proposed development. Hollow inspections and stag watches are required prior to tree felling and any trees containing bat roosts would be sectionally dismantled to reduce the possibility of injuries. With these management protocols in place it is considered unlikely that the proposed development would disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

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

A recovery plan has not been prepared for this species.

A4-12 *Falsistrellus tasmaniensis* Eastern False Pipistrelle

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Eastern False Pipistrelle is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Eastern False Pipistrelle are (DEC 2005):

- Disturbance to winter roosting and breeding sites.
- Loss of trees for foraging and hollow-bearing trees for roosting.
- Application of pesticides in or adjacent to foraging areas.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-13 *Chalinolobus dwyeri* Large-eared Pied Bat

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

These bats roost in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin *Hirundo ariel*, frequenting low to mid-elevation dry open forest and woodland close to these features (DEC 2005). Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.

The study area does not provide any potential roosting habitat for this species and as such is unlikely to disrupt the breeding aspects of this species life cycle.

The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy (DEC 2005). The study area provides potential foraging habitat for this species however given the paucity of records within the local area the likelihood of it foraging within the study area is considered to be low. As such the proposed development is unlikely to disrupt the foraging aspects of this species life cycle.

Therefore, the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of potential habitat for this species is unlikely to be important to the long-term survival within the locality.

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

Critical habitat has not been declared for this species.

A4-13 *Chalinolobus dwyeri* Large-eared Pied Bat

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

A recovery plan has not been prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Large-eared Pied Bat is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Large-eared Pied Bat are (DEC 2005):

- Clearing and isolation of forest and woodland habitats near cliffs, caves and old mine workings for agriculture or development.
- Loss of foraging habitat close to cliffs, caves and old mine workings from forestry activities and too-frequent burning, usually associated with grazing.
- Damage to roosting and maternity sites from mining operations, and recreational caving activities.
- Use of pesticides.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-14 *Miniopterus australis* Little Bent-wing Bat

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

Little Bent-wing Bat *Miniopterus australis* is described as a "cave obligate" species as it require either natural caves or structurally similar man-made objects such as mines or tunnels to full-fill their life cycle requirements. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites (Law 1996; Wilson 1982).

The study area does not contain suitable roosting habitat for this species and as such is unlikely to disrupt the breeding aspects of this species life cycle.

Little Bent-wing Bat has a preferences for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects (DEC 2005).

This species was positively recorded within the study area via ultrasonic detection during the survey period. The proposed development would result in the removal of approximately 13 hectares of foraging habitat for this species however given its high mobility and wide ranging foraging habits it is unlikely that this would significantly disrupt the foraging aspects of this species life cycle.

Therefore, the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of foraging habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of foraging habitat for this species is unlikely to be important to the long-term survival within the locality. This is due largely to the high mobility and wide ranging foraging habits of this species.

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

Critical habitat has not been declared for this species.

A4-14 *Miniopterus australis* Little Bent-wing Bat

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

A recovery plan has not been prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Little Bent-wing Bat is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Little Bent-wing Bat are (DEC 2005):

- Damage to or disturbance of roosting caves, particularly during winter or breeding.
- Loss of foraging habitat.
- Application of pesticides in or adjacent to foraging areas.
- Predation by feral cats and foxes.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-15 *Miniopterus schreibersii oceanensis* Eastern Bent-wing Bat

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

Eastern Bent-wing Bats roost in caves, old mines, tunnels, under bridges, or in similar structures. They inhabit a maternity cave that is used in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity requirements. Breeding or roosting colonies can number from 100 to 150,000 individuals. At other times of the year, populations disperse within about 300 km range of maternity caves. These bats hibernate in southern Australia between June and August (DEC 2005b). Eastern Bent-wing Bats primarily feed on moths above the canopy (Churchill 1998).

The study area does not contain suitable roosting habitat for this species and as such is unlikely to disrupt the breeding aspects of this species life cycle.

Eastern Bent-wing Bat prefers to forage above the canopy of densely vegetated habitats (DEC 2005).

This species was positively recorded within the study area via ultrasonic detection by Conacher Travers (1998). The proposed development would result in the removal of approximately 13 hectares of foraging habitat for this species however given its high mobility and wide ranging foraging habits it is unlikely that this would significantly disrupt the foraging aspects of this species life cycle.

Therefore, the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of foraging habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of foraging habitat for this species is unlikely to be important to the long-term survival within the locality. This is due largely to the high mobility and wide ranging foraging habits of this species.

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

Critical habitat has not been declared for this species.

A4-15 *Miniopterus schreibersii oceanensis* Eastern Bent-wing Bat

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

A recovery plan has not been prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Eastern Bent-wing Bat is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Eastern Bent-wing Bat are (DEC 2005):

- Damage to or disturbance of roosting caves, particularly during winter or breeding.
- Loss of foraging habitat.
- Application of pesticides in or adjacent to foraging areas.
- Predation by feral cats and foxes.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-16 *Pteropus poliocephalus* Grey-headed Flying Fox

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

Grey-headed Flying Fox are found in a variety of habitats, including rainforest, mangroves, paperbark swamps, wet and dry sclerophyll forests and cultivated areas. The adults congregate in large camps in summer and disperse in winter while young remain in camps. The number of bats within a camp is influenced by the availability of blossom in the surrounding area. Camps are commonly formed in gullies, typically close to water and in vegetation with a dense canopy. They have a nightly feeding range of 20 to 50 km from their camp. This species eat fruit or blossoms of more than 80 species of plants. Their major food source is eucalypt blossom and native fleshy fruits. They are known to raid orchards of cultivated fruit (Churchill, 1998). The availability of native fruits, nectar and pollen varies over time and throughout the range of the species. Grey-headed Flying foxes accommodate this by migrating in response to food availability, sometimes travelling hundreds of kilometres (NSW NPWS 2001).

The study area provides foraging habitat for this species. Therefore approximately 13 hectares of potential foraging habitat would be removed as a result of the proposed development. Considering the large foraging range of this species, removal of a habitat at this scale is unlikely to disrupt the life cycle such that a viable local population would be placed at risk of extinction. No potential roosting habitat would be removed.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of foraging habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The removal of 13 hectares of foraging habitat for this species is unlikely to be important to the long-term survival within the locality. This is due largely to the high mobility and wide ranging foraging habits of this species.

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

Critical habitat has not been declared for this species.

A4-16 *Pteropus poliocephalus* Grey-headed Flying Fox

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

A recovery plan has not been prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Grey-headed Flying Fox is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

DEC (2005b) identifies the following specific threats for this species:

- Loss of foraging habitat.
- Disturbance of roosting sites.
- Unregulated shooting.
- Electrocution on powerlines.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-17 *Pseudomys gracilicaudatus* Eastern Chestnut Mouse

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

In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands (DEC 2005).

Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again (DEC 2005). Feeds at night via runways through the grassy and sedge understorey, within an area of less than half a hectare. It has a broad diet of grass stems, invertebrates, fungi and seeds, with the relative significance of each component varying seasonally (DEC 2005).

The area surrounding the Lepironia wetland is considered to provide potential habitat for this species. This area would be retained as part of the proposed development and as such it is unlikely that the proposed development would disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Potential habitat for this species would not be removed or modified as a result of the proposed development.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The proposed development would not result in the removal, modification, fragmentation or isolation of habitat for this species and as such would not affect the long-term viability of local populations of this species.

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

Critical habitat has not been declared for this species.

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

A recovery plan has not been prepared for this species.

A4-17 *Pseudomys gracilicaudatus* Eastern Chestnut Mouse

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Eastern Chestnut Mouse is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Eastern Chestnut Mouse are (DEC 2005):

- Long-term fire exclusion from its habitat heavily favours the competing Swamp Rat.
- Loss of natural swampland and heathland to agriculture, mining, and urban development.
- Predation by Red Fox, cats and dogs.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-18 *Petaurus norfolcensis* Squirrel Glider

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

Estimating the local population of Squirrel Glider is problematic. Population sizes of can vary significantly in relation to several extrinsic factors, including floristic diversity and composition, fire history, management regimes such as underscrubbing and slashing, abundance of suitable hollows, competition with Sugar Gliders, size of vegetation fragment and distance to other fragments and predation pressure. Models developed by Smith (1998 and 2002), estimating population densities of Squirrel Glider in Lake Macquarie showed a density 0.43/ha for all forest types, similar to densities in the Wyong area in moderate to high quality habitat (0.46/ha).

An individual Squirrel Glider requires three essential elements during its life cycle; roosting and den trees, foraging habitats (can include year round flowering resources), and accessibility to mating partners. These essential elements are detailed for the subject site below.

Roosting Habitat:

A high density of hollow bearing trees was recorded within the study area both in the corridor and the development area. Therefore, the proposed development would result in the removal of some roosting habitat for this species however the installation of nestboxes and/or relocation of suitable hollows would sufficiently mitigate this impact. A strict tree removal protocol would be followed in order to reduce the likelihood of injuries or fatalities to individuals during the tree removal process.

Thus, roosting aspects of the species life cycle would not be significantly disrupted as a result of the proposed development.

Foraging Habitat:

The vegetation fragment within and connected to the study area provides foraging resources for Squirrel Glider. During the survey period 6 individual Squirrel Gliders were captured within the swamp forest vegetation on the lower lying sections of the study area. No Squirrel Gliders were captured within the Coastal Sand Apple/Blackbutt Forest during the survey period however this is likely to be due to the lack of flowering plants. It is considered likely that the Coastal Sand Apple/Blackbutt Forest would be more heavily utilised by Squirrel Glider when dominant species such as *Banksia serrata* is in flower. Therefore, clearing of vegetation outside of the flowering period of this species may further reduce the likelihood of injuries or fatalities resulting from accidents during tree removal. Loss of foraging habitat within the study area would be offset by retaining approximately 8 hectares of habitat within the 100 metre wide corridor and by supplementary planting of *Eucalyptus robusta* and other potential foraging resources within the corridor. Thus, the proposed development is unlikely to disrupt the foraging aspects of this species life cycle.

Access to Breeding Partners:

A 100 metre wide corridor would be retained as part of the proposed development. This corridor provides a link between habitat within Wanda Wetlands Reserve and that to the south of the study area. The corridor will be “strengthened” at the point that it crosses Soldiers Point Road to enable easier crossing opportunities for Squirrel Glider and other non-flying mammals. Therefore, the proposed development would not disrupt the breeding aspects of this species life cycle.

The proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of foraging habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The loss of 13 hectares of habitat for this species would be offset by the retention of approximately 8 hectares of habitat within the corridor. This vegetation would be subject to strict management protocols to ensure that habitat integrity is maintained in perpetuity. Further to this, the corridor will be "strengthened" at the point that it crosses Soldiers Point Road to enable safer road crossings for Squirrel Glider and other non-flying mammal species. Loss of hollows would be mitigated by providing supplementary habitat in the form of nest boxes and/or relocating suitable hollows from the development area. Therefore, the 13 hectares of habitat affected by the proposal is unlikely to be significant to the long-term survival of this species in the locality.

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

Critical habitat has not been declared for this species.

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

A recovery plan has not been prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to Squirrel Glider is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Squirrel Glider are (DEC 2005):

- Loss and fragmentation of habitat.
- Loss of hollow-bearing trees.
- Loss of flowering understorey and midstorey shrubs in forests.
- Individuals can get caught in barbed wire fences while gliding.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-19 *Phascolarctos cinereus* Koala

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

The Koala is an arboreal marsupial with fur ranging from grey to brown above, and is white below. It has large furry ears, a prominent black nose and no tail. It spends most of its time in trees and has long, sharp claws, adapted for climbing. Adult males weigh 6 - 12 kg and adult females weigh 5 - 8 kg. During breeding, males advertise with loud snarling coughs and bellows (DEC 2005).

Foraging Behaviour:

Koala is an obligate folivore that feeds primarily on the genus *Eucalyptus*. Throughout their range they have been recorded feeding on a wide variety of eucalypt and non-eucalypt species however within a particular area only a few of the *Eucalyptus* species will be preferentially utilised while others, including some non-eucalypt genera, appear to be browsed opportunistically or used for other behavioural purposes (Phillips *et al.* 2000; Moore and Foley 2000).

Phillips *et al.* (2000) studied the feeding preferences of Koala in the Port Stephens Local Government Area concluding that 2 species *Eucalyptus robusta* Swamp Mahogany and *Eucalyptus parramattensis* Drooping Red Gum are the most preferred feed species. Up to 10 additional eucalypt species and 17 non-eucalypt species were found to be utilised by Koala however it was concluded that the importance of supplementary feeding resources was related to the proximity of preferred foraging habitat. For example, the Coastal Sand Apple-Blackbutt community which is dominated by *Eucalyptus pilularis*, *Angophora costata* and *Corymbia gummifera* is considered to be of marginal importance to Koala in Port Stephens except where it occurs adjacent to areas containing either *Eucalyptus robusta* or *E. parramattensis* in which case it would provide supplementary Koala habitat (Phillips *et al.* 2000).

This was evident within the study area; Koala was only recorded within the swamp forest and along the 100 metre wide corridor which effectively provides a link between areas of swamp forest containing *Eucalyptus robusta*. No Koala activity was recorded within the development area and as such the proposed development area and as such the proposed development is unlikely to disrupt the foraging aspects of this species life cycle.

Dispersal:

Studies of Koala ecology over the past 30 years have identified dispersal as playing an important role in the dynamics of localised Koala populations as many young male and female Koalas frequently disperse from their natal range soon after weaning (Dique *et al.* 2003). A number of reasons for dispersal have been postulated including competition for mates, competition for resources and the avoidance of inbreeding (Dique *et al.* 2003). These mechanisms would likely affect males and females in different ways depending on mating systems for instance in a polygynous system young males are more likely to disperse in response to aggression or in search of greater mating opportunities (Dique *et al.* 2003).

Koala populations become vulnerable to decline when habitat becomes fragmented and dispersal opportunities are reduced. Review of aerial photography indicates that habitat within the local area is highly fragmented and as such the importance of maintaining corridors within the landscape to facilitate dispersal is paramount. The retention and improvement of the corridor on the western side of the study area would improve koala dispersal opportunities in the vicinity of the study area and as such the proposed development is unlikely to disrupt the dispersal abilities of Koala.

Therefore, the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 0.2 hectares of preferred foraging habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The loss of 0.2 hectares or preferred foraging habitat would be successfully offset by retention of 1.8 hectares of preferred habitat and supplementary planting of *Eucalyptus robusta* where suitable habitat exists within the corridor. Therefore, the 0.2 hectares of habitat being removed is unlikely to be important to the long-term survival of the species in the locality.

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

Critical habitat has not been declared for this species.

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

A recovery plan has not been prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as “clearing of native vegetation”. The extent to which it would contribute to this process in relation to Koala is unlikely to be significant.

The Key Threatening Process “invasion of native plant communities by bitou bush and boneseed” currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for Koala are (DEC 2005):

- Loss, modification and fragmentation of habitat.
- Predation by feral and domestic dogs.
- Intense fires that scorch or kill the tree canopy.
- Road-kills.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-20 *Diuris praecox* Rough Double Tail

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

Diuris praecox grows in woodland and open forest with a grassy to moderately dense understorey (DEC 2005). *D. praecox* produces leaves and flowering stems in winter to mid winter and uses floral mimicry to achieve the pollination of its flowers.

Review of the Atlas of NSW Wildlife (DEC 2006) and regional vegetation mapping prepared by House (2003) indicates that this species has been recorded in similar vegetation elsewhere in Port Stephens LGA.

D. praecox exists as subterranean tubers most of the year. It produces leaves and flowering stems in winter (DEC 2005). Further details of the life cycle of this species are unknown. As such, it is difficult to predict the effects of the proposal.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

The cryptic nature of this species makes it difficult to determine the potential impacts of the proposal.

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

Critical habitat has not been declared for this species.

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

A recovery plan has not been prepared for this species.

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

The proposed development is likely to contribute to the Key Threatening Process known as “clearing of native vegetation”. The extent to which it would contribute to this process in relation to *Diuris praecox* is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for *Diuris praecox* are (DEC 2005):

- Loss and fragmentation of habitat through clearing for urban development.
- Weed invasion.
- Uncontrolled track expansion.
- Impacts from recreational use.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-21 *Tetratheca juncea* Black-eyed Susan

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

Tetratheca juncea is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies (DEC 2005).

This species flowers from July to December and is conspicuous when in flower. Surveys were conducted during the flowering period of this species however it was not recorded indicating that it is unlikely to be present within the study area. Therefore, the proposed development is unlikely to disrupt the life cycle of this species such that a viable local population would be placed at risk of extinction.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not Applicable.

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

Not Applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would result in the removal of approximately 13 hectares of potential habitat for this species.

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

The proposed development contains provisions to maintain connectivity between habitat fragments within the local area. Therefore, the extent to which the proposed development is likely to contribute to the fragmentation or isolation of habitat is unlikely to be significant.

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

This species was not recorded within the study area during the survey period despite surveys being conducted during the flowering period. Therefore, the potential habitat that would be removed as a result of the proposal is unlikely to be important to the long-term survival of this species in the locality.

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

Critical habitat has not been declared for this species.

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

A recovery plan has not been prepared for this species.

A4-21 *Tetratheca juncea* Black-eyed Susan

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to *Tetratheca juncea* is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for *Tetratheca juncea* are (DEC 2005):

- Habitat loss due to clearing for urban development.
- Habitat degradation resulting from frequent fire, weed invasion and stormwater runoff.

The proposed development is unlikely to significantly contribute to any of these processes.

A4-22 Freshwater Wetlands

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

Not Applicable.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

The Lepironia Swamp is considered to be representative of the EEC "freshwater wetlands on coast floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions". Therefore, approximately 0.3 hectares of freshwater wetlands occurs within the study area. This represents approximately 0.05% of the extent of this community within Port Stephens LGA (based on mapping prepared by House 2003). This wetland occurs within the 100 metre wide corridor and would be retained. This area would be managed to ensure that the current hydrological regime and habitat integrity is maintained. Therefore, the proposed development is unlikely to have an adverse effect on this community such that its local occurrence is likely to be placed at risk of extinction.

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

Secondary impacts which could potentially change the composition of the community such as weed invasion and changes to hydrological patterns would be managed in accordance with weed management strategies and storm water management plans and are unlikely to significantly affect the community.

Thus, the proposed development is unlikely to adversely modify the composition of the community such that its local occurrence is likely to be placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development is unlikely to result in the removal or modification of any vegetation within the subject site which is representative of this community.

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

The proposed development is unlikely to result in the fragmentation or isolation of habitat for this community.

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

The proposed development is unlikely to result in the removal, modification, fragmentation or isolation of habitat for this community.

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

Critical habitat has not been declared for this community.

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

A recovery plan has not been prepared for this community.

A4-22 Freshwater Wetlands

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to "Freshwater wetlands" is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for "Freshwater wetlands" are (DEC 2005):

- Land clearing
- Continuing fragmentation and degradation
- Flood mitigation and drainage works
- Filling associated with urban and industrial development
- Pollution and eutrophication from urban and agricultural runoff
- Weed invasion
- Overgrazing, trampling by livestock
- Soil disturbance by pigs
- Activation of acid sulfate soils
- Dumping of landfill, rubbish and garden refuse
- Native fauna is threatened by predation, particularly by mosquito fish and cane toads
- Anthropogenic climate change

The proposed development is unlikely to significantly contribute to any of these processes.

A4-23 Swamp Sclerophyll Forest

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

Not Applicable.

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

Not Applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

All swamp forest within the study area (Map Unit's 3 & 4) are considered to be representative of "Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions" and as such there is approximately 2 hectares of this community within the study area. This represents approximately 0.05% of the extent of this community in Port Stephens LGA (based on mapping prepared by House 2003). The proposed development would require the removal of approximately 0.2 hectares of this community from stage 1. This represents approximately 0.005% of the extent within Port Stephens LGA and is unlikely to place the local occurrence of this community at risk of extinction.

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

Secondary impacts which could potentially change the composition of the community such as weed invasion and changes to hydrological patterns would be managed in accordance with weed management strategies and storm water management plans and are unlikely to significantly affect the community.

Thus, the proposed development is unlikely to adversely modify the composition of the community such that its local occurrence is likely to be placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed development would require the removal of approximately 0.2 hectares of this community which equates to approximately 0.005% of the extent within Port Stephens LGA.

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

The proposed development is unlikely to result in the fragmentation or isolation of habitat for this community.

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

The removal of 0.2 hectares of this community is unlikely to be important to the long-term survival of this community in the locality. This is due to the fact that it represents only 0.005% of the community within Port Stephens LGA.

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

Critical habitat has not been declared for this community.

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

A recovery plan has not been prepared for this community.

A4-23 Swamp Sclerophyll Forest

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

The proposed development is likely to contribute to the Key Threatening Process known as "clearing of native vegetation". The extent to which it would contribute to this process in relation to "Swamp Sclerophyll Forest" is unlikely to be significant.

The Key Threatening Process "invasion of native plant communities by bitou bush and boneseed" currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that bitou bush is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

The spread of *Lantana camara* is listed as a Key Threatening Process and currently operates within the study area. A Weed Management Strategy would be implemented as part of the overall environmental management of the proposed development. This strategy would ensure that *Lantana camara* is controlled within the study area and as such the proposed development is unlikely to significantly contribute to this process.

Specific threats identified for "Swamp Sclerophyll Forest" are (DEC 2005):

- Further clearing for urban and rural development, and the subsequent impacts from fragmentation
- Flood mitigation and drainage works
- Management of water and tidal flows
- Landfilling and earthworks associated with urban and industrial development
- Grazing and trampling by stock and feral animals (particulary pigs)
- Changes in water quality, particularly increased nutrients and sedimentation
- Weed invasion
- Climate change
- Activation of acid sulfate soils
- Removal of dead wood
- Rubbish dumping
- Frequent burning which reduces the diversity of woody plant species

The proposed development is unlikely to significantly contribute to any of these processes.

APPENDIX 8 – EPBC ASSESSMENT

A5-1 *Lathamus discolor* Swift Parrot

Factor	Response
1. Whether the action will lead to a long-term decrease in the size of a population.	No, the action is unlikely to result in a long-term decrease in the size of a population.
2. Whether the action will reduce the area of occupancy of the species.	No, the action will not reduce the area of occupancy for this species.
3. Whether the action will fragment an existing population into two or more populations.	No, the action will not result in the fragmenting of an existing population.
4. Whether the action will adversely affect habitat critical to the survival of a species.	No, the action will not adversely affect critical habitat.
5. Whether the action will disrupt the breeding cycle of a population.	No, the action will not disrupt the breeding cycle of a population.
6. Whether the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No, the action will not modify the availability or quality of habitat to the extent that a species is likely to decline.
7. Whether the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species´ habitat*.	The action is unlikely to result in invasive species becoming established in 'endangered' species habitats.
8. Whether the action will interfere with the recovery of the species.	The action is unlikely to interfere with the recovery of the species.

A5-2 *Xanthomyza phrygia* Regent Honeyeater

Factor	Response
1. Whether the action will lead to a long-term decrease in the size of a population.	No, the action is unlikely to result in a long-term decrease in the size of a population.
2. Whether the action will reduce the area of occupancy of the species.	No, the action will not reduce the area of occupancy for this species.
3. Whether the action will fragment an existing population into two or more populations.	No, the action will not result in the fragmenting of an existing population.
4. Whether the action will adversely affect habitat critical to the survival of a species.	No, the action will not adversely affect critical habitat.
5. Whether the action will disrupt the breeding cycle of a population.	No, the action will not disrupt the breeding cycle of a population.
6. Whether the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No, the action will not modify the availability or quality of habitat to the extent that a species is likely to decline.
7. Whether the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species´ habitat*.	The action is unlikely to result in invasive species becoming established in 'endangered' species habitats.
8. Whether the action will interfere with the recovery of the species.	The action is unlikely to interfere with the recovery of the species.

A5-3 *Dasyurus maculatus* Spotted-tailed Quoll

Factor	Response
1. Whether the action will lead to a long-term decrease in the size of a population.	No, the action is unlikely to result in a long-term decrease in the size of a population.
2. Whether the action will reduce the area of occupancy of the species.	No, the action will not reduce the area of occupancy for this species.
3. Whether the action will fragment an existing population into two or more populations.	No, the action will not result in the fragmenting of an existing population.
4. Whether the action will adversely affect habitat critical to the survival of a species.	No, the action will not adversely affect critical habitat.
5. Whether the action will disrupt the breeding cycle of a population.	No, the action will not disrupt the breeding cycle of a population.
6. Whether the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No, the action will not modify the availability or quality of habitat to the extent that a species is likely to decline.
7. Whether the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species´ habitat*.	The action is unlikely to result in invasive species becoming established in 'endangered' species habitats.
8. Whether the action will interfere with the recovery of the species.	The action is unlikely to interfere with the recovery of the species.

A5-4 *Pteropus poliocephalus* Grey-headed Flying Fox

Factor	Response
1. Whether the action will lead to a long-term decrease in the size of a population.	No, the action is unlikely to result in a long-term decrease in the size of a population.
2. Whether the action will reduce the area of occupancy of the species.	No, the action will not reduce the area of occupancy for this species.
3. Whether the action will fragment an existing population into two or more populations.	No, the action will not result in the fragmenting of an existing population.
4. Whether the action will adversely affect habitat critical to the survival of a species.	No, the action will not adversely affect critical habitat.
5. Whether the action will disrupt the breeding cycle of a population.	No, the action will not disrupt the breeding cycle of a population.
6. Whether the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No, the action will not modify the availability or quality of habitat to the extent that a species is likely to decline.
7. Whether the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species´ habitat*.	The action is unlikely to result in invasive species becoming established in 'endangered' species habitats.
8. Whether the action will interfere with the recovery of the species.	The action is unlikely to interfere with the recovery of the species.

A5-5 *Chalinolobus dwyeri* Large-eared Pied Bat

Factor	Response
1. Whether the action will lead to a long-term decrease in the size of a population.	No, the action is unlikely to result in a long-term decrease in the size of a population.
2. Whether the action will reduce the area of occupancy of the species.	No, the action will not reduce the area of occupancy for this species.
3. Whether the action will fragment an existing population into two or more populations.	No, the action will not result in the fragmenting of an existing population.
4. Whether the action will adversely affect habitat critical to the survival of a species.	No, the action will not adversely affect critical habitat.
5. Whether the action will disrupt the breeding cycle of a population.	No, the action will not disrupt the breeding cycle of a population.
6. Whether the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No, the action will not modify the availability or quality of habitat to the extent that a species is likely to decline.
7. Whether the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species´ habitat*.	The action is unlikely to result in invasive species becoming established in 'endangered' species habitats.
8. Whether the action will interfere with the recovery of the species.	The action is unlikely to interfere with the recovery of the species.

A5-6 *Diuris praecox* Rough Double Tail

Factor	Response
1. Whether the action will lead to a long-term decrease in the size of a population.	No, the action is unlikely to result in a long-term decrease in the size of a population.
2. Whether the action will reduce the area of occupancy of the species.	No, the action will not reduce the area of occupancy for this species.
3. Whether the action will fragment an existing population into two or more populations.	No, the action will not result in the fragmenting of an existing population.
4. Whether the action will adversely affect habitat critical to the survival of a species.	No, the action will not adversely affect critical habitat.
5. Whether the action will disrupt the breeding cycle of a population.	No, the action will not disrupt the breeding cycle of a population.
6. Whether the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No, the action will not modify the availability or quality of habitat to the extent that a species is likely to decline.
7. Whether the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species´ habitat*.	The action is unlikely to result in invasive species becoming established in 'endangered' species habitats.
8. Whether the action will interfere with the recovery of the species.	The action is unlikely to interfere with the recovery of the species.

A5-7 *Tetratheca juncea* Black-eyed Susan

Factor	Response
1. Whether the action will lead to a long-term decrease in the size of a population.	No, the action is unlikely to result in a long-term decrease in the size of a population.
2. Whether the action will reduce the area of occupancy of the species.	No, the action will not reduce the area of occupancy for this species.
3. Whether the action will fragment an existing population into two or more populations.	No, the action will not result in the fragmenting of an existing population.
4. Whether the action will adversely affect habitat critical to the survival of a species.	No, the action will not adversely affect critical habitat.
5. Whether the action will disrupt the breeding cycle of a population.	No, the action will not disrupt the breeding cycle of a population.
6. Whether the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No, the action will not modify the availability or quality of habitat to the extent that a species is likely to decline.
7. Whether the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species´ habitat*.	The action is unlikely to result in invasive species becoming established in 'endangered' species habitats.
8. Whether the action will interfere with the recovery of the species.	The action is unlikely to interfere with the recovery of the species.