

4. State Environmental Planning Policy 44 – Koala habitat protection

4.1 Potential Koala Habitat Assessment

The identification of an area of land as potential koala habitat is determined by the presence of Schedule 2 koala feed tree species, as listed under State Environmental Planning Policy (SEPP) 44 - Koala Habitat Protection. Potential koala habitat is defined as areas where the tree species listed under Schedule 2 (Table 4.1) constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. An area of land to which the policy applies must be at least one hectare in area (and may include adjoining land in the same ownership).

Table 4.1: SEPP 44 Schedule 2 Primary Browse Trees

Scientific Name	Common Name
<i>Eucalyptus albens</i>	White Box
<i>Eucalyptus camaldulensis</i>	River Red Gum
<i>Eucalyptus haemastoma</i>	Broad-leaved Scribbly Gum
<i>Eucalyptus microcorys</i>	Tallowood
<i>Eucalyptus populnea</i>	Bimble Box
<i>Eucalyptus punctata</i>	Grey Gum
<i>Eucalyptus robusta</i>	Swamp Mahogany
<i>Eucalyptus signata</i>	Scribbly Gum
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Eucalyptus viminalis</i>	Ribbon Gum

Forest Red Gum (*Eucalyptus tereticornis*) was the most commonly observed Schedule 2 species observed within the Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association in the study area. Tallowood (*Eucalyptus microcorys*) were scattered within the Blackbutt Coastal Hills Moist Open Forest vegetation association and a small number of Swamp Mahogany (*Eucalyptus robusta*) were recorded within the northeast portion of the Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association.

Forest Red Gum made up greater than 15% of the total number of trees within some areas of Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association within the study area and as such qualify as Potential Koala Habitat under SEPP 44, as indicated on Figure 3.2.

4.2 Core Koala Habitat Assessment

Core Koala Habitat is defined as “an area of land with a resident population of Koalas, as evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a Koala population” (Source: State Environment Planning Policy No. 44 - Koala Habitat Protection). Information to determine if a resident Koala population occurs in the study area was obtained by direct survey of the site and review of relevant published information and records.

4.2.1 Literature Review and Data Base Searches

A review of the Atlas for Wildlife (DEC, 2007) indicates there are four Koala records within 10km of the study area. It is likely that the Koala population in the Wedding Bells State Forest area is of low

density. Parts of the study area may possibly be utilised by the locally occurring low density Koala population, though no evidence of this use was observed.

4.2.2 Direct Survey Methods and Results

Direct survey of Koala included spotlighting, call playback, and searches for scats at the base of Schedule 2 Primary Browse Trees in areas of Potential Koala Habitat. Call play back was undertaken in early Spring (March), a period when Koala are generally considered to be active and respond to territorial calls from a dominant male Koala.

The Koala was not detected in the study area by either secondary evidence, spotlighting or call play back.

4.2.3 Conclusion

According to the definition provided in SEPP 44 – Koala Habitat Protection, there are two identified attributes that indicate Core Koala Habitat, which are described in relation to the study area as follows:

- 1) “Breeding females (that is, females with young)”. No individuals or evidence of Koala, including breeding females, was observed during diurnal surveys including scat and scratch searches.
- 2) “Recent sightings and historical records of a Koala population”. Review of the available literature indicates there are four Koala records within 10km of the study area. It is likely that the Koala population in the Wedding Bells State Forest area is of low density. Parts of the study area may possibly be utilised by the locally occurring low density Koala population, though no evidence of this use was observed.

Few records of Koala exist within 10 km and the absence of evidence of recent Koala usage (scats, scratches and direct observation) within the study area, suggests that the site does not qualify as Core Koala Habitat or an area subject to frequent Koala usage.

5. Potential impacts

5.1 General impacts

Likely and potential impacts associated with the construction and operation of the Proposal at Arararra Interchange would include:

- Loss of native vegetation, including areas of endangered ecological community
- Removal, modification and fragmentation of habitat
- Wildlife injury and mortality through collisions with vehicles
- Wildlife injury and mortality during vegetation clearance
- Stress placed on fauna displaced into adjoining habitats through competition with existing resident fauna for habitat resources
- Creation of physical barriers to fauna movement
- Risk of contamination and siltation of waterways

Key threatening processes are things that threaten, or could threaten, the survival or evolutionary development of species, populations or ecological communities. The Proposal would contribute to two key threatening processes listed under the NSW *Threatened Species Conservation Act 1995*. These are:

- Clearing of native vegetation
- Removal of dead wood and dead trees

A preliminary determination for the listing of the loss of hollow-bearing trees as a Key Threatening Process has been made by the NSW Scientific Committee. Should the loss of hollow-bearing trees be determined as a Key Threatening Process, the proposed removal of 20 hollow-bearing trees would contribute to this process.

This section includes a discussion of the potential impacts of the proposal. The significance of any potential impact of the Arararra Interchange on threatened species, populations and/or endangered ecological communities has not been assessed as part of this report. Additionally, detailed mitigation measures have not been discussed as part of this report but are incorporated into the Environmental Assessment document covering the entire Sapphire to Woolgoolga Pacific Highway Upgrade.

5.2 Potential flora impacts

5.2.1 Vegetation communities

The area of each vegetation community that would be removed or disturbed by the Proposal is presented in Table 5.1 below. This is a conservative estimate, based on the direct footprint of the concept design (including batters and cuttings) plus an additional five metres, to incorporate areas that could be disturbed during construction.

Table 5.1 Extent of vegetation removal by vegetation type found within Ararawarra Interchange study area

Broad vegetation type	Community	Endangered ecological community (TSC Act)	Extent of loss
COASTAL HILLS MOIST OPEN FOREST	Blackbutt	-	7.4 ha
COASTAL FLOOD-PLAIN FOREST	Broad-leaved Paperbark	<i>Swamp Sclerophyll Forest on Coastal Floodplain of the NSW North Coast, Sydney Basin and South east corner Bioregions.</i>	3.1 ha
COASTAL FLOOD-PLAIN FOREST	Swamp Oak	<i>Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South east corner Bioregions.</i>	<0.01 ha
OTHER	Blackbutt Plantation	-	1.3 ha
Total			11.8 ha

The Proposal would result in the removal of approximately 11.8 ha of native vegetation. The Blackbutt Coastal Hills Moist Open Forest community would incur the greatest loss, being approximately 7.4 ha.

5.2.2 Endangered ecological communities

Two endangered ecological communities listed under the *Threatened Species Conservation Act 1995* were recorded within the study area. Approximately 3.1 ha of Swamp Sclerophyll Forest would be removed as a result of the proposal. Most of the Swamp Sclerophyll Forest to be removed within the study area has a history of disturbance (ie land clearing, fragmentation), particularly to the east of the Pacific Highway and the northern-most area to be removed (see Figure 3.1). However, Swamp Sclerophyll Forest to be removed in the southwest of the study area is in good condition and the proposal is likely to result in edge effects extending outside of the area of direct removal. A small area (6 m²) of Swamp Oak Floodplain Forest would also be removed as a result of the proposal.

Impacts on endangered ecological communities could be minimised by implementing strict silt and weed control on vegetated edges and by minimising the road footprint.

5.2.3 Threatened flora species

No threatened flora species were identified during surveys. However, suitable habitat exists for the Swamp Orchid (*Phaius australis*) within the Ararawarra Interchange study area. This area was surveyed outside of the flowering period for this species when it is most easily detected. Based on the suitability of habitat, it is considered possible that this species is present in the Swamp Sclerophyll Forest areas of the Ararawarra Interchange. Prior to construction, surveys to identify this species should be undertaken during the flowering period of September to October within the footprint of the Ararawarra Interchange. Approximately 4000 m² of potential habitat for the Swamp Orchid would be removed as a result of the proposal. Additionally, a further 4000 m² of potential habitat may be modified through indirect edge effects resulting from the proposal. Further surveys would enable the presence or absence of this species to be confirmed and the potential impact quantified.

5.3 Potential fauna impacts

Fauna species have the potential to be affected during both the construction phase, through habitat loss and modification, and in the operation phase, through increased threat of road kill and increased barriers to movement within the local area. These potential impacts are further discussed below.

5.3.1 Habitat removal

The broad habitat types present within the study area include moist open forest, floodplain forest and watercourses. These habitats provide fauna resources such as hollow bearing trees, fallen timber and leaf litter, dense understorey vegetation, grassy understorey vegetation, winter flowering flora species, creeks and drainage lines.

Twenty hollow-bearing trees would be removed as a result of the proposed Arrawarra Interchange. Hollow-bearing trees within the study area may provide refuge and/or breeding habitat for a range of hollow dependant threatened species, such as:

- Glossy Black-Cockatoo
- Powerful Owl
- Masked Owl
- Squirrel Glider
- Yellow-bellied Glider
- Brush-tailed Phascogale
- Hoary Wattled Bat
- Eastern False Pipistrelle
- East Coast Freetail Bat
- Eastern Long-eared Bat
- Greater Broad-nosed Bat

Table 5.2 below presents a summary of the likely impacts of the proposed Arrawarra Interchange on threatened species and EEC's within the study area.

Winter-flowering species such as Broad-leaved Paperbark, Forest Red Gum and Tallowwood occur within the moist open forest and swamp sclerophyll forest communities and removal of these habitats would reduce the availability of important seasonal food sources for fauna species within the local area. The proposed Arrawarra Interchange would result in the loss of approximately 11.8 ha of these communities.

A series of culverts and one bridge (Arrawarra Creek) will be replaced as a result of the proposal. Culverts and bridges within the study area may provide roosting/breeding habitat for the following threatened microchiropteran bat species:

- Large-footed Myotis
- Little Bent-wing Bat
- Large Bent-wing Bat
- Eastern Cave Bat

Whilst culvert and bridge habitat will be replaced by new structures, it is unknown whether the new structures will be suitable for roosting and/or breeding. Demolition and construction of bridges and culverts should be undertaken outside of the microbat maternity season (November) and winter months when bat species are likely to be less active.

5.3.2 Habitat fragmentation and edge effects

Habitat fragmentation is the division of a single (contiguous) area of bushland into two or more areas. This has the potential to disrupt wildlife movement corridors, increase edge to interior ratios and decrease the amount of available habitat for threatened fauna. Habitat contiguity is important as some threatened species require large areas of intact habitat. The larger the area of habitat the greater the potential carrying capacity and the lower the level of threats such as road kill, predation and competition from animals associated with edge environments.

Fragmentation due to road construction may create isolated areas of native vegetation, which become too small to support viable populations of native flora and fauna and where populations may become genetically depressed. The removal of vegetation as a result of the proposal is likely to increase habitat fragmentation impacts on fauna species by widening the distance between vegetation remnants.

Edge effects resulting from the proposed Arrawarra Interchange would have the greatest impact within Blackbutt forest and Swamp Sclerophyll Forest on the west of the existing Pacific Highway.

5.3.3 Fauna movement barriers and mortality

Roads can impact on fauna through direct mortality resulting from vehicle collision and through the creation of barriers that prevent or restrict fauna movement. Fauna movement barriers may isolate fauna populations or they may prevent or limit fauna access to seasonally abundant resources, such as vegetation communities dominated by winter flowering species.

The existing Pacific Highway is a 25 m wide, linear clearing within the study area and is likely to be already acting as a movement barrier to some less mobile fauna species. In addition, powerline easements and local roads 10-20 m wide may also present a barrier to movement for some fauna species.

Arboreal mammals such as Sugar Gliders, Squirrel Gliders and Yellow-bellied Gliders can potentially glide over a physical barrier such as the existing highway, depending on the proximity of adjacent canopy trees. However, reported estimates of glide distances and trajectory suggests that the threatened Squirrel Glider and Yellow-bellied Glider are capable of gliding up to 50 m and 90 m, respectively, and depending on glide point height and other environmental parameters (van der Ree 2006; Daly 2005; NPWS 2003; Quin 1995). The habitat of the Yellow-bellied Glider and Squirrel Glider is likely to become further fragmented by the proposed dual carriageway highway.

During the initial stages of construction, the clearing of vegetation may result in injury or death to resident fauna. Species at risk include nocturnal species such as microbats, possums and gliders which shelter during the day, and ground dwelling species such as snakes, lizards, amphibians, and small mammals which may not be able to move fast enough or cover large enough distances to avoid clearing activities. Mobile fauna species that are less active or inactive during cooler seasons, such as microbats, may suffer increased mortality resulting from vegetation clearing activities during these seasons. Vegetation clearing during breeding seasons may place additional stress on fauna species and may result in mortality of young and/or adults. There is also the risk of displaced fauna succumbing to predation, or stress induced by competing with existing resident populations for resources, particularly shelter / refuge habitat.

Vehicle collision is likely to be the major cause of fauna mortality during the operation phase of the proposed Arrawarra Interchange. Species groups at risk include medium to large terrestrial mammals, diurnal birds, nocturnal birds, amphibians and reptiles.

Threatened amphibian species such as Green-thighed Frog, Wallum Sedge Frog and Wallum Froglet may experience higher mortality rates as a result of the operation of the proposed Arrawarra Interchange. Goldingay and Taylor (2006) report on high levels of frog mortality, particularly of Wallum Sedge Frog, Wallum Froglet and the Northern Banjo Frog (*Limnodynastes terraereginae*) on a coastal road in north-east NSW. No amphibian roadkill surveys have been undertaken within the study area or along the remainder of the Sapphire to Woolgoolga upgrade route. Frogs within the study area may use existing culverts to cross under the highway during light rainfall events. However, during heavier rainfall, high water levels are unlikely to facilitate frog movement through culverts and frogs may cross the wet bitumen surface. The construction of the proposed Arrawarra Interchange will increase the amount of road surface and may increase the amount of frog mortality resulting from vehicle collision. Current best-practice frog exclusion fencing methods and specially designed culverts should be considered adjacent to Swamp Sclerophyll Forest and other low-lying vegetation communities within

both the Arrawarra Interchange study area and the remainder of the Sapphire to Woolgoolga upgrade route.

6. Conclusion

The proposed Arararra Interchange is likely to directly and indirectly impact upon threatened fauna species, two endangered ecological communities and potentially one threatened flora species. Potential impacts associated with the proposed Arararra Interchange include both foraging and breeding habitat loss, habitat fragmentation, direct mortality, increased action of listed Key Threatening Processes and edge effects. The magnitude of potential impacts on threatened species, populations and endangered ecological communities is likely to increase when considering the entire Sapphire to Woolgoolga Pacific Highway Upgrade. Detailed measures to mitigate potential impacts of the proposal have not been discussed in this report but are included in the Environmental Assessment document addressing the entire Sapphire to Woolgoolga Pacific Highway Upgrade.

7. References

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Appendix A

Threatened species likelihood of occurrence assessment

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
FROGS					
<i>Crinia tinnula</i>	Wallum Froglet	V	—	Wallum swamps and associated low land meandering watercourses on coastal plains (Ehmann 1997). Occurs in elevations up to around 50m and is closely related to freshwater habitats in the coastal zone (NPWS 2005a). Found most commonly in wallum wetlands characterised by low nutrients, highly acidic, tanin-stained waters that are typically dominated by paperbarks and tea-trees. Also found in sedgeland and wet heathland (NPWS 2005a)	Recorded. Further records occur north of Corindi Beach and at Hearn's Lake
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DEC 2005a). Fast flowing streams are not utilised for breeding purposes by this species (Mahony 1999). Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DEC 2005a). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes— <i>Typha</i> sp. and spikerushes— <i>Eleocharis</i> sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (<i>Gambusia holbrooki</i>) (NPWS 1999m). Recorded north of Red Rock (BioNet, 2007).	Unlikely. No suitable habitat present (no still, ephemeral or permanent ponds lined with <i>Typha</i> sp. and other well established fringing vegetation).

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Litoria brevipalmata</i>	Green Thighed Frog	V	—	Wet sclerophyll forest along the northern coast of NSW to Ourimbah (Anstis 2002). Also in a variety of habitats including dry to wet sclerophyll forest, rainforests and shrubland with a healthy understorey (NPWS 2005b). Breeding aggregations occur in still water habitats such as grassy temporary to semi-permanent ponds and flooded ditches in late spring and summer (Cogger 2000; Anstis 2002; NPWS 2005b). Recorded to the west of Emerald Beach, approximately 10 km to the south of the Arrawarra Interchange (Lewis Ecological Surveys, 2006).	Likely. Suitable habitat present and local records to the west of Emerald Beach. Additionally, Lewis Ecological Surveys (2006) identified drainage lines and depressions within the study area as containing potential habitat for the Green-thighed Frog.
<i>Litoria olongburensis</i>	Wallum Sedge Frog	V	V	Wallum, woodlands and sedgeland on coastal swamps dominated by <i>Melaluca quinquinervia</i> with an understorey of the sedge <i>Leprionia articulata</i> are typical habitat (NPWS 2005c). Suitable wallum swamps are characterised by low nutrients, highly acidic, tannin-stained waters occurring on Pleistocene coastal sand deposits (NPWS 2005c).	Likely. Suitable habitat present in wallum areas such as Swamp Sclerophyll Forest and sedgeland.
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	A variety of forest habitats from rainforest through wet and moist sclerophyll forest to riparian habitat in dry sclerophyll forest (NPWS 2005t) that are generally characterised by deep leaf litter or thick cover from understorey vegetation (Ehmann 1997). Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans (Ehmann 1997) or still water environments (NSW Scientific Committee 2002b). Recorded in Conglomerate State Forest.	Unlikely. Marginal habitat present within upper reaches of Little Arrawarra Creek. However, creeks within the study area are highly disturbed, precluding the species from the area.

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	Found on forested slopes of the escarpment and adjacent ranges in riparian vegetation, subtropical and dry rainforest, wet sclerophyll forests and swamp sclerophyll forest (NPWS 2005d; Ehmann 1997). This species is associated with flowing streams with high water quality, though habitats may contain weed species (Ehmann 1997). This species is not known from riparian vegetation disturbed by humans (NSW Scientific Committee 1999). During breeding eggs are kicked up onto an overhanging bank or the streams edge (NPWS 2005d).	Unlikely. Marginal habitat present within upper reaches of Little Arrawarra Creek. However, creeks within the study area are highly disturbed, precluding the species from the area.
REPTILES					
<i>Coeranoscincus reticulatus</i>	Three-toed Snake-tooth Skink	V	V	The Three-toed Snake-tooth Skink occurs in the coast and ranges from the Macleay valley in NSW to south-eastern Queensland (DEC, 2005n). It is very uncommon south of Grafton (DEC, 2005n). It occupies rainforest and occasionally moist eucalypt forest, on loamy or sandy soils (DEC, 2005n). The Three-toed Snake-tooth Skink lives in loose soil, leaf litter and rotting logs, and feeds on earthworms and beetle grubs (DEC, 2005n).	Unlikely. Marginal habitat present within Swamp Sclerophyll Forest. However, not detected during surveys, it is considered to be very uncommon south of Grafton and there are no local records within 40 km of study area.
<i>Emydura signata</i> <i>Emydura macquarii</i>	Bellinger River Emydura	V	V	The Bellinger River Emydura is restricted to the upper Bellinger River above Thora. It prefers long, deep pools in broad reaches of the upper Bellinger River.	Unlikely. Extremely restricted distribution well outside of the study area and no suitable habitat present

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arwarra Interchange study area					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Hoplocephalus stephensii</i>	Stephen's Banded Snake	V	—	Found in a variety of habitats from rainforest through wet and moist sclerophyll forests to dry sclerophyll forests (NPWS 2005e). However it is most commonly found in wet to moist forests with rocky outcrops, cliffs or ridges and tends to favour ecotones between wet and dry forests (NPWS 2005e). It most frequently uses gaps in the peeling bark of large senescent or dead trees for daytime shelter (NPWS 2005e). However it can use hollow trunks, limbs, epiphytes, vine thickets, rock crevices or rock slabs (NPWS 2005e).	Unlikely. No suitable habitat present (no rocky outcrops, cliffs or ridges)
<i>Underwoodisaurus sphyrurus</i>	Border Thick-tailed Gecko	V	V	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree (DEC, 2005m). Most common in the granite country of the New England Tablelands (DEC, 2005m). Rocky hills with dry open eucalypt forest or woodland (DEC, 2005m). Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter (DEC, 2005m).	Unlikely. No suitable habitat present (no rocky hills within study area, rock slabs or boulders)
DIURNAL BIRDS					
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	—	Associated with dry open woodland with grassy areas, dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland (Pittwater Council 2000; Marchant & Higgins 1993). Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Environment Australia 2000; Marchant & Higgins 1993). Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed in lightly disturbed.	Unlikely. Marginal open forest habitat present. However, study area has experience a high level of logging disturbance which is likely to preclude the species.

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Calidris alba</i>	Sanderling	V	—	Occur in coastal areas on low beaches, near reefs and inlets along tidal mudflats and bare open coastal lagoons (NPWS 1999a). Rarely seen in near-coastal wetlands such as lagoons, hypersaline lakes, saltponds and samphire flats (NPWS 1999a)	Unlikely. No suitable habitat present (no coastal areas or near-coastal wetlands).
<i>Calidris tenuirostris</i>	Great Knot	V	—	Sheltered coastal habitats containing large intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons (NPWS 1999q). Often recorded on sandy beaches with mudflats nearby, sandy spits and inlets, or exposed reefs or rock platforms (Morris 1989; Higgins & Davies 1996).	Unlikely. No suitable habitat present (no coastal areas).
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V	—	Associated with a variety of forest types containing Allocasuarina species, usually reflecting the poor nutrient status of underlying soils (Environment Australia 2000; NPWS 1997; NPWS 1999b). Intact drier forest types with less rugged landscapes are preferred (NPWS 1999b). Nests in large trees with large hollows (Environment Australia 2000).	Recorded. Numerous additional records within 10 km of study area.
<i>Charadrius leschenaultii</i>	Greater Sand Plover	V	—	Entirely coastal in NSW, foraging on intertidal sand and mudflats in estuaries, roosting during high tide on sandy beaches or rocky shores (NPWS 1999c)	Unlikely. No suitable habitat present (no coastal areas).
<i>Coracina lineata</i>	Barred Cuckoo-shrike	V	—	It is associated with subtropical, dry and littoral rainforests and is restricted to below 500m elevation (NPWS 2005f).	Unlikely. Marginal habitat present within northwest Swamp Sclerophyll Forest and margins. However, not detected during surveys.
<i>Dromaius novaehollandiae</i> NSW North Coast Bioregion and Port Stephens LGA Population	Emu	E2	—	Occupies a range of mainly open habitats including plains, grasslands, woodlands, shrubs and occasionally forest (NSW Scientific Committee 2002a). Not found in rainforest (Simpson & Day 1999). Recorded less than six kilometres to the north, just south of Red Rock (BioNet, 2007).	Likely. Local records and marginal open forest habitat present.

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Hoplocephalus stephensii</i>	Stephen's Banded Snake	V	—	Found in a variety of habitats from rainforest through wet and moist sclerophyll forests to dry sclerophyll forests (NPWS 2005e). However it is most commonly found in wet to moist forests with rocky outcrops, cliffs or ridges and tends to favour ecotones between wet and dry forests (NPWS 2005e). It most frequently uses gaps in the peeling bark of large senescent or dead trees for daytime shelter (NPWS 2005e). However it can use hollow trunks, limbs, epiphytes, vine thickets, rock crevices or rock slabs (NPWS 2005e).	Unlikely. No suitable habitat present (no rocky outcrops, cliffs or ridges)
<i>Underwoodisaurus sphyrurus</i>	Border Thick-tailed Gecko	V	V	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree (DEC, 2005m). Most common in the granite country of the New England Tablelands (DEC, 2005m). Rocky hills with dry open eucalypt forest or woodland (DEC, 2005m). Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter (DEC, 2005m).	Unlikely. No suitable habitat present (no rocky hills within study area, rock slabs or boulders)
DIURNAL BIRDS					
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	—	Associated with dry open woodland with grassy areas, dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland (Pittwater Council 2000; Marchant & Higgins 1993). Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Environment Australia 2000; Marchant & Higgins 1993). Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed in lightly disturbed.	Unlikely. Marginal open forest habitat present. However, study area has experience a high level of logging disturbance which is likely to preclude the species.

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V	—	A coastal species that inhabits rock coastlines, coral cays, reefs and occasionally sandy beaches and Marchant & Higgins 1993; Simpson & Day 1999).	Unlikely. No suitable habitat present (no coastal areas).
<i>Haematopus longirostris</i>	Pied Oystercatcher	V	—	Roosts and forages on sandy beaches, sand banks, mudflats and estuaries (Marchant & Higgins 1993, Simpson & Day 1999).	Unlikely. No suitable habitat present (no coastal areas).
<i>Irediparra gallinacea</i>	Comb-crested Jacana	V	—	Freshwater wetlands, such as lagoons, billabongs, swamps, lakes and reservoirs, generally with abundant floating aquatic vegetation (Marchant and Higgins 1999).	Unlikely. No suitable habitat present (no freshwater wetlands with abundant floating aquatic vegetation).
<i>Ixobrychus flavicollis</i>	Black Bittern	V	—	Occurs in both terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation (NPWS 1999g). In areas with permanent water it may occur in flooded grassland, forest, woodland, rainforest and mangroves (NPWS 1999g)	Unlikely. No suitable habitat present (no wetlands with permanent water and abundant floating aquatic vegetation within study area or flooded areas adjacent to wetlands).
<i>Lathamus discolor</i>	Swift Parrot	E	E	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984; Schodde and Tidemann 1986; Forshaw and Cooper 1981). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum (<i>Corymbia maculata</i>), Red Bloodwood (<i>C. gummifera</i>), Mugga Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>) (DEC 2005h).	Unlikely. Preferred winter flowering forage species were scarce within the study area.

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Limosa limosa</i>	Black-tailed Godwit	V	—	Primarily found along the coast on sandspits, lagoons and mudflats (NPWS 1999s). The species has also been found to occur inland on mudflats or shallow receding waters of portions of large muddy swamps or lakes (Pizzey and Knight 1997; Higgins & Davies 1996).	Unlikely. No suitable habitat present (no coastal areas).
<i>Lophoictinia isura</i>	Square-tailed Kite	V	—	In coastal areas associated tropical and temperate forests and woodlands on fertile soils with an abundance of passerine birds (Marchant & Higgins 1993, NPWS 1999h). May be recorded inland along timbered watercourses (NPWS 1999h). In NSW it is commonly associated with ridge or gully forests dominated by Woollybutt (<i>Eucalyptus logiflora</i>), Spotted Gum (<i>E. maculata</i>), or Peppermint Gum (<i>E. elata</i> , <i>E. smithii</i>) (NPWS 1999h). Recorded within one kilometre of the study area (DEC, 2007).	Likely. Suitable habitat present and recent local records.
<i>Monarcha leucotis</i>	White-eared Monarch	V	—	Associated with lowland subtropical rainforest edges and remnants; littoral and floodplain rainforest, swamp sclerophyll with mesomorphic mid storey, coastal wet sclerophyll (Environment Australia 2000; NPWS 2005i). It is thought to avoid moving into small remnants; preferring to move through areas of continuous forest cover (Environment Australia 2000). Recorded approximately five kilometres to the southwest of the study area within Wedding Bells State Forest (BioNet, 2007).	Likely. Suitable Swamp Sclerophyll Forest habitat present.

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Pandion haliaetus</i>	Osprey	V	—	Associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995). Osprey may nest on the ground, on sea cliffs or in trees (Olsen 1995). Osprey generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995). Numerous local records (BioNet, 2007, DEC, 2007).	Likely. Likely to fly over study area and marginal nesting/roosting habitat present.
<i>Pezoporus wallicus wallicus</i>	Ground Parrot (eastern subspecies)	V	—	Predominantly restricted to coastal heath and sedgeland, generally below one metre in height, that provide a high density of cover and food foraging resources (Blakers et al. 1984; Simpson & Day 1999). Recorded two kilometres to the north of the study area (DEC, 2007)	Unlikely. No suitable habitat present (no coastal heath or suitable sedgeland).
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	—	Open woodlands dominated by mature eucalypts with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs (NSW Scientific Committee 2001d). This species avoids very wet areas (Blakers et al. 1984). Recorded prior to 1990, approximately 10 km to the north of the study area (BioNet, 2007).	Unlikely. No suitable habitat present (no woodland)
<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V	—	Associated with large, undisturbed patches of tall tropical or subtropical rainforest, at all altitudes, preferably with a diversity of fruit (Marchant and Higgins 1999; NPWS 2005k). Occasionally located in patches of monsoon rainforest, closed gallery forest, wet sclerophyll forest, tall open forest, open woodland or vine thickets near rainforest (Marchant and Higgins 1999; NPWS 2005k).	Unlikely. No suitable habitat present (low occurrence and diversity of fruiting rainforest species recorded within study area).

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V	—	Tall tropical and subtropical, evergreen or semi-deciduous rainforests, especially with a dense growth of vines trees (Marchant and Higgins 1999). Also located in closed wet sclerophyll forest, gallery forests or sclerophyll woodlands with abundant fruiting trees, near or next to rainforest (NPWS 2005). Is thought to prefer large areas of vegetation, but has been located in patches and occasionally in parks and gardens with fruiting trees (Marchant and Higgins 1999).	Unlikely. No suitable habitat present (low occurrence and diversity of fruiting rainforest species recorded within study area).
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V	—	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms (DEC 2005j). It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (<i>ibid.</i>). Part of the population is migratory or nomadic (<i>ibid.</i>). At least some of the population, particularly young birds, moves south through Sydney, especially in autumn (<i>ibid.</i>). Breeding takes place from September to January (<i>ibid.</i>). Will feed in adjacent mangroves or eucalypt forests (Blakers et al. 1984).	Unlikely. No suitable habitat present (low occurrence and diversity of fruiting rainforest species recorded within study area).
<i>Rostratula benghalensis australis</i>	Painted Snipe (Australian subspecies)	E	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DEC 2005k). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (<i>ibid.</i>). Breeding is often in response to local conditions; generally occurs from September to December (DEC 2005k). Roosts during the day in dense vegetation (NSW Scientific Committee 2004a). Forages nocturnally on mud-flats and in shallow water (DEC 2005k). Feeds on worms, molluscs, insects and some plant-matter (<i>ibid.</i>).	Unlikely. No suitable habitat present (no wetlands, mudflats or shallow water). Additionally no records within 50 km (BioNet, 2007; DEC, 2007).

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Sterna albifrons</i>	Little Tern	E	—	Almost exclusively coastal, preferring sheltered areas (NPWS 1999o), however may occur several kilometres inland in harbours, inlets and rivers (Smith 1990). Australian birds breed on sandy beaches and sand spits (Simpson & Day 1999).	Unlikely. No suitable habitat present (no coastal areas, harbours, inlets or rivers).
<i>Sterna fuscata</i>	Sooty Tern	V	—	Forages offshore, usually only observed onshore in breeding season or when storms force them to shelter (NPWS 1999p)	Unlikely. No suitable habitat present (no coastal areas).
<i>Stictonetta naevosa</i>	Freckled Duck	V	—	Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters (NPWS 1999v).	Unlikely. No suitable habitat present (no wetlands).
<i>Todiramphus chloris</i>	Collared Kingfisher	V	—	In NSW it is most commonly observed in the Tweed River estuary, where it breeds (DEC, 2005i). It appears to be an irregular visitor further south (DEC, 2005i). Collared Kingfishers are virtually restricted to mangroves and other estuarine habitats and mainly occur about the mouths of the larger coastal rivers (DEC, 2005i). Nests are usually in a hollow in a mangrove tree or drilled into termite nests in a large eucalypt or paperbark adjacent to mangroves (DEC, 2005i).	Unlikely. No suitable habitat present (no estuarine areas or mangroves within study area or adjacent).

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Turnix melanogaster</i>	Black-breasted Button-quail	E	V	Dry rainforests, vine scrub or lantana thickets (Marchant & Higgins 1993). In NSW the species inhabits dry or subtropical forests which contain Brigalow, Belah, Bottletrees, Hoop Pine, Lantana, Ironbark, Wattle, Spotted Gum, Wallaby Grass or Rhodes Grass (Bennett 1985; Hughes & Hughes 1991). Observations in Lantana thickets and hoop pine plantations indicate this species may be able to utilise human modified environments (Blakers et al. 1984). Nearest record is west of Coffs Harbour, more than 30 km from the study area near Dorrigo (BioNet, 2007).	Unlikely. Marginal habitat present on edges of Swamp Sclerophyll Forest in northwest of study area. However, no records within 30 km and not detected during survey.
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E	E, M	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (<i>Casuarina cunninghamiana</i>) (Garnett 1993). Areas containing Swamp Mahogany (<i>Eucalyptus robusta</i>) in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000).	Likely. Suitable foraging habitat present.

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
NOCTURNAL BIRDS					
<i>Ninox strenua</i>	Powerful Owl	V	—	Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Environment Australia 2000, Debus & Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Environment Australia 2000). Recorded less than one kilometre to the south of the study area (Connell Wagner, 2005).	Likely. Suitable habitat present and recorded nearby.
<i>Tyto novaehollandiae</i>	Masked Owl	V	—	Associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland (NPWS 2005m) and especially the ecotone between wet and dry forest, and non forest habitat (Environment Australia 2000). Known to utilise forest margins and isolated stands of trees within agricultural land (Hyem 1979) and heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained (Kavanagh & Peake 1993). Recorded approximately five kilometres to the west of the study area (BioNet, 2007).	Likely. Suitable habitat present and local records.
<i>Tyto tenebricosa</i>	Sooty Owl	V	—	Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species (Environment Australia 2000, Debus 1994). Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows (Debus 1994, Garnett 1993, Hyem 1979).	Unlikely. No suitable habitat present (no tall wet old growth forest on fertile soil).

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
MAMMALS (EXCLUDING BATS)					
<i>Aepyprymnus rufescens</i>	Rufous Bettong	V	—	Prefer forests with a grassy to sparse understorey including coastal forest, tall wet sclerophyll forest and dry forests west of GDR (NPWS 2005n). It is most commonly found on sites derived from sedimentary rock and in north eastern NSW in forests characterised by Spotted Gum (<i>Corymbia maculata</i> and <i>C. henryi</i>) (NPWS 2005n). It has been known to feed on introduced pasture species (NPWS 2005n). Recorded 10 km to the north and south and more than 20 km to the west of the study area (BioNet, 2007).	Likely. Marginal habitat present in open forest habitats.
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	—	Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2004). Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit (Turner & Ward 1995). The presence of Banksia sp. and Leptospermum sp. are an important habitat feature (NPWS 2005v). Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old birds nests and in the branch forks of tea-trees (Turner & Ward 1995).	Unlikely. Marginal habitat present. However, important forage species (<i>Banksia</i> sp. and <i>Leptospermum</i> sp.) are absent or occur in low abundance within the study area.

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Dasyurus maculatus</i> <i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll Spotted-tailed Quoll (SE Mainland Population)	V —	— E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; NPWS 1999j), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (NPWS 1999j). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000). Recorded less than two kilometres to the southwest of the study area in 1986 (BioNet, 2007).	Likely. Suitable habitat present within open forest habitats.
<i>Petaurus australis</i>	Yellow-bellied Glider	V	—	This species is restricted to tall mature forests, preferring productive tall open sclerophyll forests with a mosaic of tree species including some that flower in winter (Environment Australia 2000, Braithwaite 1984, Davey 1984, Kavanagh 1984; NPWS 1999k). Large hollows within mature trees are required for shelter, nesting and breeding (Henry and Craig 1984; NPWS 1999k).	Recorded. Other local records exist less than one kilometre to the south of the study area (Connell Wagner, 2005).
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	—	Associated with dry hardwood forest and woodlands (Menkhorst et al. 1988; Quin 1995). Habitats typically include gum barked and high nectar producing species, including winter flower species (Menkhorst et al. 1988). The presence of hollow bearing eucalypts is a critical habitat value (Quin 1995). Recorded approximately one kilometre to the east of the study area near Arrawarra (BioNet, 2007).	Likely. Suitable habitat present. However, not recorded during the survey. Likely to occur at low densities.

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arwarra Interchange study area					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Strahan 1995).	Unlikely. No suitable habitat present (no rocky areas).
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	—	Preferred habitat is Dry Open forest with a sparse open understorey, however, has been located in heath, swamps and rainforest and wet sclerophyll forest (NPWS 1999). Recorded approximately 10 km to the north and 15 km to the south of the study area (BioNet, 2007).	Likely. Suitable habitat present within open forest habitat.
<i>Phascolarctos cinereus</i>	Koala	V	—	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis	Likely. Potential Koala habitat present (Forest Red Gum – <i>Eucalyptus tereticornis</i>). Likely to occur at low densities.
<i>Planigale maculata</i>	Common Planigale	V	—	Subtropical to dry rainforest, dry sclerophyll forest, heathland and grassland up to 400m elevation (NPWS 2005o; Strahan 1998). Habitat selection is dependant on surface cover (NPWS 2005o). Recorded in 1994 less than one kilometre to the south of the study area (BioNet, 2007). Recorded within 2 km of the study area.	Likely. Suitable habitat present. Not recorded during targeted survey; however, the species is difficult to capture and may have been undetected within the study area.
<i>Potorous tridactylus</i> <i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo Long-nosed Potoroo (SE Mainland Population)	V —	— V	Associated with dry coastal heath and dry and wet sclerophyll forests (Strahan 1998) with dense cover for shelter and adjacent more open areas for foraging (Menkhorst & Knight 2004). Recorded along the Pacific Highway near Emerald Beach, less than 10 km to the south of the current study area	Likely. Suitable habitat present and recent local records.

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Pseudomys gracilicaudatus</i>	Eastern Chestnut Mouse	V		Grassy forests woodlands and wet heaths; prefers early post fire serial stage; in areas where foxes scarce or absent; seeds and stems important. Sheltering grass nest on surface of ground or burrow network (Environment Australia 2000). Recorded over 20 km to the north within Yuraygir National Park (BioNet, 2007).	Unlikely. Marginal habitat present. However, not recorded during targeted survey.
<i>Pseudomys oralis</i>	Hastings River Mouse	E	E	An open canopy and shrub layer appear to be the major predictive habitat features of this species (Read & Tweedie 1996). Open forest or woodland with a grassy sedge rush or heath understorey that is about 10-75cm above the ground (NPWS 1999w). Ground cover may vary from almost no cover to a dense, rank cover of grasses, herbs and sedges (DEH 2006a). Sedges, particularly <i>Carex</i> , <i>Juncus</i> and <i>Cyperus</i> spp. are common to most sites (DEH 2006a). This habitat occurs beside creeks (permanent and ephemeral) and soakages, but is also found on ridges and grassy Plains (DEH 2006a). Shelter areas such as rock piles, hollow logs, yabby burrows or cavities in the butts of large old trees are also required to be present (NPWS, 1999w). Recorded more than 30 km to the west of the study area (BioNet, 2007).	Unlikely. Marginal habitat present. However, not recorded during targeted survey.

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
MAMMALS (BATS)					
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998; NPWS 2005p). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998; NPWS 2005p). Closest record is approximately 20 km to the west of the study area within Conglomerate State Forest (BioNet, 2007).	Unlikely. No suitable roosting/breeding habitat present (no cave habitats, no rock outcrops or cliff faces within study area)
<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	V	—	The preferred habitat of this species appears to be variable, with dry open forest, woodland, vine thickets, coastal scrub, sand dunes, grasslands and floodplains recorded (Churchill 1998). This species often forages along watercourses, swampy areas and over farm dams. In NSW, this species has been recorded in Spotted Gum (<i>Corymbia maculata</i>), Grey Box (<i>Eucalyptus moluccana</i>) and Northern Ironbark (<i>E. siderophloia</i>) and woodland characterised by Scribbly Gums (<i>E. signata</i>) and Pink Bloodwood (<i>C. intermedia</i>) and sites dominated by the Blackbutt (<i>E. pilularis</i>) (Churchill 1998). Roost sites have been identified as tree hollows, rock crevices and the roofs of buildings (Churchill 1998). Closest record is five kilometres to the north, just south of Red Rock (BioNet, 2007).	Likely. Suitable habitat present and local record.

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	—	Prefers moist habitats with trees taller than 20m (DEC 2005f). Roosts in tree hollows but has also been found roosting in buildings or under loose bark (DEC 2005f). Closest records are five kilometres to the north of the study area, just south of Red Rock and west of the study area within Conglomerate State Forest (BioNet, 2007).	Likely. Marginal habitat present and local records.
<i>Kerivoula papuensis</i>	Golden-tipped Bat	V	—	The most favoured habitat for this species is moist closed forests often with a rainforest influence, however, some captures have been made in dry forests some distance from any rainforest (Lunney et. al. 1986; Parnaby and Mills, 1994). It has been suggested that the amount of vines and complex tree layers allows for increased numbers of spiders and webs and such areas are sought by the Golden-tipped Bat (Schulz & Eyre 2000). This species is often caught over streams within rainforest and are known to frequently roost within the pendulous nests of Yellow-throated and Large-billed Scrub Wrens and Brown Gerygone in such areas (Schulz & Eyre 2000). Recorded approximately five kilometres to the south of the study area, west of Woolgoolga (BioNet, 2007).	Likely. Marginal habitat present and local records.

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Miniopterus australis</i>	Little Bent-wing Bat	V	—	Prefers well-timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests (Churchill 1998). This species shelter in a range of structures including culverts, drains, mines and caves (Environment Australia 2000). Relatively large areas of dense vegetation of either wet sclerophyll forest, rainforest or dense coastal banksia scrub are usually found adjacent to caves in which this species is found (NPWS 2005q). Breeding occurs in caves, usually in association with <i>M. schreibersii</i> (Environment Australia 2000, NPWS 2005q).	Recorded.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	V	—	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). It forages above and below the tree canopy on small insects (AMBS 1995, Dwyer 1995, Dwyer 1981). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000, Dwyer 1995).	Recorded.
<i>Mormopterus norfolkensis</i>	East Coast Freetail Bat	V	—	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia 2000; Allison & Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Environment Australia 2000; Allison & Hoye 1998).	Recorded.

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Myotis adversus</i>	Large-footed Myotis	V	—	Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water (Churchill 1998). While roosting is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains (Churchill 1998). However the species apparently has specific roost requirements, and only a small percentage of available caves, mines, tunnels and culverts are used (Richards 1998).	Likely. Suitable foraging habitat along creek within the study area and in dams adjacent to the study area.
<i>Nyctophilus bifax</i>	Eastern Long-eared Bat	V	—	This species prefers wetter habitats, ranging from rainforest and monsoon forest to riverine forests of paperbark, but may be found in open woodland, tall open forest and dry sclerophyll woodland (Churchill 1998). These forest bats have been recorded roosting under peeling bark, among epiphytes, in tree hollows and in foliage (Churchill 1998). Individuals are likely to change roost sites nightly (NPWS 2005r).	Likely. Suitable habitat present, although, not within core distribution.
<i>Pteropus alecto</i>	Black Flying-Fox	V	—	Mangroves, paperbark forests and occasionally patches of rainforest are most commonly utilised for camp sites (Strahan 1998; Churchill 1998). They have been found to occupy a range of habitats of tropical and sub-tropical forests and woodlands (Churchill 1998). Preferred food includes blossoms (such as eucalypts, paperbarks and turpentines), also introduced fruits and blossoms (Strahan 1998).	Likely. Suitable foraging habitat present

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		TSC Act	EPBC Act		
<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	Recorded.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	—	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland (Churchill 1998), open country, mallee, rainforests, heathland and waterbodies (SFNSW 1995). Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock (Environment Australia 2000) and in abandoned sugar glider nests (Churchill 1998). The Yellow-bellied Sheath-tail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (Environment Australia 2000).	Likely. Suitable habitat present.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	—	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 1998). Within denser vegetation types use is made of natural and man made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 1998).	Recorded.

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		TSC Act	EPBC Act		
<i>Syconycteris australis</i>	Common Blossom-bat	V	—	The combination of heathland and coastal rainforest is essential for this species (Churchill 1998). Breeding and sheltering habitats are in subtropical and littoral rainforests and a diverse range of nectar producing plant communities are required year round; it will occasionally eat some rainforest fruits (Churchill 1998; Environment Australia 2000).	Unlikely. No suitable habitat present (no heathland or coastal rainforest).
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	—	Inhabit tropical mixed woodland and wet sclerophyll forest on the coast and the dividing range but extend into the drier forest of the western slopes and inland areas (Churchill 1998). Has been found roosting in sandstone overhand caves, boulder piles, mine tunnels and occasionally in buildings (Churchill 1998).	Likely. Suitable habitat present. However, closest records are more than 40 km to the north and south of study area (BioNet, 2007).
INVERTEBRATES					
<i>Petalura gigantea</i>	Giant Dragonfly	E	—	Swamps, streamlines and seepages in mainly natural condition with short to moderate vegetation and a relatively deep soil base (Trueman 2005). Larvae permanently burrow into soil and so do not survive in permanent ponds or other open water (Trueman 2005).	Unlikely. Marginal habitat present within Swamp Sclerophyll Forest. However, the high level of disturbance is likely to have precluded the species.
MIGRATORY TERRESTRIAL SPECIES LISTED UNDER EPBC ACT					
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	—	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	Likely. Species is likely to fly over the study area. However, no suitable foraging or breeding habitat present.

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Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Hirundapus caudacutus</i>	White-throated Needletail	—	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	Likely. Species is likely to fly and forage over the study area.
<i>Merops ornatus</i>	Rainbow Bee-eater	—	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May (Pizzey and Doyle 1988). Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (<i>ibid</i>). Nest is a chamber at the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (<i>ibid</i>).	Likely. Suitable habitat present.
<i>Monarcha melanopsis</i>	Black-faced Monarch	—	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	Likely. Marginal habitat present
<i>Monarcha trivirgatus</i>	Spectacled Monarch	—	M	Wet forests, mangroves (Simpson and Day 1999).	Likely. Marginal habitat present
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	—	M	Associated with drier eucalypt forests, absent from rainforests (Blakers et al. 1984), open forests, often at height (Simpson & Day 1999).	Likely. Suitable habitat present
<i>Rhipidura rufifrons</i>	Rufous Fantail	—	M	Wet forests, less often open forests (Simpson & Day 1999)	Likely. Suitable habitat present
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E	E, M	SEE DIURNAL BIRDS ABOVE	SEE DIURNAL BIRDS ABOVE

Table A: Assessment of Likelihood of Occurrence of Threatened Fauna Species within the Arrawarra Interchange study area

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<p>Disclaimer: Data extracted from the Atlas of NSW Wildlife, BioNet and DEH Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. In recognising this, a literature review complemented by appropriate field survey has been undertaken that targets a larger number of species than is listed in this table. 'Migratory marine species' and 'listed marine species' listed on the EPBC Act (and listed on the DEH protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine habitat.</p>					

E = Endangered

E2 = Endangered population

V = Vulnerable

M = Migratory

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Acacia chrysotricha</i>	Newry Golden Wattle	E	—	An understorey species on rainforest edges and in wet or dry eucalypt forest in steep narrow gullies on quartzite soils (DEC, 2005bk). The round, yellow flower heads are present from July-August (DEC, 2005bk). Recorded less than five kilometres to the south near Safety Beach (BioNet 2007).	Unlikely. No suitable habitat present (no rainforest edges or steep gullies in wet or dry eucalypt forest).
<i>Acronychia littoralis</i>	Scented Acronychia	E	E	It is found between Fraser Island in Queensland and Port Macquarie on the north coast of NSW (DEC, 2005bm). It grows in littoral rainforest on sand (DEC, 2005bm). Recorded approximately five kilometres to the north, just south of Red Rock (DEC, 2007).	Unlikely. No suitable habitat present (no littoral rainforest).

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Allocasuarina defungens</i>	Dwarf Heath She-oak	E	E	Found only in NSW from the Nabiac area, north-west of Forster, to Byron Bay on the NSW north coast (DEC 2005bg). <i>A. defungens</i> is a straggly oak about 2m high with blue-green foliage found in heath on sand (sometimes clay and sandstone soils), and swamp sclerophyll forest margins (DEC 2005bg). The species also extends onto exposed nearby-coastal hills or headlands adjacent to sandplains (DEC 2005bg). Recorded approximately 7 km to the north of the study area (BioNet 2007).	Unlikely. Suitable habitat present in Swamp Sclerophyll Forest. However, not detected during surveys.
<i>Amorphospermum whitei</i>	Rusty Plum	V	E	Typical habitat consists of gully rainforest or wet sclerophyll with a well-developed rainforest understorey growing on medium fertility soils formed on metasediment or rhyolite (Floyd 1989). The altitudinal range of this species is from near sea level to 600 m (Floyd 1989). Recorded around two kilometres to the southwest (DEC, 2007) and at numerous locations around Woolgoolga (Ecos Environmental Pty Ltd, 2005).	Unlikely. The southern ecotone of the northwest swamp sclerophyll forest offers some very marginal habitat. However, disturbance history (ie logging) is likely to have precluded this species from occurring and the species was not detected during surveys.
<i>Angophora robur</i>	Large-fruited Angophora	V	V	Dry open forest in sandy or skeletal soils on sandstone, or occasionally granite, with frequent outcrops of rock (DEC, 2005bl). Recorded more than 10 km to the west of the study site (BioNet, 2007).	Unlikely. No suitable habitat present (soil type unsuitable and no rock outcrops).

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Arthraxon hispidus</i>	Hairy Jointgrass	V	V	Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps (DEC, 2005cb). Recorded south of Coffs Harbour, more than 20 km south of the study area.	Unlikely. Marginal habitat present in Swamp Sclerophyll Forest. However, not detected during surveys and logging disturbance is likely to have precluded the species.
<i>Asperula asthenes</i>	Trailing Woodruff	V	V	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 (Harden 1994). Recorded approximately 30 km to the west within Kangaroo River State Forest (BioNet, 2007).	Unlikely. Marginal habitat present within low areas of Swamp Sclerophyll Forest in northwest study area and along the banks of Little Arrawarra Creek. However, recorded more than 30 km away and not detected during surveys.
<i>Boronia umbellata</i>	Orara Boronia	V	V	Found at only a few locations between Glenreagh and Lower Bucca, north of Coffs Harbour, but it is locally common in the restricted area where it occurs (DEC, 2005bn). It grows as an understorey shrub in and around gullies in wet open forest (DEC, 2005bn). It appears to regenerate well after disturbance, but it is not known whether prolonged or repeated disturbance affects long-term persistence (DEC, 2005bn). Recorded approximately five kilometres to the west of the study area in Conglomerate State Forest (BioNet, 2007).	Unlikely. Marginal habitat present in Swamp Sclerophyll Forest. However, not detected during surveys.

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Callistemon linearifolius</i>	Netted Bottlebrush	V	—	Grows in dry sclerophyll forest on the coast and adjacent ranges (DEC 2005af). <i>C. linearifolius</i> has been recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW (DEC 2005af). Recorded approximately 10 km to the west of the study area (BioNet, 2007).	Unlikely. Suitable dry sclerophyll forest habitat present. However, not detected during surveys.
<i>Chamaesyce psammogeton</i>	Sand Spurge	E	—	<i>C. psammogeton</i> is a prostrate perennial herb, which grows on foredunes and exposed sites on headlands often with Spinifex (DEC 2005ab). Flowers in Summer.	Unlikely. No suitable habitat present (no foredunes or headlands).
<i>Cynanchum elegans</i>		E	E	Climber or twiner with a variable form (NPWS 2002ab). It occurs in dry rainforest gullies, scrub and scree slopes. It prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest. However has been found in littoral rainforest; <i>Leptospermum laevigatum</i> – <i>Banksia integrifolia</i> subsp <i>integrifolia</i> coastal scrub; <i>Eucalyptus tereticornis</i> aligned open forest/ woodland; <i>E. maculata</i> aligned open forest/woodland; and <i>Melaleuca armillaris</i> scrub to open scrub (NPWS 2002ab). Flowers between August and May, peaking in November (NPWS 2002ab).	Unlikely. The southern ecotone of the northwest swamp sclerophyll forest offers some very marginal habitat. However, not detected during survey.

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Eleocharis tetraquetra</i>	Square-stemmed Spike Rush	E	–	Thought to be extinct in NSW until it was rediscovered in 1997 at Boambee near Coffs Harbour (DEC, 2005ca). It has since been found in other north coast localities near Grafton and Murwillumbah (DEC, 2005ca). Found in damp locations on stream edges and in and on the margins of freshwater swamps (DEC, 2005ca). Recorded near Coffs Harbour, more than 20 km to the south (DEC, 2007).	Unlikely. Suitable habitat present in the northwest of the study area. However, not detected during survey.
<i>Eucalyptus tetrapleura</i>	Square-fruited Ironbark	V	V	Restricted to the coastal lowlands and foothills of northern NSW around Casino and Grafton (DEC, 2005bo). Dry or moist eucalypt forest on moderately fertile soil, often in low areas with poor drainage (DEC, 2005bo). Recorded approximately 10 km to northwest of study area (DEC, 2007).	Unlikely. Suitable eucalypt forest habitat present in the study area. However, not detected during survey.
<i>Grammitis stenophylla</i>	Narrow-leaf Finger Fern	E	–	In NSW it has been found on the south, central and north coasts and as far west as Mount Kaputar National Park near Narrabrai (DEC, 2005bp). Moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest (DEC, 2005bp). Recorded approximately 10 km to west of study area (BioNet, 2007).	Unlikely. Suitable habitat present in the northwest of the study area and marginal habitat adjacent to Little Arrawarra Creek. However, not detected during survey.
<i>Hicksbeachia pinnatifolia</i>	Red Boppel Nut	V	V	Subtropical rainforest, moist eucalypt forest and Brush Box forest (DEC, 2005bq). Recorded approximately five kilometres to the south of the study area (DEC, 2007).	Unlikely. The southern ecotone of the northwest swamp sclerophyll forest offers some very marginal habitat. However, not detected during survey.

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Lindsaea incisa</i>	Slender Screw Fern	E	—	In NSW it is known only from a few locations between Woombah and just south of Coffs Harbour (DEC, 2005br). Dry eucalypt forest on sandstone and moist shrubby eucalypt forest on metasediments (DEC, 2005br). It is usually found in waterlogged or poorly drained sites along creeks, where ferns, sedges and shrubs grow thickly (DEC, 2005br). Recorded approximately 10 km to the west of the study area (BioNet, 2007).	Unlikely. Marginal habitat present near Little Arrawarra Creek and in the northwest of the study area. However, not detected during survey.
<i>Macadamia tetraphylla</i>	Rough-shelled Bush Nut	V	V	Confined chiefly to the Richmond and Tweed Rivers in north-east NSW, extending just across the border into QLD (DEC, 2005bs). Found in subtropical rainforest, usually near the coast (DEC, 2005bs). Recorded less than two kilometres to the southwest of the study area (DEC, 2007). Ecos Environmental Pty (2005) consider local specimens to have been introduced to the area.	Unlikely. No suitable habitat present (no subtropical rainforest).

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Marsdenia longiloba</i>	Slender Marsdenia	E	V	Subtropical and warm temperate rainforest, lowland moist eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops (DEC, 2005bt). Moist open forest with a fern-grass understorey and occasional small rainforest trees, often on hillslopes adjacent to gully rainforest (Ecos Environmental Pty Ltd, 2005). It appears to prefer soils of medium fertility formed on substrates such as metasediment (Ecos Environmental Pty Ltd, 2005). Recorded around three kilometres to the south of the study area, just west of Woolgoolga (DEC, 2007; Ecos Environmental Pty Ltd, 2005).	Unlikely. The southern ecotone of the northwest swamp sclerophyll forest offers some very marginal habitat. However, not detected during survey.
<i>Maundia triglochinosides</i>		V	-	Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct (DEC 2005bh). <i>Maundia triglochinosides</i> is an aquatic herbaceous plant found in swamps or shallow fresh water on heavy clay on the north and central NSW coast. Recorded 15 km to the north within Yuraygir National Park (BioNet, 2007).	Unlikely. Marginal habitat present in Little Arrawarra Creek and in the northwest of the study area. However, not detected during survey.
<i>Melichrus hirsutus</i>	Hairy Melichrus	E	E	Restricted to a few locations near Grafton in north-east NSW (DEC, 2005ce). Dry eucalypt forest with a shrubby understorey on sandy infertile soils with rock outcrops (DEC, 2005ce). Recorded 20 km to west and north of study area (DEC, 2007).	Unlikely. No suitable habitat present (no sandy soils with rock outcrops).

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species					
Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Parsonsia dorrigoensis</i>		V	E	Scattered populations in the north coast region between Kendall and Woolgoolga (DEC, 2005bu). Found in subtropical and warm-temperature rainforest, on rainforest margins, and in moist eucalypt forest up to 800 m, on brown clay soils (DEC, 2005bu). Flowers in summer (DEC, 2005bu). Recorded 10 km to the west of the study area within Conglomerate State Forest (DEC, 2007).	Unlikely. The southern ecotone of the northwest swamp sclerophyll forest and margins offer some very marginal habitat. However, not detected during survey.
<i>Phaius australis</i>	Swamp Orchid	E	E	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas (DEC, 2005bv). Flowers September to October (DEC, 2005bv). Recorded approximately two kilometres to the south near Safety Beach (DEC, 2007).	Likely. Suitable habitat present in Swamp Sclerophyll Forest. Survey was conducted outside of flowering period and was unlikely to detect species.

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Quassia</i> sp.1	'Mooney Creek' Quassia	E	E	The habitat of the Moonee Quassia at Moonee and other coastal sites is wet sclerophyll forest, typically comprising canopy species such as <i>Eucalyptus microcorys</i> (Tallowwood), <i>Lophostemon confertus</i> (Brushbox), <i>Syncarpia glomulifera</i> (Turpentine), and <i>Allocasuarina torulosa</i> (Forest Oak) (DEC, 2005bw). This wet forest habitat usually supports a varying density and diversity of rainforest understorey species (DEC, 2005bw). The habitat of populations in the Grafton district consists of tall dry Eucalypt forests of <i>Eucalyptus planchoniana</i> (Needlebark Stringybark)/ <i>Eucalyptus pyrocarpa</i> (Large-fruited Blackbutt) above a well developed shrub layer (DEC, 2005bw). It occurs with populations of the threatened plants <i>Boronia umbellata</i> , <i>Parsonsia dorrigoensis</i> and <i>Amorphospermum whitei</i> . Populations of <i>Eucalyptus rummeryi</i> , <i>Austrobuxus swainii</i> and <i>Marsdenia liisae</i> have also been recorded in the same area as the Moonee Quassia at Conglomerate State Forest (DEC, 2005bw). Recorded approximately seven kilometres to the southwest of the study area (DEC, 2007).	Unlikely. Marginal habitat present in Swamp Sclerophyll Forest and margins. However, not detected during survey.

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Sarcochilus fitzgeraldii</i>	Ravine Orchid	V	V	North-east NSW, north of the Macleay River, to Maleny in south-east Queensland (DEC, 2005cd). The Ravine Orchid grows mainly on rocks, amongst organic matter, in cool, moist, shady ravines, gorges and on cliff faces in dense subtropical rainforest at altitudes between 500 and 700 m (DEC, 2005cd). Occasional clumps are found on the bases of fibrous-barked trees and it flowers between Spring and Summer (DEC, 2005cd). Recorded 10 km to the west of Sapphire turnoff (DEC, 2007).	Unlikely. No suitable habitat present (no ravines, cliff faces or rocky areas).
<i>Senna acclinis</i>	Rainforest Cassia	E	—	Grows in or on the edges of subtropical and dry rainforest (DEC, 2005bx). Recorded approximately seven kilometres to the south of the study area (DEC, 2007).	Unlikely. Marginal habitat present adjacent to Little Arrawarra Creek and margins of Swamp Sclerophyll Forest. However, not detected during survey.
<i>Thesium australe</i>	Austral Toadflax	V	V	Occurs in grassland or grassy woodland (DEC 2005ar). Often found in damp sites in association with Kangaroo Grass (<i>Themeda australis</i>) DEC 2005ar). Recorded within Moonee Beach Nature Reserve, approximately 10 km to the south of the study area	Unlikely. No suitable habitat present (no grassland or grassy woodland). Not detected during survey.

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Tylophora woollsii</i>	Cryptic Forest Twiner	E	E	It is found from the NSW north coast and New England Tablelands to southern Queensland, but is very rare within that range (DEC, 2005cc). Known on the Tablelands from the Bald Rock and Boonoo Boonoo areas north of Tenterfield (DEC, 2005cc). Grows in moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins (DEC, 2005cc). Flowering occurs in summer and autumn, usually between January and March but sometimes as late as November (DEC, 2005cc). Recorded south of Coffs Harbour and 30 km to the west of Woolgoolga (DEC, 2007)	Unlikely. Marginal habitat present within Swamp Sclerophyll Forest and margins. However, not detected during survey and records more than 20 km away.
<i>Typhonium</i> sp. aff. <i>brownii</i>	Stinky Lily	E	—	Only known from four locations in the ranges west of Coffs Harbour and Woolgoolga: Kangaroo River, Bruxner Park, Bindarri National Park and Upper Corindi (DEC, 2005bz). Occurs on reasonably fertile soils, in moist eucalypt forest and the moist eucalypt forest-subtropical rainforest interface (DEC, 2005bz). It is best detected during Summer (DEC, 2005bz). Recorded approximately two kilometres to the south, just west of Woolgoolga (DEC, 2007).	Unlikely. Marginal habitat present within Swamp Sclerophyll Forest and margins. However, the study area has relatively poor soils and a high level of logging disturbance likely to preclude the species.

Table B: Assessment of Likelihood of Occurrence of Threatened Flora Species

Scientific Name	Common Name	Conservation Significance		Habitat Associations	Likelihood of Occurrence
		TSC Act	EPBC Act		
<i>Zieria prostrata</i>	Headland Zieria	E	E	Restricted to four coastal headlands in the Coffs Harbour area of north-east NSW (DEC, 2005by). Low grassy heath on exposed sites and wind-pruned open to sparse shrubland on more sheltered aspects (DEC, 2005by). Recorded approximately five kilometres to the south, near Safety Beach (BioNet, 2007).	Unlikely. No suitable habitat present (no headlands or exposed sites with heath).
<p>Disclaimer: Data extracted from the Atlas of NSW Wildlife and EPBC Act Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. In recognising this, a literature review complemented by appropriate field survey has been undertaken that targets a larger number of species than is listed in this table.</p>					

Appendix B

Flora species list

Scientific Name	Common Name	TSCA	EPBC	Blackbutt Forest E Block	Swamp Sclerophyll Forest SW Block	Swamp Sclerophyll Forest Central W Block	Swamp Sclerophyll Forest NW Block	Blackbutt Forest NW Block + Central W Block	Freshwater Wetland NW Block
<i>Acacia binervia</i>	Coast Myall	-	-					+	
<i>Acacia falcata</i>	Sickle Wattle	-	-	+					
<i>Acacia fimbriata</i>	Fringed Wattle	-	-	+		+		+	
<i>Acacia irrorata</i>	Green Wattle	-	-					+	
<i>Acacia longifolia</i>	Sydney Golden Wattle	-	-	+					
<i>Acacia myrtifolia</i>	Red Stem Wattle	-	-					+	
<i>Acmella grandiflora</i>	-	-	-				+		
<i>Ageratum conyzoides*</i>	Goatweed	-	-						+
<i>Allocasuarina littoralis</i>	Black She-oak	-	-	+		+	+		
<i>Allocasuarina torulosa</i>	Forest Oak	-	-	+				+	
<i>Alphitonia excelsa</i>	Red Ash	-	-	+			+	+	
<i>Amyema congener</i>	Mistletoe	-	-	+					
<i>Aristida vagans</i>	Threeawn Speargrass	-	-	+					
<i>Asplenium flabellifolium</i>	Necklace Fern	-	-			+			
<i>Axonopus affinis*</i>	-	-	-		+	+			+
<i>Baccharis halimifolia</i>	Groundsel Bush	-	-			+	+		+
<i>Baumea articulata</i>	Jointed Twig-rush	-	-						+

Scientific Name	Common Name	TSCA	EPBC	Blackbutt Forest E Block	Swamp Sclerophyll Forest SW Block	Swamp Sclerophyll Forest Central W Block	Swamp Sclerophyll Forest NW Block	Blackbutt Forest NW Block + Central W Block	Freshwater Wetland NW Block
<i>Baumea juncea</i>	-	-	-				+		
<i>Baumea rubiginosa</i>	Soft Twig-rush	-	-						+
<i>Billardiera scandens</i>	Apple Dumplings	-	-					+	
<i>Breynia oblongifolia</i>	Coffee Bush	-	-	+		+	+	+	
<i>Callistemon salignus</i>	Willow Bottlebrush	-	-		+		+	+	
<i>Cassytha pubescens</i>	Devil's Twine	-	-	+	+	+	+		
<i>Chrysanthemoides monilifera ssp. rotundata</i> *	Bitou Bush	-	-	+					
<i>Corymbia intermedia</i>	Pink Bloodwood	-	-	+			+	+	
<i>Cymbopogon refractus</i>	Barbwire Grass	-	-	+				+	
<i>Cyperus haspan</i>	-	-	-						+
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	-	-					+	
<i>Desmodium rhytidophyllum</i>	-	-	-	+				+	
<i>Dianella caerulea</i>	Flax Lily	-	-	+		+			
<i>Dichondra repens</i>	Kidney Weed	-	-			+		+	+
<i>Dillwynia retorta</i>	Eggs and Bacon	-	-			+			
<i>Dodonaea triquetra</i>	Hop Bush	-	-					+	

Scientific Name	Common Name	TSCA	EPBC	Blackbutt Forest E Block	Swamp Sclerophyll Forest SW Block	Swamp Sclerophyll Forest Central W Block	Swamp Sclerophyll Forest NW Block	Blackbutt Forest NW Block + Central W Block	Freshwater Wetland NW Block
<i>Echinopogon ovatus</i>	Forest Hedgehog Grass	-	-				+		
<i>Eclipta platyglossa</i>	-	-	-				+		
<i>Elaeocarpus obovatus</i>	Hard Quandong	-	-					+	
<i>Eleocharis phillippinensis</i>	-	-	-						+
<i>Eleocharis sphacelata</i>	Tall Spike-rush	-	-				+		+
<i>Entolasia marginata</i>	Bordered Panic	-	-			+	+	+	
<i>Entolasia stricta</i>	Wiry Panic	-	-	+		+	+	+	
<i>Epacris pulchella</i>	NSW Coral Heath	-	-					+	
<i>Eragrostis brownii</i>	Brown's Lovegrass	-	-			+		+	
<i>Eucalyptus globboidea</i>	White Stringybark	-	-	+					
<i>Eucalyptus microcorys</i>	Tallowwood	-	-	+				+	
<i>Eucalyptus paniculata</i>	Grey Ironbark	-	-	+				+	
<i>Eucalyptus pilularis</i>	Blackbutt	-	-	+				+	
<i>Eucalyptus resinifera</i>	Red Mahogany	-	-	+		+		+	
<i>Eucalyptus robusta</i>	Swamp Mahogany	-	-				+		
<i>Eucalyptus tereticornis</i>	Forest Red Gum	-	-		+	+	+		

Scientific Name	Common Name	TSCA	EPBC	Blackbutt Forest E Block	Swamp Sclerophyll Forest SW Block	Swamp Sclerophyll Forest Central W Block	Swamp Sclerophyll Forest NW Block	Blackbutt Forest NW Block + Central W Block	Freshwater Wetland NW Block
<i>Eustrephus latifolius</i>	Wombat Berry	-	-	+			+		
<i>Exocarpos cupressiformis</i>	Native Cherry	-	-	+					
<i>Fimbristylis dichotoma</i>	Common Fringe-rush	-	-						+
<i>Fuirena ciliaris</i>	-	-	-						+
<i>Gahnia aspera</i>	Saw Sedge	-	-				+	+	
<i>Gahnia clarkei</i>	Tall Saw-sedge	-	-				+		
<i>Glochidion ferdinandi</i>	Cheese Tree	-	-	+	+	+	+		
<i>Glycine micropylla</i>	Twining Glycine	-	-	+				+	
<i>Gonocarpus chinensis</i>	-	-	-				+		
<i>Gonocarpus micranthus</i>	-	-	-	+		+			
<i>Goodenia heterophylla</i>	-	-	-					+	
<i>Goodenia paniculata</i>	-	-	-						+
<i>Goodenia rotundifolia</i>	-	-	-	+					
<i>Hakea dactyloides</i>	Broad-leaved Hakea	-	-	+					
<i>Hakea sericea</i>	Silky Hakea	-	-				+		
<i>Hardenbergia violacea</i>	False Sarsparilla	-	-	+					

Scientific Name	Common Name	TSCA	EPBC	Blackbutt Forest E Block	Swamp Sclerophyll Forest SW Block	Swamp Sclerophyll Forest Central W Block	Swamp Sclerophyll Forest NW Block	Blackbutt Forest NW Block + Central W Block	Freshwater Wetland NW Block
<i>Hibbertia aspera</i>	Rough Guinea Flower	-	-				+		
<i>Hibbertia diffusa</i>	-	-	-	+		+	+	+	
<i>Hydrocotyle peduncularis</i>	-	-	-						+
<i>Hygrophila angustifolia</i>	-	-	-				+		
<i>Hypolepis muelleri</i>	Harsh Ground Fern	-	-				+		
<i>Imperata cylindrica</i>	Blady Grass	-	-	+		+	+	+	
<i>Ipomoea cairica</i> *	Blue Morning Glory	-	-	+					
<i>Isolepis</i> sp.	Rush sp.	-	-						+
<i>Juncus prismatocarpus</i>	-	-	-						+
<i>Kennedia rubicunda</i>	Dusky Coral Pea	-	-					+	
<i>Lantana camara</i> *	Lantana	-	-				+	+	
<i>Lepidium</i> sp.	Peppercress sp	-	-						+
<i>Lepidosperma laterale</i>	Variable Sword-sedge	-	-	+					
<i>Leptospermum juniperinum</i>	Prickly Tea-tree	-	-	+				+	
<i>Leucopogon juniperinus</i>	Prickly Beard-heath	-	-	+		+		+	
<i>Lomandra longifolia</i>	Spiky-headed Mat-rush	-	-	+		+	+	+	

Scientific Name	Common Name	TSCA	EPBC	Blackbutt Forest E Block	Swamp Sclerophyll Forest SW Block	Swamp Sclerophyll Forest Central W Block	Swamp Sclerophyll Forest NW Block	Blackbutt Forest NW Block + Central W Block	Freshwater Wetland NW Block
<i>Lomandra micrantha</i>	-	-	-	+				+	
<i>Lophostemon suaveolens</i>	Swamp Box	-	-	+	+	+	+		+
<i>Melaleuca linariifolia</i>	Snow in Summer	-	-	+					
<i>Melaleuca quinquinervia</i>	Broad-leaved Paperbark	-	-		+	+	+		+
<i>Myrsine howittiana</i>	Brush Muttonwood	-	-				+		
<i>Oplismenus aemulus</i>	Basket Grass	-	-	+					
<i>Ozothamnus diosmifolius</i>	Ball Everlasting	-	-	+				+	
<i>Parsonsia straminea</i>	Common Silkpod	-	-			+	+	+	
<i>Paspalum dilatatum</i> *	Paspalum	-	-				+	+	+
<i>Patersonia sericea</i>	Wild Iris	-	-					+	
<i>Persoonia lanceolata</i>	Lance-leaved Geebung	-	-			+			
<i>Persoonia lanceolata</i>	Lance Leaf Geebung	-	-	+				+	
<i>Philydrum lanuginosum</i>	Woolly Frogmouth	-	-				+		+
<i>Pimelea linifolia</i>	Slender Rice Flower	-	-			+	+		
<i>Polymeria calycina</i>	Bindweed	-	-	+		+	+	+	
<i>Pratia purpurascens</i>	Whiteroot	-	-	+				+	

Scientific Name	Common Name	TSCA	EPBC	Blackbutt Forest E Block	Swamp Sclerophyll Forest SW Block	Swamp Sclerophyll Forest Central W Block	Swamp Sclerophyll Forest NW Block	Blackbutt Forest NW Block + Central W Block	Freshwater Wetland NW Block
<i>Pseuderanthemum variabile</i>	Pastel Flower	-	-	+					
<i>Pteridium esculentum</i>	Bracken	-	-	+				+	
<i>Pultenaea retusa</i>	-	-	-	+	+	+	+		
<i>Scaevola ramosissima</i>	Purple Fan Flower	-	-			+	+		
<i>Schoenus sp.</i>	Rush sp	-	-						+
<i>Schoenus brevifolius</i>		-	-						+
<i>Setaria pumila</i>	Pale Pigeon Grass	-	-						+
<i>Smilax glycyphylla</i>	Sarsaparilla	-	-			+			
<i>Sporobolus africanus</i>	Parramatta Grass	-	-					+	
<i>Stephania japonica</i>	Snake Vine	-	-					+	
<i>Syncarpia glomulifera</i>	Turpentine	-	-					+	
<i>Themeda australis</i>	Kangaroo Grass	-	-	+		+		+	
<i>Thysanotus juncifolius</i>	Fringed Lily	-	-			+			
<i>Verbena bonariensis</i> *	Purpletop	-	-	+					
<i>Villarsia exaltata</i>	Yellow Marsh Flower	-	-				+		+
<i>Viola hederacea</i>	Native Violet	-	-			+			

Appendix C

Fauna species list

Group	Family	Scientific Name	Common Name	TSCA	EPBC
Amphibians	HYLIDAE	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	-	-
Amphibians	MYOBATRACHIDAE	<i>Crinia tinnula</i>	Wallum Froglet	V	-
Amphibians	MYOBATRACHIDAE	<i>Limnodynastes peronii</i>	Striped Marsh Frog	-	-
Amphibians	MYOBATRACHIDAE	<i>Pseudophryne coriacea</i>	Red-backed Toadlet	-	-
Birds	ACCIPITRIDAE	<i>Haliastur sphenurus</i>	Whistling Kite	-	-
Birds	ARDEIDAE	<i>Ardea alba</i>	Great Egret	-	-
Birds	ARDEIDAE	<i>Egretta novaehollandiae</i>	White-faced Heron	-	-
Birds	ARTAMIDAE	<i>Cracticus torquatus</i>	Grey Butcherbird	-	-
Birds	ARTAMIDAE	<i>Strepera graculina</i>	Pied Currawong	-	-
Birds	CACATUIDAE	<i>Calyptorhynchus fumereus</i>	Yellow-tailed Black Cockatoo	-	-
Birds	CACATUIDAE	<i>Calyptorhynchus lathami</i>	Glossy Black Cockatoo	V	-
Birds	CAMPEPHAGIDAE	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	-	-
Birds	CLIMACTERIDAE	<i>Cormobates leucophaeus</i>	White-throated Treecreeper	-	-
Birds	CORVIDAE	<i>Corvus coronoides</i>	Australian Raven	-	-
Birds	CUCULIDAE	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	-	-
Birds	DICRURIDAE	<i>Rhipidura fuliginosa</i>	Grey Fantail	-	-
Birds	LARIDAE	<i>Larus novaehollandiae</i>	Silver Gull	-	-
Birds	MELIPAGIDAE	<i>Anthochaera chrysoptera</i>	Little Wattlebird	-	-
Birds	MELIPAGIDAE	<i>Manorina melanocephala</i>	Noisy Miner	-	-
Birds	MELIPAGIDAE	<i>Meliphaga lewinii</i>	Lewin's Honeyeater	-	-
Birds	MELIPAGIDAE	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	-	-
Birds	MELIPAGIDAE	<i>Philemon corniculatus</i>	Noisy Friarbird	-	-
Birds	ORIOLOIDAE	<i>Sphecotheres viridis</i>	Figbird	-	-

Group	Family	Scientific Name	Common Name	TSCA	EPBC
Birds	PACHYCEPHALIDAE	<i>Colluricincla megarhyncha</i>	Little Shrike-thrush	-	-
Birds	PELICANIDAE	<i>Pelecanus conspicillatus</i>	Australian Pelican	-	-
Birds	PETROIICIDAE	<i>Microeca fascinans</i>	Jacky Winter	-	-
Birds	PLOCEIDAE	<i>Neochima temporalis</i>	Red-browed Finch	-	-
Birds	PODARGIDAE	<i>Podargus strigoides</i>	Tawny Frogmouth	-	-
Birds	PSITTACIDAE	<i>Alisterus scapularis</i>	Australian King Parrot	-	-
Birds	PSITTACIDAE	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	-
Birds	PSOPHODIDAE	<i>Psophodes olivaceus</i>	Eastern Whipbird	-	-
Birds	PTILONORHYNCHIDAE	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird	-	-
Birds	SYLVIIDAE	<i>Acrocephalus stentoreus</i>	Clamorous Reed-Warbler	-	-
Mammals	CANIDAE	<i>Canis lupus familiaris</i> *	Dog	-	-
Mammals	DASYURIDAE	<i>Antechinus stuartii</i>	Brown Antechinus	-	-
Mammals	EQUIDAE	<i>Equus caballus</i> *	Horse	-	-
Mammals	LEPORIDAE	<i>Oryctolagus cuniculus</i> *	Rabbit	-	-
Mammals	MACROPODIDAE	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	-	-
Mammals	MOLOSSIDAE	<i>Mormopterus norfolkensis</i>	East Coast Freetail Bat	V	-
Mammals	MOLOSSIDAE	<i>Mormopterus</i> sp 2	Freetail Bat	-	-
Mammals	MURIDAE	<i>Hydromys chrysogaster</i>	Water Rat	-	-
Mammals	MURIDAE	<i>Rattus fuscipes</i>	Bush Rat	-	-
Mammals	MURIDAE	<i>Rattus lutreolus</i>	Swamp Rat	-	-
Mammals	MURIDAE	<i>Rattus rattus</i> *	Black Rat	-	-
Mammals	PETAURIDAE	<i>Petaurus australis</i>	Yellow-bellied Glider	V	-

Group	Family	Scientific Name	Common Name	TSCA	EPBC
Mammals	PETAURIDAE	<i>Petaurus breviceps</i>	Sugar Glider	-	-
Mammals	PHALANGERIDAE	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	-	-
Mammals	PTEROPODIDAE	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V
Mammals	RHINOLOPHIDAE	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe-bat	-	-
Mammals	VESPERTILIONIDAE	<i>Chalinolobus gouldi</i>	Gould's Wattled Bat	-	-
Mammals	VESPERTILIONIDAE	<i>Nyctophilus</i> sp.	Long-eared Bat	-	-
Mammals	VESPERTILIONIDAE	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-
Mammals	VESPERTILIONIDAE	<i>Vespadelus pumilus</i>	Eastern Forest Bat	-	-
Mammals	VESPERTILIONIDAE	<i>Miniopterus australis</i>	Little Bent-wing Bat	V	-
Mammals	VESPERTILIONIDAE	<i>Miniopterus schreibersii</i>	Large Bent-wing Bat	V	-
Reptiles	SCINCIDAE	<i>Lampropholis amricula</i>	Friendly Sunskink	-	-
Reptiles	SCINCIDAE	<i>Lampropholis delicata</i>	Garden Sun Skink	-	-