# Failford Road to Tritton Road

## Review of environmental factors - Appendix A

## Flora and fauna assessment

May 2008

# Review of Flora and Fauna
# Pacific Highway Upgrade Failford Road to Tritton Road

17 July 2006

Prepared for:
Roads and Traffic Authority
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**Pacific Highway Upgrade Failford Road to Tritton Road**
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# EXECUTIVE SUMMARY

This report investigates the impact to terrestrial flora and fauna that may result from the proposed upgrade of the Pacific Highway between Failford Road and Tritton Road. The proposed highway upgrade involves the construction of a new southbound carriageway parallel to the existing southbound carriageway, with the existing southbound carriageway used for northbound traffic. The existing northbound carriageway will be retained as a local service road.

The project also incorporates modifications to several intersections to improve road safety. These works include a grade-separated interchange for the intersections of Failford Road and St Peters Close with the Pacific Highway; an overpass from Bullocky Way, across the highway to a service road linking Failford Road to Possum Brush Road; and a new access point to Tritton Road from Possum Brush Road due to the closure of the direct highway access point.

The proposed development will require removal of a strip of vegetation approximately 15 ha in area. This will include approximately 7.1 ha of vegetation to the south of the existing southbound carriage to construct the new southbound carriageway between Bullocky Way and Failford Road, and approximately 2.4 ha required to construct the proposed Failford Interchange. Approximately 5.1 ha of additional clearing will be required to connect Bullocky Way with the existing northbound carriageway.

The flora and fauna within the study area, approximately 3.75 km long, was investigated. A desktop review of existing information and a limited field investigation took place in early spring to confirm the findings of the previous studies and identify significant habitats within the study area.

One hundred and twenty-one species of vascular plant, identified at least to genus, were found to exist within the study area, of which 99 are native. No threatened plant species were observed. Thirty-eight species of vertebrate were identified either directly or through evidence such as characteristic skeletal material, scats or scratch marks. Most of the bird species identified are typical of those found in fragmented rural landscapes, with few species observed that are usually associated with larger woodland or forested areas.

While mammal species were not targeted, evidence of foraging by animals such as Echidnas, gliders and many digging marks typical of a bandicoot species were observed. There was little evidence of breeding activity within the study area; however, a likely Kookaburra nest site within a termite nest and an egg potentially laid by a Powerful Owl were observed. The remains of this large egg were found at the base of a tree with a large hollow, located between the north and southbound lanes of the Pacific Highway.

Aquatic habitat within the study area between Possum Brush Road and Failford Road is limited to seepages and pools created from drainage works for the existing road infrastructure. Farm dams are located north of Possum Brush Road and south of Failford Road. Two moist habitats are located south west of the Failford Road intersection with the Pacific Highway with another approximately 300 m north of Failford Road. The most significant habitat, in terms of shelter, is hollows within trees. There are several larger trees that contain hollows and dead trees that are hollow; however the majority of trees are relatively young and have not developed hollows.

The shrub understorey and fallen timber has been cleared in most areas for agricultural and fire hazard reduction purposes. This has severely limited the availability of shelter for larger terrestrial reptile and small mammal species. No exfoliated rock habitat or other rocky areas, with the exception of rock exposed during road construction, is present within the study area.

Potential impacts from the proposed road upgrade include the clearing of approximately 15 ha of vegetation, including a 9.5 ha strip of woodland and forest to the south of the existing southbound carriageway and approximately 5.1 ha in the location of the proposed Failford and Bullocky Way Interchanges.

Clearing of woodland will result in the loss of roosting and foraging opportunities for birds and arboreal mammals. Indirect impacts that may result from the proposed development include noise during road construction and increased difficulty for fauna in traversing the highway after widening. There may be some increase in the potential for collision between wildlife and vehicles as a result of increased vehicle speeds.

There is an increased potential for the spread of weed species through the movement of soil containing seed, stem and root material if areas where weeds are present are not treated prior to earth moving activities. There is also the potential for the spread of plant pathogens, for example *Phytophora* sp. fungi, into the area on equipment used during the construction of the proposed road works. Presently there is no evidence of dieback within the study area resulting from *Phytophora* sp. infection.

There is no direct evidence of species protected by the *Threatened Species Conservation Act 1995* or *Environment Protection and Biodiversity Conservation Act 1999* within the footprint of the proposed development. It is unlikely that there will be significant impact on threatened species. Mitigation measures that reduce the potential effect of the proposed highway upgrade on disruption to arboreal mammal movement and the life-cycle of the Powerful Owl have been suggested. Mitigation measures include the timing of construction activities to avoid sensitive periods of the life-cycle of the Powerful Owl and provision of aerial walkways to maintain wildlife movement across the highway.

In addition, weed management measures will assist in mitigating the potential effect of the proposed highway upgrade on native biodiversity.

# 1 INTRODUCTION

This report has been prepared by HLA-Envirosciences Pty Limited (HLA), on behalf of the NSW Roads and Traffic Authority (RTA), to investigate the potential affect the proposed upgrade of approximately 3.75 km of the Pacific Highway between Failford Road (5 km north of Nabiac) to the intersection of Tritton Road and the Pacific Highway, would have on terrestrial flora and fauna. This section of the highway was improved to dual carriageway in the early 1990s by constructing a southbound carriage and utilising the former highway for northbound traffic. The northbound carriageway retained the original alignment and profile of the former highway and has a higher potential for accidents and is restricted at present to a lower speed limit.

Failford Road is also an important road linking the Pacific Highway to the coastal towns of Tuncurry, Forster and Hallidays Point (RTA 2005). The present intersection is potentially hazardous and it is proposed to construct an interchange to reduce the potential for accidents at this location.

## 1.1 Proposed Development

The proposed development consists of the construction of a new carriageway adjacent to the existing southbound Pacific Highway carriageway on the eastern side. The existing southbound carriageway would then become the northbound carriageway and much of the existing northbound carriageway would be retained as a two-way local service road linking Possum Brush Road, Bullocky Way, St Peters Close and local properties to the Failford Road interchange. The proposed development would raise the standard of this section to be consistent with adjoining sections of the highway.

The upgrade of the Pacific Highway for this section would be undertaken in two stages as detailed below. The proposed development would be designed for 110 km/h travel speed and would provide a high standard four-lane dual carriageway. The carriageways would be separated by a 12 m median (minimum) that would allow the future addition of an extra two lanes if required.

The proposed development will require removal of approximately 15 ha of vegetation. This includes a 9.5 ha strip of vegetation to the south of the existing southbound carriageway, to construct the new southbound carriageway between Bullocky Way and Failford Road. This does not include trees established for roadside landscaping north of Bullocky Way. The construction of the proposed Failford and Bullocky Way Interchanges with the existing northbound carriageway will require the removal of the vegetation in the remaining 5.1 ha.

### 1.1.1 Stage 1

The new southbound carriageway, the two-way service road, and a grade-separated interchange at Failford Road would be constructed.

***Interchanges***

In Stage 1 a grade separated interchange is proposed at the intersection of the Pacific Highway and Failford Road. The interchange would provide a two-lane bridge over the highway which, together with the service road would allow for all turning movements from Failford Road, Bullocky Way, Tritton Road, Possum Brush Road and St Peters Close to and from the highway.

To avoid impacts to Failford Cemetery, the north-bound Pacific Highway onload ramp would be located near Possum Brush Road.

***Access***
The existing northbound carriageway would become a two-way service road, providing access to adjoining properties and Possum Brush Road. The existing Possum Brush Road highway intersection and cross median access would close. Access to the highway would be provided at the Failford Road grade separated interchange and the northbound onload ramp near Possum Brush Road. This would allow local traffic to cross over the highway. Left-in left-out access would be provided at Bullocky Way.

### 1.1.2 Stage 2

The Bullocky Way overbridge would be built to link Failford and Bullocky Way to the service road, providing a connection across the highway between Possum Brush and Failford.

## 1.2 Scope of Works

The scope of works of this report is to:

- Review information currently available, including searches of the Department of Environment and Conservation (DEC) Atlas of NSW Wildlife, DEC PlantNET database and an on-line search of the Commonwealth Department of Environment and Heritage (DEH) for matters of national environmental significance, to identify significant plants and communities that occur within the study area;
- Prepare a list of species found in the area, and those potentially occurring in the area;
- Undertake a field survey in spring to identify plants, animals, and ecological communities present within the study area;
- Prepare an impact assessment, in accordance with Section 5A of the *Environmental Planning and Assessment Act 1979* (EP & A Act), for threatened species, populations and ecological communities listed under the *Threatened Species Conservation Act 1995* (TSC Act) potentially affected by the proposal;
- Prepare an impact assessment for threatened species and ecological communities, listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), potentially affected by the proposal;
- In the event that threatened species are affected, determine whether a Species Impact Statement is required under the TSC Act or whether referral to the Commonwealth Environment Minister is required in accordance with the EPBC Act;
- Prepare of a list of suggested measures to mitigate potential effects on flora and fauna; and
- Recommend if further work is required to fully assess the significance of the potential impacts.

## 1.3 The Study Area

The area investigated in this study is defined as the length of the Pacific Highway along which the proposed works will take place with a buffer zone approximately 50 m wide along either side of the area of the works. The approximate outline of the study area is shown in **Figure 1**.

# 2 INFORMATION REVIEW

A desktop review of information was conducted to identify significant matters that may occur within the local area. The information reviewed comprised:

- On-line Databases maintained by the Department of Environment and Heritage (DEH);
- Department of Environment and Conservation (DEC) Atlas of NSW Wildlife;
- DEC PlantNET;
- Ecological studies relevant to the local area; and
- Vegetation mapping.

## 2.1 Flora

### 2.1.1 Previous Studies

**Broad-scale Remnant Vegetation Mapping**
Broad-scale mapping completed by the Greater Taree City Council (GTCC) and Vegetation mapping held by the Great Lakes Council (GLC) in the vicinity of the study area was reviewed to ensure consistency in describing the communities. The remnant vegetation mapping was supplied in geographic information system format. The community descriptions for the Great Lakes Council have more detail (GLC 2005), while community descriptions for communities mapped by the GTCC include only dominant canopy species and are based on information given in a supporting spreadsheet. The present road reserve forms part of the boundary between the two Local Government Areas (LGA). The remnant vegetation mapping for both LGAs is based on aerial photography and is relatively coarse. Validation of the vegetation mapping was undertaken by comparison with recent aerial photography provided by the RTA. Areas that are cleared are often mapped as remnants, while some smaller remnants and regrowth are not mapped. The remnant vegetation mapping for both LGAs is shown in **Figure 2**.

Remnant vegetation to the east of the road reserve is within the GLC LGA. The majority of the remnant woodland/forest vegetation, including the island remnant, is classified as Grey Gum/Grey Ironbark/White Mahogany. Another significant community in terms of area is the White Mahogany/Red Mahogany/Grey Ironbark/Grey Gum community. Communities that have a smaller area within the development footprint are the Mahogany/Ironbark/Grey Gum/Blackbutt community and Tallowwood/Sydney Blue Gum Community.

Mapping to the west of the Pacific Highway held by the GTCC uses a different vegetation community classification. The most commonly occurring mapped remnant vegetation community within the study area is the Dry Tallowwood Mixed Stand community. A community dominated by Blackbutt occurs in the vicinity of the Failford Cemetery. To the north there are small roadside remnants of Blue Gum with Rainforest Understorey. A small remnant of the Small Fruited Grey Gum community lies between the northbound and southbound carriageways.

The spatial proximity of communities near the LGA boundary was used to determine the equivalent community classification for the two LGAs. For example, the island of vegetation to be affected by the proposed intersection between the existing northbound and southbound carriageways is classified as Grey Gum/Grey Ironbark/White Mahogany by the GLC, while the part occurring within the GTCC is classified as the Small Fruited Grey Gum. The Dry Tallowwood Mixed Stand mapped by the GTCC appears to be a general community type where no particular species co-dominates. The distributional pattern is similar to the White

Mahogany/Red Mahogany/Grey Ironbark/Grey Gum community mapped by the GLC. The Mahogany/Ironbark/Grey Gum/Blackbutt community mapped by the GLC is similar to the Blackbutt community mapped by GTCC. While the Sydney Blue Gum with Rainforest Understorey community mapped by GTCC is spatially disjunct to the Tallowwood/Sydney Blue Gum Community, they are considered equivalent based on dominant species.

The majority of the proposed development will affect vegetation within the GLC. The area and significance of each vegetation community, within the GLC (GLC 2003), is given in **Table 1**.

**Table 1: Significance of Vegetation Communities Mapped near Study Area within Great Lakes Council LGA**

| Community | Area within LGA | Significance |
|---|---|---|
| Grey Gum/Grey Ironbark/White Mahogany | 9298 | Moderate |
| White Mahogany/Red Mahogany/Grey Ironbark/Grey Gum | 12,803 | High |
| Mahogany/Ironbark/Grey Gum/Blackbutt | 153 | High |
| Tallowwood/Sydney Blue Gum | 8,573 | High |

**RTA (2005)**
The preliminary review of the proposed development (RTA 2005) does not differentiate between vegetation communities; however, it lists many species of tree that dominate the communities. It is noted that the vegetation is dominated by eucalypt remnants and regrowth, which has been disturbed by rural activities and road construction.

**Ecotone (2001)**
The ecological assessment (Ecotone 2001) for the Pacific Highway upgrade immediately to the south of the present study area, between Bundacree Creek and Possum Brush, was reviewed to identify the presence of significant species or communities that may occur within the present study area. The findings of the flora survey, which included part of the present study area, were not detailed and did not include mapping of vegetation communities.

One hundred and forty-three flora species, from three communities, were identified in the Ecotone (2001) study. The vegetation communities were described as Riparian/Moist Open Forest Zone, Woodland and Modified Land - Pasture/Grassland. The condition of the Riparian/Moist Open Forest and Woodland communities was described as moderate to fair.

The Riparian/Moist Open Forest Zone community is described as being dominated by Sydney Blue Gum (*Eucalyptus saligna*), Small-fruited Grey Gum (*E. propinqua*), Tallowwood (*E. microcorys*), Brushbox (*Lophostemon confertus*) and Red Bloodwood (*Corymbia gummifera*). The lower understorey is dominated by small trees that occur in moister environments, for example Blue Lilly Pilly (*Syzygium oleosum*) and Grey Myrtle (*Backhousia mrytifolia*). The shrub layer was generally sparse, with many woody weed species present. The groundcover was densest where introduced species dominated. One threatened species, *Asperula asthenes*, was recorded within this habitat.

The Woodland is described as having a sparse overstorey, no shrub understorey and a grassy groundcover. The dominant tree species was Grey Ironbark (*E. siderophloia*), with Forest Red Gum (*E. tereticornis*) and Small-fruit Grey Gum also occurring. The groundcover is described as being dominated by native species, including Kangaroo Grass (*Themeda australis*), Wallaby Grass (*Austrodanthonia fulva*) and Blady Grass (*Imperata cylindrica var. major*).

The third community described was Modified Land - Pasture/Grassland, generally comprising scattered trees and exotic grasses.

### 2.1.2 On-line databases

The records of terrestrial flora species held within the DEC Atlas of NSW Wildlife (ANSWW) were extracted on 12 September 2005. Records were extracted from within a search area generated by establishing a 10 km buffer zone around the study area. The DEC PlantNET on-line database was also reviewed to identify additional records of significant species in the local area. Records for species that are protected by the provisions of the TSC Act and/or are considered a Rare Or Threatened Australian Plant Species (ROTAP) were extracted from the database using a search area bounded by 31° 59' S, 32° 11' S, 152° 19' W and 152° 34' W, covering an area of approximately 10 km from the extremities of the study area.

The NSW Scientific Committee's Final Determinations were reviewed to identify Endangered Ecological Communities (EEC) and endangered populations (EP) protected by the TSC Act that occur in the North Coast. The list of critical habitats that may occur in the local area were identified by reviewing online databases maintained by the DEC.

Eight threatened vascular plant species, listed in **Table 2**, are recorded in the local area. The ROTAP codes listed in **Table 2** are explained in **Table 3**, based on the descriptions within Briggs and Leigh (1996).

**Table 2: Threatened Flora within 10 km of the Study Area**

| Species | Status TSC Act | EPBC Act Status | ROTAP Code | Database |
|---|---|---|---|---|
| Asclepiadaceae<br>Cynanchum elegans | Endangered | Endangered | 3ECi | ANSWW<br>PlantNET |
| *Casuarinaceae*<br>*Allocasuarina defungens* | Endangered | Endangered | 2E | ANSWW<br>PlantNET |
| *Casuarinaceae*<br>*Allocasuarina simulans* | Vulnerable | Vulnerable | 2VCa | ANSWW<br>PlantNET |
| *Fabaceae (Caesalpinioideae)*<br>*Senna acclinis* | Endangered | - | 3RC | ANSWW<br>PlantNET |
| *Juncaginaceae*<br>*Maundia triglochinoide* | Vulnerable | - | - | ANSWW |
| *Myrtaceae*<br>*Callistemon acuminatus* | - | - | 3RC- | PlantNET |
| *Myrtaceae*<br>*Eucalyptus rudderi* | - | - | 3RC- | PlantNET |
| *Myrtaceae*<br>*Syzygium paniculatum* | Vulnerable | Vulnerable | 3VCi | ANSWW |
| *Rubiaceae*<br>*Asperula asthenes* | Vulnerable | Vulnerable | 3VC | ANSWW<br>PlantNET |
| *Scrophulariaceae*<br>*Lindernia alsinoides* | Endangered | - | - | ANSWW |

**Table 3: Explanation of ROTAP Codes for Species listed in Table 2**

| ROTAP Code | Explanation of Code |
|---|---|
| 2 | Geographic range in Australia less than 100 km |
| 3 | Geographic range in Australia greater than 100 km |
| E | Species at risk of disappearing in the wild 10 –20 years if land use at current locations change |
| V | Species at risk of disappearing in the wild 20 –50 years if land use at current locations change |
| R | Rare in Australia however there is no identifiable threat |
| C | Species is reserved in proclaimed conservation reserve. Adequacy of conservation is given by proceeding E, V or R |
| - | Reserved population size unknown |
| a | At least 1000 plants present in conservation reserves |
| i | Less than 1000 plants present in conservation reserves |

The review of the on-line final determinations by NSW Scientific Committee identified 11 endangered ecological communities (EEC) that occur within the North Coast Bioregion. These are:

- Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion;
- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps Bioregions;
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South east Corner Bioregions;
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions;
- Lowland Rainforest on Floodplain in the NSW North Coast Bioregion;
- White Box Yellow Box Blakely's Red Gum Woodland;
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney basin and South East Corner bioregions; and
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Based on the NSW Scientific Committee's Final Determinations, one endangered population potentially occurs within the local area. This is the *Eucalyptus seeana* population in the Greater Taree LGA.

A review of the on-line critical habitat register and recovery plans did not identify the presence of critical habitat for any flora species or community in the local area.

## 2.2 Fauna

### 2.2.1 Previous Studies

**Ecotone (2001)**
The ecological assessment (Ecotone 2001) for the Pacific Highway upgrade immediately to the south of the present study area, between Bundacree Creek and Possum Brush, was reviewed to identify the type of fauna species, particularly significant species, that occur in the local area. The study recorded three species of mammal, five species of frog, four species of reptile and 36 bird species. One, possibly two, threatened species were identified, however the majority of species detected are considered common and widespread.

The two threatened species recorded were insectivorous bats, these being the Eastern Mastiff Bat (*Mormopterus norfolkensis*) and the Little Bentwing Bat (*Miniopterus australis*). The Eastern Mastiff Bat (*Mormopterus norfolkensis*) was recorded within the forest adjacent to the roadside, while there was a tentative recording of the Little Bentwing Bat (*Miniopterus australis*). While it is likely both species were foraging, only roosting habitat for the Eastern Mastiff Bat is present. This species roosts in tree hollows, while the Little Bentwing Bat roosts in subterranean habitats. No threatened species utilising aquatic or riparian habitats were recorded.

**RTA (2005)**
The review undertaken by the RTA identified that the study area is within a wildlife corridor which links the Talawahl Nature Reserve to Darawank Nature Reserve (RTA 2005). The locations of three sections that facilitate the crossing of the existing highway by arboreal and avifauna, based on the descriptions given in the RTA (2005) review, are shown in **Figure 4**. Also noted in the RTA (2005) review was the presence of foraging resources for Koalas and Glossy Black-Cockatoos, as well as potential nest and den sites for owls and arboreal mammals.

### 2.2.2 On-line databases

The records of terrestrial species held within the Atlas of NSW Wildlife were extracted on 12 September 2005. Records were extracted from within a search area generated by establishing a 10 km buffer zone around the study area. The endangered populations and critical habitats listed within the TSC Act that occur on the North Coast were identified.

Within the search area, there are records for 278 species of vertebrate, with a further nine additional taxa that could be identified to genus level only. These are listed in **Appendix 1**. Twenty-four of the species, listed in **Table 4**, are threatened in NSW.

**Table 4: TSC Act Threatened Fauna Recorded within 10 km of the Study Area**

| Species | Status TSC Act |
|---|---|
| Wallum Froglet (*Crinia tinnula*) | Vulnerable |
| Australasian Bittern (*Botaurus poiciloptilus*) | Vulnerable |
| Glossy Black-Cockatoo (*Calyptorhynchus lathami*) | Vulnerable |
| Black-necked Stork (*Ephippiorhynchus asiaticus*) | Endangered |
| Sooty Oystercatcher (*Haematopus fuliginosus*) | Vulnerable |
| Pied Oystercatcher (*Haematopus longirostris*) | Vulnerable |
| Black Bittern (*Ixobrychus flavicollis*) | Vulnerable |

| Species | Status TSC Act |
|---|---|
| Square-tailed Kite (*Lophoictinia isura*) | Vulnerable |
| Barking Owl (*Ninox connivens*) | Vulnerable |
| Powerful Owl (*Ninox strenua*) | Vulnerable |
| Osprey (*Pandion haliaetus*) | Vulnerable |
| Little Tern (*Sterna albifrons*) | Endangered |
| Grass Owl (*Tyto capensis*) | Vulnerable |
| Masked Owl (*Tyto novaehollandiae*) | Vulnerable |
| Sooty Owl (*Tyto tenebricosa*) | Vulnerable |
| Spotted-tailed Quoll (*Dasyurus maculatus*) | Vulnerable |
| Little Bentwing-bat (*Miniopterus australis*) | Vulnerable |
| Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) | Vulnerable |
| Eastern Freetail-bat (*Mormopterus norfolkensis*) | Vulnerable |
| Large-footed Myotis (*Myotis adversus*) | Vulnerable |
| Yellow-bellied Glider (*Petaurus australis*) | Vulnerable |
| Squirrel Glider (*Petaurus norfolcensis*) | Vulnerable |
| Brush-tailed Phascogale (*Phascogale tapoatafa*) | Vulnerable |
| Koala (*Phascolarctos cinereus*) | Vulnerable |
| Grey-headed Flying-fox (*Pteropus poliocephalus*) | Vulnerable |
| Common Blossom-bat (*Syconycteris australis*) | Vulnerable |

The review of the on-line Final Determinations by the NSW Scientific Committee found that there is one endangered population that potentially occurs within the local area. This is the Emu, *Dromaius novaehollandiae*, population in the NSW North Coast Bioregion.

A review of the on-line critical habitat register and recovery plans did not identify the presence of critical habitat for any fauna species in the local area.

## 2.3 Matters of National Environmental Significance

The on-line databases maintained by the Commonwealth Department of Environment and Heritage (DEH) were searched to identify any matters of National Environmental Significance (NES) that potentially may occur within 5 km of the centre of the study area. The search was centred on 32° 05' S and 152° 25' W. A 5 km search radius was used to exclude marine or estuarine species.

Actions that are likely to have a significant impact on a matter of NES are subject to a rigorous assessment and approval process under the environmental assessment provisions of the EPBC Act. An action includes a project, development, undertaking, activity, or series of activities. Administrative guidelines of significance have been developed to assist in determining whether such actions are likely.

The EPBC Act and the administrative guidelines identify six matters of national environmental significance. These are:

- World Heritage properties;
- Ramsar wetlands of international importance;
- Listed threatened species and communities;
- Migratory species protected under international agreements;
- Nuclear actions; and
- The Commonwealth marine environment.

The presence or otherwise of Critical Habitat within 5 km of the study area was also identified during the search, but no such habitat was identified.

A summary of relevant matters of NES identified by the search is given in **Table 5**. The likely impact on matters that have been identified as having potential to occur within the search area is discussed in **Section 5.5**.

**Table 5: Potential for Matters of NES to Occur within 5 km of Study Area**

| Matter | Potential Occurrences in Search Area |
|---|---|
| World Heritage properties | None |
| Wetlands of international importance | 1 |
| Threatened species and communities | 15 |
| Migratory species | 9 |
| Nuclear actions | None |
| Commonwealth marine environment | None |

Ten threatened species of vertebrate and five species of flora, protected by the provisions of the EPBC Act, potentially occur within 5 km of the study area. The species and their potential habitat use within the study area are listed in **Table 6**.

**Table 6: Potential for Nationally Threatened Species to occur within 5 km of the Study Area**

| Species | EPBC Act Status | Presence/Habitat Use Within Study Area |
|---|---|---|
| Swift Parrot<br>*Lathamus discolor* | Endangered | Roosting, movement between habitats |
| Australian Painted Snipe<br>*Rostratula australis* | Vulnerable | None |
| Regent Honeyeater<br>*Xanthomyza phrygia* | Endangered | Foraging, roosting, movement between habitats |
| Green and Golden Bell Frog<br>*Litoria aurea* | Vulnerable | Breeding, foraging |
| Stuttering Frog<br>*Mixophyes balbus* | Vulnerable | None |

| | | |
|---|---|---|
| Giant Barred Frog<br>*Mixophyes iteratus* | Endangered | None |
| Large Pied Bat<br>*Chalinolobus dwyeri* | Vulnerable | Foraging, roosting, breeding |
| Spotted-tail Quoll<br>*Dasyurus maculatus maculatus* | Endangered | Foraging |
| Long-nosed Potoroo<br>*Potorous tridactylus tridactylus* | Vulnerable | Foraging |
| Grey-headed Flying-fox<br>*Pteropus poliocephalus* | Vulnerable | Foraging |
| *Allocasuarina defungens* | Endangered | None |
| *Allocasuarina simulans* | Vulnerable | None |
| *Asperula asthenes* | Vulnerable | Potential habitat |
| Leafless Tongue-orchid<br>*Cryptostylis hunteriana* | Vulnerable | Potential habitat |
| White-flowered Wax Plant<br>*Cynanchum elegans* | Endangered | Potential habitat |

Nine migratory species of bird potentially occur within 5 km of the study area. The species and potential habitat utilisation are listed in **Table 7**.

**Table 7: Potential for Protected Migratory Species to occur within 5 km of the Study Area**

| Species | Type of Presence |
|---|---|
| White-bellied Sea-Eagle<br>*Haliaeetus leucogaster* | Species or species habitat likely to occur within area |
| White-throated Needletail<br>*Hirundapus caudacutus* | Species or species habitat may occur within area |
| Black-faced Monarch<br>*Monarcha melanopsis* | Breeding may occur within area |
| Spectacled Monarch<br>*Monarcha trivirgatus* | Breeding likely to occur within area |
| Satin Flycatcher<br>*Myiagra cyanoleuca* | Breeding likely to occur within area |
| Rufous Fantail<br>*Rhipidura rufifrons* | Breeding may occur within area |
| Regent Honeyeater<br>*Xanthomyza phrygia* | Species or species habitat may occur within area |
| Latham's Snipe<br>*Gallinago hardwickii* | Species or species habitat may occur within area |
| Painted Snipe<br>*Rostratula benghalensis* s. lat. | Species or species habitat may occur within area |

# 3 SITE INVESTIGATION METHODS

## 3.1 Flora Survey

The flora of the study area was investigated by undertaking a limited field survey involving quadrats and transects to verify existing vegetation community mapping, with the aid of recent aerial photography. These transects involved random meanders in the linear communities along the length of the proposed roadworks, allowing for approximately a 50 m buffer zone. Community descriptions were aligned, where possible, with those defined in remnant vegetation mapping completed for the Greater Taree LGA and Great Lakes LGA. Field investigations took place between 5 and 7 October 2005 with a total of approximately 30 hours of survey effort, including five hours of work at night. The species observed are limited to species that were readily identifiable during the timing of the survey.

The flora investigations were undertaken by:

- Limited field survey involving 20 m x 20 m quadrats in large community units within the study area;
- Random meander transects in linear communities, such as riparian vegetation, and habitat where significant species are likely to occur; and
- Targeted survey for significant species that are easily identified given the seasonal constraints.

The study area was extensively walked over where landowner permission had been granted. The survey effort focused on potential habitat for threatened species, with less time spent in highly modified habitats, such as cuttings and bunds. Significant weed species were recorded when observed and species used in garden landscaping were not recorded, except where these had established within the road reserve.

Targeted species are those that are listed as threatened under the TSC Act, EPBC Act or are a Rare Or Threatened Australian Plant (ROTAP) species that have been recorded within in the local area.

Taxonomic nomenclature used in this report follows that of Harden (1992), Harden (1993), Harden (2000) and Harden (2002), with updates that are consistent with the PlantNET database maintained by the Royal Botanic Gardens, Sydney.

## 3.2 Fauna

The fauna investigations took place between 5 and 7 October 2005 and comprised:

- Incidental observations during targeted flora survey;
- Call playback of owl territorial calls;
- Searches of potential shelters, by turning rocks, logs and debris such as sheets of roofing iron; and
- Identification of potentially significant habitats such as trees with hollow development.

The fauna survey focused on the identification of habitat features and indirect evidence of significant species. Significant species are those that are listed as threatened in the TSC Act or EPBC Act. Incidental observation of fauna took place during the vegetation survey and during

other targeted fauna survey, between 0800 and 1930 hours. Observations of birds, amphibians, reptiles, mammals or evidence of these were recorded. The targeted fauna surveys included listening for frog species at aquatic habitats for a minimum of half an hour, beginning at dusk, and owl territorial call playback. Playback involved the broadcast of commercially available owl calls recorded to CD using a 15 W megaphone. Small species of terrestrial fauna were surveyed by searching potential refuge sites, such as under logs, rocks, exfoliated bark and rubbish. It is estimated that approximately 15 hours were spent focusing on fauna and their habitat.

The survey activities and methods used were constrained in this instance by a number of factors, these being property access, weather and occupational health and safety issues related to working near a National Highway. Landscaped gardens were not assessed as these generally provide poor habitat for significant species. Weather will influence the activity of exothermic fauna, for example frogs and reptiles, on a particular day. Cooler and extremely hot weather will reduce activity. The metabolic rate drops during cooler weather while species will seek shelter in hotter weather. Details of the weather for the local area during the field investigations and preceding four days are provided in **Table 8**.

The investigation of fauna utilising habitats within the study area was limited by the proximity of the study area to the Pacific Highway and seasonal timing of the field investigations. It was not possible to undertake standard survey methods such as spotlighting for reasons of safety, including that of road users. The linear nature of the remnant vegetation and modified understorey meant that trapping was impractical and unlikely to result in the capture of significant fauna types, while the cooler weather would have affected insectivorous bat activity negatively.

**Table 8: Weather Conditions Prior to and During Site Investigations**

| Date | Min. Temp. (°C) | Max. Temp. (°C) | Rainfall (mm) | 9 am Relative Humidity (%) | 9 am Wind Speed (km/h) | 3 pm Relative Humidity (%) | 3 pm Wind Speed (km/h) |
|---|---|---|---|---|---|---|---|
| 1/09/2005 | 12 | 20 | 0.2 | 48 | 11 | 56 | 17 |
| 2/09/2005 | 14 | 24 | 0 | 82 | 6 | 67 | 13 |
| 3/09/2005 | 7 | 18 | 0 | 52 | 9 | 52 | 13 |
| 4/09/2005 | 11 | 18 | 32 | 98 | Calm | 72 | 39 |
| 5/09/2005 | 9 | 19 | 5 | 66 | 19 | 71 | 22 |
| 6/09/2005 | 11 | 19 | 0 | 74 | 11 | 53 | 15 |
| 7/09/2005 | 7 | 20 | 0.2 | 74 | 7 | 55 | 19 |
| 8/09/2005 | 5 | 23 | 0 | 78 | 9 | 63 | 22 |
| 9/09/2005 | 7 | 26 | 0 | 78 | 4 | 59 | 24 |
| 10/09/2005 | 9 | 29 | 0.2 | 90 | 4 | 54 | 20 |
| 11/09/2005 | 14 | 25 | 2 | 97 | 15 | 27 | 20 |
| 12/09/2005 | 9 | 19 | 2 | 44 | 22 | 27 | 31 |

# 4 RESULTS AND DISCUSSION

## 4.1 Field Investigations – Flora

One hundred and twenty one species of vascular plant, identified at least to genus, were recorded within the study area. The species are listed in **Appendix 2**. Of these, 99 are native. No threatened species were observed, however four of the species recorded within the study area are listed under Schedule 13 of the *National Parks and Wildlife Act 1975* (NPW Act). This Schedule regulates the trade of listed species that are at risk of over collection for the cut-flower and nursery industries. The four species within the study area are:

- Rough Maidenhair (*Adiantum hispidulum*)
- Elkhorn (*Platycerium bifurcatum*)
- Cabbage Palm (*Livistona australis*)
- Snake Orchid (*Cymbidium suave*)

Twenty-one of the species recorded are exotic and one species identified to genus level (*Sporobolus* sp.) is also likely to be exotic. Five noxious species were recorded during the field investigations. The most common of these was *Lantana camara*, which occurred in thickets along most sections of the road reserve that had been significantly disturbed during the road construction. Crofton weed and Blackberry were present in or near drainage lines, within the island vegetation between the carriageways of the Pacific Highway and also to the east of the southbound carriageway and north of Failford Road, often forming dense infestations. The noxious and environmental weeds recorded within the study area are listed in **Table 9**. An explanation of the codes for the different noxious weed categories is given in **Table 10**. An environmental weed is a species that is not declared noxious but can still affect the environment by interfering with the growth and spread of native flora, thereby also affecting native fauna.

**Table 9: Significant Weeds Recorded within the Study Area**

| Species | Weed Type | LGA |
|---|---|---|
| Bracken (*Pteridium esculentum*) | -<br>Environmental weed | GLC<br>GTCC |
| Crofton Weed (*Ageratina adenophora*) | Noxious, W3<br>Noxious, W3 | GLC<br>GTCC |
| Camphor Laurel (*Cinnamomum camphora*) | -<br>Environmental weed | GLC<br>GTCC |
| Lantana (*Lantana camara*) | Pending noxious declaration<br>Noxious, W2 | GLC<br>GTCC |
| Small-leaved Privet (*Ligustrum sinense*) | -<br>Environmental weed | GLC<br>GTCC |
| Blackberry (*Rubus discolor*) | -<br>Noxious, W2 | GLC<br>GTCC |

**Table 10: Noxious Weed Categories used in Table 9**

| Category | Category Description |
|---|---|
| W2 | Must be fully and continuously suppressed and destroyed. |
| W3 | Must be prevented from spreading and its numbers and distribution reduced. |

Woodland and forest is mostly present between Bullocky Way and Failford Road, particularly to the east of the southbound carriageway of the Pacific Highway. The woodland and forest vegetation is less continuous west of the northbound carriageway of the Pacific Highway, with narrow remnants present north of the intersection with Bullocky Way, and also to the south of Failford Cemetery. There are two forest remnant units between the northbound and southbound carriageways of the Pacific Highway, with the largest located between the intersections of Bullocky Way and Failford Road and the Pacific Highway. The remainder of the trees are isolated or are landscape plantations.

Aquatic habitat within the study area between Tritton Road and Failford Road is limited to seepages and pools created from drainage works for the existing road infrastructure. Farm dams are also located north of Possum Brush Road and south of Failford Road. A moist habitat dominated by *Melaleuca quinquinerva* and Swamp Oak (*Casuarina glauca*), with some Brush-box (*Lophostemon confertus*), is present in the extreme south west of the project area.

The remnant vegetation communities within the study area have had a history of disturbance, ranging from selective logging, the clearing of the understorey, woody weed invasion or species alteration due to changed physical conditions, such as increased light or an altered hydrological regime. This, in addition to ecotonal effects between recognised communities, has resulted in much of the vegetation within the study area not obviously belonging to a specific recognised vegetation community. Many species were observed in small areas of habitat within broader vegetation communities, for example moist areas associated with dams, drains and where drainage has been impeded by road works. The communities within the study area have been allocated to previous remnant vegetation communities based on the dominance of canopy species in conjunction with shrub species dominance.

Six vegetation communities are recognised within the study area. Differences between these communities and the mapping undertaken by GLC and GTCC are attributable to the presence or absence of key canopy species. The cleared land community is described but has not been mapped separately.

The six mapped communities are:

- Grey Gum/Grey Ironbark/White Mahogany Community.
- Mahogany/Ironbark/Grey Gum/Blackbutt.
- Tallowwood/Sydney Blue Gum.
- Landscaping/Modified Shrublands.
- Forest Red Gum/Black Oak.
- Paperbark/Brush Box/Swamp Oak.

The remainder of the study area comprises pasture or cleared land.

Descriptions of these six communities follow below.

**Grey Gum/Grey Ironbark/White Mahogany Community**

The dominant vegetation community observed was dry sclerophyll woodland, dominated by Tallowwood and White Mahogany, with patches of Grey Gum and Grey Ironbark dominating small areas or scattered in low densities throughout the community. The trees are mostly young with the occasional larger tree. An example of the community is shown in **Plate 1**. The understorey varied from absent with a sparse groundcover in places where bushfire fuel management has taken place, to dense woody weed infestation. The shrub diversity, in terms of species present and structure, was greatest from Failford Road to approximately 500 m north of

the road intersection with the Pacific Highway. The upper understorey was dominated by eucalypt regeneration, scattered Black Oak (*Allocasuarina littoralis*) and *Jacksonia scoparia*. The lower understorey was dominated by fabaceous species, including *Pultenaea villosa*, and *Acacia falcata*. The ground cover was generally sparse, dominated in places by Blady Grass (*Imperata cylindrica var. major*) in less disturbed habitats or Whiskey Grass (*Andropogon virginicus*), however the majority of the community had sparse a sparse grass cover that included Kangaroo Grass (*Themeda australis*), Wire Grass (*Aristida* sp.) and Wallaby Grass (*Austrodanthonia* sp.). Small patches of Forest Oak (*Allocasuarina torulosa*) and Pink Bloodwood (*Corymbia intermedia*) occur within this community. The understorey is very sparse and ground cover is dominated by Black Oak cladodes.

The Grey Gum/Grey Ironbark/White Mahogany community mapped for this study includes the White Mahogany/Red Mahogany/Grey Ironbark/Grey Gum community mapped by GLC. While the overall remnant may have dominant species that allow the communities to be distinguished, there is little difference in the community within the study area. This community dominates the remnant vegetation west of the Pacific Highway and has moderate significance with regard to flora biodiversity, particularly east of the existing southbound carriageway. The low diversity of exotic species and simplified shrub understorey in most sections of this community reduced the overall conservation significance to moderate. This is despite the relatively high diversity of native species and better understorey structure in this community for a section approximately 500 m long, to the north of Failford Road.

**Mahogany/Ironbark/Grey Gum/Blackbutt**

This community occurs in the southern part of the study area, around Failford Cemetery and adjacent to the study area north of Failford Road. Blackbutt (*E. pilularis*) dominates small areas, however most of the community within the study area near Failford Cemetery is dominated by Ironbarks (*E. siderophloia*) and to lesser extent Grey Gum. The shrub understorey of the community is low and sparse. Species present include *Pittosporum undulatum*, White Dogwood (*Ozothamnus diosmifolius*), Lantana, Coffee Bush (*Breynia oblongifolia*) and *Leucopogon juniperinus*. Leaf litter and fallen timber result in a ground cover that is dominated by grasses and forbs with a patchy distribution. The ground cover species include Spiny-headed Mat-rush (*Lomandra longifolia*), Kangaroo Grass (*Themeda australis*) and *Dianella caerulea* var*. producta*. Also present are scrambling species, for example Appleberry (*Billardiera scandens*), Slender Tickfoil (*Desmodium varians*) and Red Running Pea (*Kennedia rubicunda*). The community is considered to be of moderate conservation significance due to the higher diversity of exotic species in the understorey, particularly in moister areas, and reduced shrub understorey structure.

**Tallowwood/Sydney Blue Gum**

The largest remnant of this community occurs between the present north and southbound Pacific Highway carriageways immediately south of Possum Brush Road. The remnant is dominated by Sydney Blue Gum (*Eucalyptus saligna*) and Turpentine (*Syncarpia glomulifera* subsp*. glomulifera*), with an understorey dominated by mesic low tree and tall shrub species, for example Red Ash (*Alphitonia excelsa*) and Blue Lilly Pilly (*Syzygium oleosum*). The lower understorey has species such as Narrow-leaved Palm Lily (*Cordyline stricta*) and *Indigofera australis*. Vines, including Sarsaparilla (*Smilax australis*), Headache Vine (*Clematis glycinoides var. glycinoides*), Snake Vine (*Stephania japonica* var*. discolor*) and Climbing Guinea Flower (*Hibbertia scandens*) are very common in this community. Roadside vegetation to the west of the remnant is similar to the island vegetation; however there is more evidence of a change in floristic composition caused by the narrower nature and proximity to grazed pasture.

The riparian vegetation in the southern part of study area is similar to this community, however Blackbutt (*Eucalyptus pilularis*) is a more common canopy species and Cheese Tree (*Glochidion ferdinandi* var*. ferdinandi*) is a common understorey species. All remnants have

woody weeds, for example Lantana, with Small-leaved Privet (*Ligustrum sinense*) common in the southern riparian vegetation.

This community shows edge effect changes in floristic composition, primarily being a proliferation of vines, and woody weeds, for example Wild Tobacco Bush (*Solanum mauritianum*) and Lantana, at the interface with cleared areas. The presence of exotic species and linear nature of the remnants within the study area reduces the conservation significance in terms of flora to moderate. **Plate 2** shows the community north of Possum Brush Road where the understorey has been reduced in comparison to that between the north and southbound carriageways south east of the intersection of the highway with Possum Brush Road.

**Landscaping/Modified Shrublands**
This community is highly modified, resulting from revegetation or regeneration following the clearing of the original vegetation for road works. Some areas, for example west of the intersection between the Pacific Highway and Failford Road, have been planted with native species, including Spotted Gum (*Corymbia maculata*), Forest Oak (*Allocasuarina littoralis*) and Western Golden Wattle (*Acacia decora*). While the vegetation is dense, the ground cover is sparse.

Other areas, for example the Pacific Highway reserve south of the present sealed limit of the old Pacific Highway, have regenerated from the original vegetation community and are presently dominated by shrubs, for example *Acacia falcata*, *Zieria smithii* and *Jacksonia scoparia*, and eucalypt regeneration, with isolated remnant emergent trees and dead trees present.

Much of the present reserve is dominated by young eucalypt regeneration, *Acacia falcata* and Lantana. *Acacia falcata* and Lantana dominates highly disturbed areas, particularly on steeper cuttings, for example on the south east of the Failford Road-Pacific Highway intersection. An example of the road reserve landscape community is shown in **Plate 3**, while an example of the modified shrubland, located south of the intersection of Failford Road and the southbound carriageway of the Pacific Highway is shown in **Plate 4**. The community has low flora conservation significance.

**Forest Red Gum/Black Oak**
To the north of Bullocky Way there is a small stand of Forest Red Gum (*E. tereticornis*) with the groundcover dominated in part by Spiny-headed Mat-rush. The remnant is located in the road reserve for the former Bullocky Way route and is bound by the bund for the present day Bullocky Way to the south and cleared pasture to the north. While the trees are of a moderate size, no hollow development was observed. The former Bullocky Way route is shown in **Plate 5**. Black Oak (*Allocasuarina litoralis*) forms a remnant woodland to the north east of the stand of Forest Red Gum. Forest Red Gum and Black Oak are mapped together based on proximity, topographic position and reduced diversity of the understorey. The significance of this community, in terms of flora conservation, is moderate for the areas dominated by Forest Red Gum and low for areas dominated by Black Oak.

**Paperbark/Brush Box/Swamp Oak**
This community is present in the south-western part of the study area and is dominated by Broad-leaved Paperbark (*Melaleuca quinquinerva*) to the east and Swamp Oak (*Casuarina glauca*) to the west. The eastern part of the community has a greater diversity of trees and shrubs, including Forest Red Gum and Flax-leaved Paperbark (*Melaleuca linariifolia*), often supporting Common Silkpod (*Parsonsia straminea*). Brush Box (*Lophostemon confertus*) occurs along the fringes of the wetter part of the habitat. The conservation significance of this community is moderate, based on the presence of species otherwise absent from within the study area, relatively small size of the remnant and general degradation of the groundcover due to stock movement.

**Pasture/Cleared Land**
Cleared land to either side of the highway is highly modified from clearing, pasture improvement and grazing. It is dominated by exotic species, including Kikuyu (*Pennisetum clandestinum*), Pigeon Grass (*Setaria* sp.) and Fireweed (*Senecio madagascariensis*). Isolated trees or stands of trees have been retained as windbreaks and shade for stock. These are presumed to be remnants of the former vegetation cover and occur on moist soils. The Pasture/Cleared Land community, shown in **Plate 3**, affected by the proposed highway upgrade is located mostly to the east of the southbound carriageway, between the northern limit of the study area and Bullocky Way. The community has low flora conservation significance.

## 4.2 Field Investigations – Fauna

Thirty-eight species of vertebrate were identified either directly or through evidence such as characteristic skeletal material, scats or scratch marks. The species are listed in **Appendix 1**. Many of the 27 bird species observed were nectivorous and feeding on the Tallowwood blossoms or insectivorous species attracted to insects that were attracted to the blossom.

Most bird species are typical of those found in fragmented rural landscapes, with a few species, for example the Yellow Robin (*Eopsaltria australis*), Common Bronze Wing (*Phaps chalcoptera*) and Lewin's Honeyeater (*Meliphaga lewinii*), observed that are usually associated with larger woodland or forested areas.

Mammal species were not targeted using trapping techniques, due to the spatial constraint of the study area and proximity to the Pacific Highway. Evidence of mammal use in the study area, such as faecal material and foraging, was observed. Characteristic evidence of foraging included that of Echidnas, gliders and many digging marks typical of a bandicoot species. Feeding scars, shown in **Plate 6**, were observed on a tree located to the west of the northbound carriageway of the Pacific Highway, south of the intersection of the highway with Possum Brush Road. Two macropod species were observed and a large arboreal antechinus, likely to be the Yellow-footed Antechinus (*Antechinus flavipes*) were also observed within the study area.

There was little evidence of breeding activity within the study area, with the exception of a likely Kookaburra nest site within a termite nest and the remains of a large egg. The egg was found at the base of a tree with a large hollow, located between the north and southbound lanes of the Pacific Highway, suggesting recent breeding activity. The dimensions and colour of the egg were compared to egg descriptions in Simpson and Day (1999) and Higgins (1999) for large raptors and cockatoo species. The possibility that the egg was from a Lace Monitor (*Varanus varius*) was also considered. Information regarding Lace Monitor egg dimensions was sourced from (Greer 2004). The conclusion reached was that the egg was most likely that of a Powerful Owl. The Powerful Owl is a threatened species protected by the provisions of the TSC Act.

The tree and highlighted hollow is shown in **Plate 7**, while the location within the study area is shown in **Figure 4**.

There is very little aquatic habitat within the study area between Possum Brush Road and Failford Road. Stock, including horses and cattle, affect the stock dams and moist habitats within pastures. All aquatic habitats that were inspected and that permanently contain water have Mosquito Fish (*Gambusia holbrooki*) present. Mosquito Fish are a threat to the Green and Golden Bell Frog (NPWS 2003a). Frog species that were observed in all habitats were typical of stock dams or ephemeral drainage lines; however, no Green and Golden Bell Frogs were heard or observed.

The most significant habitat, in terms of shelter, is hollows within trees. There are several larger trees that contain hollows and dead tree that are hollow, as shown in **Plate 8**, within the Bullocky Way road reserve. These would provide habitat for many species of arboreal mammal,

including insectivorous bat species, possums and gliders. Additionally, hollows provide denning opportunity for arboreal snake species and breeding opportunities for many species of parrot and cockatoos.

The shrub understorey and fallen timber has been cleared in most areas for agricultural and fire hazard reduction purposes. This has severely limited the availability of shelter for larger terrestrial reptile and small mammal species. No exfoliated rock habitat or other rocky areas, with the exception of rock exposed by road construction, is present within the study area.

The significance of the communities in terms of fauna conservation varies between low and high. Areas of low significance include the Pasture/Cleared Land community and Landscaping/Modified Shrublands as they afford few sheltering, nesting or foraging opportunities for native fauna, particularly threatened species. All other areas have moderate conservation significance.

The majority of the Grey Gum/Grey Ironbark/White Mahogany community, Mahogany/Ironbark/Grey Gum/Blackbutt community and Paperbark/Brush Box/Swamp Oak Forest Red Gum/Black Oak community provide foraging opportunities for nectivorous species, such as honeyeaters, and some foraging value to Koalas and other species that browse on eucalyptus foliage. The Tallowwood/Sydney Blue Gum and Forest Red Gum/Black Oak communities both provide foraging opportunities for sap consuming species, such as the Yellow-bellied Glider, Squirrel Glider and Sugar Glider.

In terms of wildlife movement, woodland remnants with taller trees that occur on either side of the existing carriageways provide dispersal opportunities for glider species, for example the Yellow-bellied Glider, the Squirrel Glider and the Sugar Glider. The areas with larger trees also tend to have tree hollows present. The locations of habitat trees, with regard to hollow development, are shown in **Figure 4**. Wildlife corridors shown in **Figure 4** are considered to have conservation value as they reduce potential isolation of the species.

# 5 IMPACT ASSESSMENT

## 5.1 Existing Impacts

Activities that have affected the study area include clearing for agriculture, stock agistment, bushfire fuel hazard reduction activities and road construction. The majority of trees are relatively young and have not developed hollows. The construction of the existing Pacific Highway has resulted in the clearing of taller vegetation from the roadside and the steep cuttings that are dominated by *Acacia falcata* regeneration and Lantana between the Bullocky Way and Failford Road intersections. The reduction and fragmentation of the canopy cover results in better light penetration and airflow, allowing colonising species, including many weed species, to take advantage of the altered conditions. The reduction in shading and increased airflow also results in ground moisture decreasing, resulting in an increased potential for changes in the biodiversity of flora, and consequently fauna, of an area.

Other existing impacts to the area include vehicular movement. The existing road is likely to reduce the ability for species to move through the local area due to the absence of vegetation cover increasing the likelihood of smaller species being killed by larger carnivores, the increased potential for collision with wildlife and alteration of animal behaviour adjacent to roads in the presence of noise, light and movement.

## 5.2 Potential Impacts

Potential impacts from the proposed road upgrade include the clearing of approximately 15 ha of woodland or forest, located mostly east of the existing southbound carriageway between the Failford Road intersection and the Bullocky Way intersection. Clearing of remnant vegetation will result in the loss of roosting and foraging opportunities for birds and arboreal mammals. Approximately 1 ha of cleared or partially cleared pasture or landscape plantations, in addition to the remnant vegetation, will be removed. This is located mostly east of the existing southbound carriageway, north from the Bullocky Way intersection to 300 m north of the Possum Brush Road intersection. Indirect impacts that may result from the proposed development include noise during the construction phase and increased difficulty, for particularly arboreal mammals such as gliders, in traversing the highway after widening. There may be some increase in the potential for collision between wildlife and vehicles as a result of increased vehicle speeds.

There is an increased potential for the spread of weed species through the movement of soil containing seed, stem and root material if areas where weeds are present are not treated prior to earth moving activities. There is also the potential for the spread of plant pathogens, for example *Phytophora* sp. fungi into the area on equipment used during the construction of the proposed road works. Presently there is no evidence of dieback within the study area resulting from *Phytophora* sp. infection.

## 5.3 Threatened Species Considerations

The TSC Act identifies and protects native plants and animals in danger of becoming extinct in NSW. The purposes of the TSC Act include the conservation of biological diversity and promotion of ecologically sustainable development, ensuring the impact of any action affecting threatened species, populations and ecological communities is properly assessed, and encouraging the conservation of threatened species, populations and ecological communities. The TSC Act allows for the integration of threatened species assessment into the State's planning system and removes the requirement to obtain a separate threatened species licence in addition to development consent under the EP&A Act.

This section provides an overview of the matters protected by the provisions of the TSC Act. The detailed assessment of matters potentially affected by the proposed highway upgrade is given in **Appendix 3**.

### 5.3.1 Threatened, Endangered and Vulnerable Species

The following is a brief summary of the potential for threatened species identified as having potential to occurring within 10 km of the proposed highway upgrade, excluding species that utilise marine or estuarine habitats, to be affected by the proposed upgrade. No marine or estuarine habitat will be affected by the proposed development.

No threatened species were recorded within the study area.

Where appropriate, detailed assessments of impact have been prepared and are presented in **Appendix 3**. The results of these assessments are summarised in **Table 11**.

*Cynanchum elegans* – Endangered
This species was not recorded within the study area and should have been detected if present, given the timing of the field investigations. The habitat for the species is described as Dry-vine Thicket or Dry Rainforest (Benson and McDougall 1993) and the ecotone between dry subtropical Rainforest and sclerophyll Forest/woodland communities (NPWS 2002). These communities are not present within the study area. This species will not be affected by the proposed development. A detailed assessment of impact has not been prepared.

*Allocasuarina defungens* – Endangered
This species was not recorded within the study area and should have been detected if present, given the timing of the field investigations. The habitat for the species' Nabiac population is described as moist heath, with *Banksia ericifolia*, *B. oblongifolia*, *Melaleuca nodosa*, *Schoenus brevifolius*, *Pseudanthus orientalis*, *Leptospermum polygalifolium*, *L. semibaccatum*, *Hypolaena fastigata* and *Boronia safrolifera* as common species (Benwell 1993, cited in DEH 2006a). This habitat is absent from the study area. This species will not be affected by the proposed development. A detailed assessment of impact has not been prepared.

*Allocasuarina simulans* – Vulnerable
This species was not recorded within the study area and should have been detected if present, given the timing of the field investigations. Within the Booti Booti National Park, the species grows in sandy podzolic soils on dunes exposed to the prevailing onshore winds, where the species dominates patches of dry heathland (Griffith *et al*. 2000). Species within the community include *Acacia ulicifolia*, *Isopogon anemonifolius*, *Monotoca scoparia* and *Ricinocarpus pinifolius* (Griffith *et al*. 2000 cited in DEH 2006b). The species' habitat is absent from the study area. This species will not be affected by the proposed development. A detailed assessment of impact has not been prepared.

*Senna acclinis* – Endangered
This species was not recorded within the study area and should have been detected if present given the timing of the field investigations. The species grows in subtropical Rainforest (Harden 2002) or on the edges of subtropical and dry rainforest (DEC 2005a). There is no subtropical or dry rainforest within the study area. This species or its habitat will not be affected by the proposed development. A detailed assessment of impact has not been prepared.

*Maundia triglochinoide* – Vulnerable
This species was not recorded within the study area. The species habitat is described simply as swamps and creek (Benson and McDougall 2002) and swamps or shallow freshwater on heavy clay (Harden 1993). Aquatic habitats within the study area are either degraded through weed invasion, by for example Crofton Weed, are ephemeral or affected by stock agistment. This

species or its habitat will not be affected by the proposed development. A detailed assessment of impact has not been prepared.

*Syzygium paniculatum* – Vulnerable
This species was not recorded within the study area and should have detected if present given the timing of the field investigations. The species habitat is described as littoral rainforest including species such as Tuckeroo (*Cupanosis anacardiodes*), Rusty Fig (*Ficus rubiginosa*), Cheese Tree (*Glochidion ferdinandi*), *Eleocarpus obovatus*, Lilly Pilly (*Acmena smithii*) or gallery rainforest with *A. smithii*, *Crytocarya glaucescens* and *Canthium coprosmoides* (Benson and McDougall 1998) and subtropical rainforests and stabilised dunes near the sea (Harden 2002). Some associated species are present within the study area, however rainforest is absent. This species or its habitat will not be affected by the proposed development. A detailed assessment of impact has not been prepared.

*Asperula asthenes* – Vulnerable
This species was not recorded within the study area and should have detected if present given the timing of the field investigations. The species habitat is described as damp sites that are often along riverbanks (Harden 2003). Most aquatic habitats within the study area are degraded through weed invasion, by for example Crofton Weed, are ephemeral or affected by stock agistment. Despite there being potential habitat for the species located 200 m south west of the proposed Failford Road-Pacific Highway interchange, where there is an ephemeral soak, the soak itself will not be affected by the proposed highway upgrade, with the possible exception of retaining moisture for longer periods if the drainage is impeded by the proposed works. A detailed assessment of impact has not been prepared.

*Lindernia alsinoides* – Endangered
This species was not recorded within the study area. The species is described as growing in swampy sites in sclerophyll forest and coastal heath (Harden 1992). Most aquatic habitats within the study area are degraded through weed invasion, by for example Crofton Weed, are ephemeral or affected by stock agistment. Despite there being potential habitat for the species located 200 m south west of the proposed Failford Road- Pacific Highway interchange, where there is an ephemeral soak, the soak itself will not be affected by the proposed highway upgrade, with the possible exception of retaining moisture for longer periods if the drainage is impeded by the proposed works. A detailed assessment of impact has not been prepared.

Wallum Froglet (*Crinia tinnula*) – Vulnerable
This small species of frog breeds in acid *Melaleuca* swamps and Wallum areas with poor drainage, preferring shallow freshwater and brackish wetlands, with tall and dense emergent vegetation (Barker *et al*. 1995). There are no acid swamps likely to be affected by the proposed highway upgrade. It is highly unlikely the species will utilise habitats within the study area and, consequently, a detailed assessment of impact has not been prepared.

Australasian Bittern (*Botaurus poiciloptilus*) – Vulnerable
This species was not recorded within the study area. This species is associated with terrestrial wetlands and occasionally estuary habitats where it favours tall reed beds and forages in shallow still water (Marchant and Higgins (1990b). Most aquatic habitats within the study area are degraded through weed invasion, by for example Crofton Weed, are ephemeral or affected by stock agistment and none have significant reed beds. It is unlikely the species will utilise habitats within the study area. A detailed assessment of impact has not been prepared.

Glossy Black-Cockatoo (*Calyptorhynchus lathami*) – Vulnerable
This species was not recorded within the study area. The Glossy Black-Cockatoo is dependant on the presence of *Allocasuarina* species as it is a specialist forager of the seeds of these species. It prefers woodland that has mature *Allocasuarina* as an understorey below *Angophora* and *Eucalyptus*, *Allocasuarina* spp. lined watercourses and also stony ridges. Nesting occurs in

a hollow of a tall tree that can be living or a dead tree (Higgins 1999). Potential foraging habitat, *Allocasuarina littoralis*, is present within the study area. A detailed assessment of impact is given in **Appendix 3**.

Black-necked Stork (*Ephippiorhynchus asiaticus*) – Endangered
This species was not recorded within the study area. The species is usually associated with permanent and seasonal wetlands, in tropical and temperate Australia, where the species forages in saline water that is up to 0.5 m deep for freshwater for small vertebrates, such as fish, snakes, turtles and frogs (Marchant and Higgins 1990a). Aquatic habitats within the study area are small, degraded through weed invasion, by for example Crofton Weed, are ephemeral or affected by stock agistment and none have significant reed beds. It is unlikely the species will utilise habitats within the study area. A detailed assessment of impact has not been prepared.

Sooty Oystercatcher (*Haematopus fuliginosus*) – Vulnerable
This species was not recorded within the study area. This species is strictly a marine coastal species, rarely more than fifty metres from the shore, inhabiting rocky shores with little foliose algae and nearby beaches where it is a relatively sedentary resident (Marchant and Higgins 1993). No habitat for the species is present within the study area or is likely to be affected by the proposed highway upgrade. A detailed assessment of impact has not been prepared.

Pied Oystercatcher (*Haematopus longirostris*) – Vulnerable
This species was not recorded within the study area. This coastal species inhabits intertidal sand and mud flats of large embayments, sandy beaches and occasionally rocky shores (Marchant and Higgins 1993). No habitat for the species is present within the study area or is likely to be affected by the proposed highway upgrade. A detailed assessment of impact has not been prepared.

Black Bittern (*Ixobrychus flavicollis*) – Vulnerable
This species was not recorded within the study area. The preferred habitat for the Black Bittern is terrestrial wetlands and also estuarine and littoral habitats, where it prefers habitats that are fringed with dense vegetation around open water. It has also been recorded in grasslands, shrubland, woodland and rainforest (Marchant and Higgins 1990b). Most aquatic habitats within the study area are degraded through weed invasion, by for example Crofton Weed, are ephemeral or degraded by stock agistment and none have aquatic habitats fringed with dense vegetation. It is unlikely the species will utilise habitats within the study area. A detailed assessment of impact has not been prepared.

Square-tailed Kite (*Lophoictinia isura*) – Vulnerable
This species was not recorded within the study area. In NSW the habitats preferred by the Square-tailed Kite are typically ridge and gully habitats, dominated by *Eucalyptus longifolia*, *Corymbia maculata*, *E. elata* and *E. smithii*, with a shrubby understorey. They feed on passerines, foliage insects and small terrestrial vertebrates in open woodland (Marchant and Higgins 1993). While dominant tree species are absent, there is a mosaic of canopy densities and areas with shrubby understories. A detailed assessment of impact is given in **Appendix 3**.

Barking Owl (*Ninox connivens*) – Vulnerable
This species was not recorded within the study area. The habitat for the Barking Owl includes areas containing many large trees for roosting and breeding within dry sclerophyll forest and woodlands, and also partly cleared land including farmland (Marchant and Higgins 1993). The study area has potential habitat for the Barking Owl. A detailed assessment of impact is given in **Appendix 3**.

Powerful Owl (*Ninox strenua*) – Vulnerable
A large egg, possibly laid by a Powerful Owl was observed within the study area. The Powerful Owl inhabits dry sclerophyll forests and woodland, often with dense forest nearby (Higgins

1999). Therefore the study area has potential habitat for the Powerful Owl. A detailed assessment of impact is given in **Appendix 3**.

Osprey (*Pandion haliaetus*) – Vulnerable
This species was not recorded within the study area. The Osprey is said to be tolerant of human activity (Marchant and Higgins 1993). The species is usually associated with coastal, littoral and terrestrial wetlands (including inland rivers) habitats, nesting in a prominent open position near water (Marchant and Higgins 1993). There is no aquatic habitat within the habitat that the species is likely to utilise. A detailed assessment of impact has not been prepared.

Little Tern (*Sterna albifrons*) – Endangered
This species was not recorded within the study area. The Little Tern is migratory, breeding in Australia, usually just above the high tide mark on sandy spits or beaches (Frith 1982). There are no beaches within the study area and no potential habitat will be affected by the proposed highway upgrade. A detailed assessment of impact has not been prepared.

Grass Owl (*Tyto capensis*) – Vulnerable
This species was not recorded within the study area. Preferred habitat types for this species is open tussock grasslands, with densities higher in rank pastures on fertile soils rather than infertile soils associated with heaths or sedgelands (Higgins 1999). There is a small area of tussock grassland and sedgeland within the study area. A detailed assessment of impact is given in **Appendix 3**.

Masked Owl (*Tyto novaehollandiae*) – Vulnerable
This species was not recorded within the study area. Known habitat types for this species include tall dense forests, open forest and woodland with a sparse understorey that includes large hollows for roosting and breeding. Breeding takes place in near vertical hollows, in tall, often prominent trees. Prey items are mainly terrestrial mammals. Most records are within 300 m of lowland sclerophyll forest, lowland forest, Red Gum forest and valley floor forest (Higgins 1999). There is potential foraging and breeding habitat within and adjacent to the study area. A detailed assessment of impact is given in **Appendix 3**.

Sooty Owl (*Tyto tenebricosa*) – Vulnerable
This species was not recorded within the study area. The Sooty Owl is usually associated with gullies on escarpments 500 m or more above mean sea level, in or adjacent to tall old growth montane sclerophyll forests and rainforests with potential nesting dead trees. The forests usually have tall emergent vegetation, and a dense understorey that has moister vegetation types including Lillypilly (*Acmena smithii*), *Pittosporum* sp., Blackwood (*Acacia melanoxylon*), Tree Ferns (*Cyathea* sp.) and Coachwood (*Ceratopetalum apetalum*). Foraging for arboreal and terrestrial mammals (occasionally birds, reptiles and insects) is usually restricted to dense forest, especially rainforest gullies, although the species will forage in other vegetation communities. (Higgins 1999). While there is wet sclerophyll forest within the study area, the habitats are well below the altitude usually associated with the species. It is unlikely the species will utilise habitats within the study area. A detailed assessment of impact has not been prepared.

Spotted-tailed Quoll (*Dasyurus maculatus*) – Vulnerable
This species was not recorded within the study area. The Spotted-tailed Quoll is partly arboreal and is mostly nocturnal, inhabiting a wide variety of habitats. These include rainforest, woodland, coastal heathland and riparian forests from the coast to the snowline. Den sites include caves, crevices and also hollow logs (Edgar and Belcher 1998). There is potential foraging habitat within and adjacent to the study area. A detailed assessment of impact is given in **Appendix 3**.

Little Bentwing-bat (*Miniopterus australis*) – Vulnerable

This species was not recorded within the study area. The Little Bent-wing Bat roosts in subterranean locations, and the species forages beneath the canopy of dense forest and woodlands (Dwyer 1998a). While the species is unlikely to roost within the study area, it will potentially forage. A detailed assessment of impact is given in **Appendix 3**.

Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) – Vulnerable
This species was not recorded within the study area. The roost sites for this species include underground mine workings, caves, stormwater culverts and occasionally buildings (Dwyer 1998b). While the species is unlikely to roost within the study area, it will potentially forage. A detailed assessment of impact is given in **Appendix 3**.

Eastern Freetail-bat (*Mormopterus norfolkensis*) – Vulnerable
This species was not recorded within the study area. Habitat preferences for this species are assumed to be dry sclerophyll forest and woodland east of the Great Dividing Range. It has also been recorded in rainforests, flying over a creek. It mainly roosts in trees, although it has been know to utilise man made structures (Allison and Hoye 1998). There are potential roosts and foraging habitat within the study area. A detailed assessment of impact is given in **Appendix 3**.

Large-footed Myotis (*Myotis adversus*) – Vulnerable
This species was not recorded within the study area. Although the species has been known to utilise tree hollows, it mainly roosts in subterranean locations close to water such as caves, but in the southern range of the species distribution it will also utilise man-made structures including abandoned underground mines, tunnels, under bridges and building cavities (Churchill 1998). The species will utilise most riparian communities, foraging mainly for insects and also fish (Churchill 1998). The species is unlikely to roost or forage within the study area as there are no significant water bodies or riparian habitat. A detailed assessment of impact has not been prepared.

Yellow-bellied Glider (*Petaurus australis*) – Vulnerable
This species was not recorded within the study area. This species is the largest of the gliding possums, inhabiting tall, mature wet eucalypt forest. It mainly forages on eucalypt sap and insect exudates, while eucalypt blossom, arthropods and pollen provide important nutriment. Sap is obtained by scarring the trunk of a tree. Diurnal dens are usually hollows in large living smooth barked *Eucalyptus* spp. (Russell 1998). There is potential foraging and breeding habitat within and adjacent to the study area. A detailed assessment of impact is given in **Appendix 3**.

Squirrel Glider (*Petaurus norfolcensis*) – Vulnerable
This species was not recorded within the study area. The Squirrel Glider utilises dry sclerophyll habitats and woodlands where it dens in tree hollows. It feeds on insects, nectar, pollen, sugary insect exudates and sap. Trees utilised include Forest Red Gums (*E. tereticornis*). Acacia species that exude sap are also favoured (Suckling 1998). There is potential foraging and breeding habitat within and adjacent to the study area. A detailed assessment of impact is given in **Appendix 3**.

Brush-tailed Phascogale (*Phascogale tapoatafa*) – Vulnerable
This species was not recorded within the study area. The Brush-tailed Phascogale is mainly arboreal, feeding on nectar, insects, spiders, small vertebrates and ants in large trees. Mating and the raising of young take place in a tree hollow. The species will utilise tree hollows, stumps and even globular bird nests during the day (Soderquist 1998). There is potential foraging and breeding habitat within and adjacent to the study area. A detailed assessment of impact is given in **Appendix 3**.

Koala (*Phascolarctos cinereus*) – Vulnerable
This species was not recorded within the study area. Tree species that occur within the study area that are known foraging species include Forest Red Gum (*E. tereticornis*), Swamp

Mahogany (*E. robusta*), Tallowwood (*E. microcorys*) and *Melaleuca quinquinerva* (Schedule 2, SEPP 44). There is potential foraging habitat within and adjacent to the study area. A detailed assessment of impact is given in **Appendix 3**. Additional assessment regarding Koala habitat is given in **Section 5.4**.

Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable
This species was not recorded within the study area. The species forages on a wide variety of flowers and fruits, such as figs, palms (Tidemann 1998) and commercial crops as well as nectar and pollen from flowering Myrtaceous species including *E. microcorys* (Eby 1995, cited in Benson and McDougall 1997). There is potential foraging habitat within and adjacent to the study area. A detailed assessment of impact is given in **Appendix 3**.

Common Blossom-bat (*Syconycteris australis*) – Vulnerable
This species was not recorded within the study area. The diet of species in the southern part of its range is mostly nectivorous, where *Melaleuca* swamps are critical feeding habitats (Law and Spencer 1998). An area of *Melaleuca quinquinerva* is present in the southern part of the study area. A detailed assessment of impact is given in **Appendix 3**.

**Table 11: Summary of Threatened Species Assessments**

| Species Name | Common Name | Act | Status | Factors Considered in the Assessment (see Appendix 3)* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | a | b | c | d | e | f | g |
| *Calyptorhynchus lathami* | Glossy Black-Cockatoo | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |
| *Lophoictinia isura* | Square-tailed Kite | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |
| *Ninox connivens* | Barking Owl | TSC | V | No | n/a | n/a | No | n/a | No | n/a |
| *Ninox strenua* | Powerful Owl | TSC | V | **Yes** | n/a | n/a | No | n/a | No | n/a |
| *Tyto capensis* | Grass owl | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |
| *Tyto novaehollandiae* | Masked Owl | TSC | V | No | n/a | n/a | No | n/a | No | n/a |
| *Dasyurus maculatus* | Spotted-tailed Quoll | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |
| *Miniopterus australis* | Little Bentwing-bat | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |
| *Miniopterus schreibersii oceanensis* | Eastern Bentwing-bat | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |
| *Mormopterus norfolkensis* | Eastern Freetail-bat | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |
| *Petaurus australis* | Yellow-bellied Glider | TSC | V | No | n/a | n/a | **Yes** | n/a | No | n/a |
| *Petaurus norfolcensis* | Squirrel Glider | TSC | V | No | n/a | n/a | **Yes** | n/a | n/a | n/a |
| *Phascogale tapoatafa* | Brush-tailed Phascogale | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |

| Species Name | Common Name | Act | Status | Factors Considered in the Assessment (see Appendix 3)* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | a | b | c | d | e | f | g |
| *Phascolarctos cinereus* | Koala | TSC | V | No | n/a | n/a | No | n/a | No | n/a |
| *Pteropus poliocephalus* | Grey-headed Flying-fox | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |
| *Syconycteris australis* | Common Blossom-bat | TSC | V | No | n/a | n/a | No | n/a | n/a | n/a |

Notes:

Status codes: E - Endangered; V - Vulnerable.

Yes: impact of the proposal could occur.

No: impact of the proposal is not likely to be significant.

n/a: the particular factor is not applicable to the species.

### 5.3.2 Endangered Ecological Communities

No endangered ecological communities were recorded within the study area.

### 5.3.3 Endangered Populations

No endangered populations listed under Schedule 1, Part 2 of the TSC Act are present within the study area or will be affected by the proposed highway upgrade.

### 5.3.4 Key Threatening Processes

A key threatening process (KTP) is defined in the TSC Act as a process that:

- Adversely affects two or more threatened species, populations or ecological communities; or
- Could cause species, populations or ecological communities that are not currently threatened to become threatened.

The proposed highway upgrade potentially involves the following three key threatening processes:

- Clearing of native vegetation.
- Invasion of native plant communities by exotic perennial grasses.
- Removal of dead wood and dead trees.

These are discussed in detail in **Appendix 3**.

In addition, the 'Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. lat)' is proposed for listing as a KTP. While the proposed highway upgrade will not involve the planting of Lantana, there is the potential for the spread of the species in disturbed areas through the movement of soil containing stem and seed material. The preliminary determination for the invasion, establishment and spread of Lantana is discussed in **Appendix 3**.

### 5.3.5 Critical Habitat

There is no Critical Habitat declared under the provisions of the TSC Act within the study area.

## 5.4 State Environmental Planning Policy No. 44 — Koala Habitat Protection

The aims of State Environmental Planning Policy No. 44 - Koala Habitat Protection (SEPP No.44) are *'to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:*

*(a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and*
*(b) by encouraging the identification of areas of core koala habitat, and*
*(c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.'*

The study area is located within the Greater Taree City Council and Great Lakes LGAs, both of which are listed in Schedule 1 of SEPP No.44. The study area also contains Tallowwood (*E. microcorys*) and Forest Red Gum (*E. tereticornis*), listed in Schedule 2 of SEPP No.44 as species that are known food resources for Koalas. As Tallowwood and Forest Red Gum constitute more than 15 per cent of the canopy cover, it is considered that potential Koala habitat, as defined in SEPP No.44, is present.

Core Koala habitat is defined as an area with a resident Koala population, including recent sightings, especially where females and young are present. No Koalas or evidence of Koalas were observed within the study area. There are 49 records within the NSW DEC Atlas of NSW Wildlife within a 20 km x 20 km grid centred on the study area. The nearest recorded locations are approximately 3 km to the south east, 5 km to the north east and 5 km to the south west.

While it is possible that Koalas will pass through the site occasionally, it is unlikely there is a resident population due to the proximity of the existing highway. The study area is therefore not considered to be core Koala habitat. The provisions for the protection of core Koala habitat under SEPP No.44 do not therefore require further consideration.

## 5.5 EPBC Act Considerations

Under the EPBC Act, an action will require approval from the Commonwealth Environment Minister if:

- The action has, will have, or is likely to have a significant impact on a matter of national environmental significance; and
- The action is not the subject of one of a list of exceptions.

Administrative guidelines of significance have been developed to assist in determining whether an action should be referred to the Environment Minister for a decision on whether approval is required. In particular, they are intended to provide guidance on whether a proposed action is likely to have a significant impact on any of the matters of national environmental significance. The following assessment has been undertaken using the EPBC Act administrative guidelines on significance.

### 5.5.1 World Heritage properties

There are no World Heritage Properties located within 5 km of the proposed road upgrade, and none will be affected by the proposed development.

### 5.5.2 Ramsar wetlands of international importance

The Wetland of International Importance (WII) identified by the search is the Myall Lakes WII. The catchment for the Myall Lakes is located approximately 30 km to the south. The search area overlapped the catchment for this WII; however the study area is within the catchment of the Wallamba River. The Wallamba River drains into the South Pacific Ocean via Wallis Lake and therefore the Myall Lakes are not affected by activities within the study area.

### 5.5.3 Listed threatened species and communities

It is unlikely that the Swift Parrot is reliant on habitats directly affected by the proposed development as an insignificant number of potential foraging trees will be cleared as a result of the proposed development. The species is a winter visitor to the area and is therefore likely to utilise winter flowering trees. The only species recorded within the area that flowers in winter is the Spotted Gum (*Corymbia maculata*). The species also forages, to a lesser extent, on seeds, psyllids, lerps and fruit (Higgins 1999). The area potentially affected by the proposed highway upgrade is not significant in the context of foraging resources in the local area. For example the area potentially to be cleared represents less than 0.5 percent of woodland or forest within 1 km of the study area or 0.5 percent of the 3150 ha Talawahl Nature Reserve that is located nearby.

The other threatened species that have a high dietary component of nectar or pollen are the Regent Honey-eater and Grey-headed Flying Fox. None of the tree species recorded within the area potentially affected, either directly or indirectly, are listed as favoured food types of the Regent Honey-eater (Higgins *et al*. 2001). They Grey-headed Flying-fox forages readily within Spotted Gum, however the impact to this species is not likely to be significant given the limited area of trees to be removed.

No habitat for the Painted Snipe will be affected by the proposed development. The species utilises swamps that have dense shore or emergent vegetation (Marchant and Higgins 1993), a habitat type that does not occur in the area.

No habitats that are typical of the Green and Golden Bell Frog (Pyke and White 1996) will be affected by the proposed development. Aquatic habitats near the proposed development are infested with the Mosquito Fish (*Gambusia holbrooki*), a known threat to the species (NPWS 2003a).

No aquatic habitat that is suitable for either *Mixophyes* sp. occurs within the area potentially affected by the proposed development. Habitat for Stuttering Frog is described as in montane forests east of the Great Dividing Range (Cogger 2000) in rainforest (Barker *et al*. 1995) and wet sclerophyll habitats mostly near permanent water (Robinson 1993). The Giant Barred Frog inhabits coastal riverine rainforest and upland areas including the Border Ranges, the Conondale Range (Barker *et al*. 1995) and historically south to Narooma (Cogger 2000). It currently is restricted to permanent rocky rainforest streams and slower moving rivers in montane areas.

The Long-nosed Potoroo is generally restricted to coastal heath, dry sclerophyll forest and wet sclerophyll forest that have an annual rainfall above 760 mm. A relatively thick ground cover is a major habitat requirement for the species. It is more common in areas with light sandy soil where it forages for arthropods and their larvae, roots, tubers and fungi (Johnston 1998). Two small areas of dry sclerophyll forest with dense understorey or groundcover will be removed as

a result of the proposed highway upgrade. These are located to the north of Failford Road, removed for the construction of the proposed southbound carriageway, and within an island remnant between the present carriageways of the Pacific Highway, for the construction of the proposed intersection of the Bullocky Way and existing northbound carriageway of the Pacific Highway. The species is highly unlikely to significantly utilise either area, as the area to be removed as part of the highway upgrade is part of a more than 150 ha native vegetation remnant with parts that contain similar understorey and groundcover. The Long-nosed Potoroo is highly unlikely to have a permanent population residing within the remnant vegetation between the existing north and southbound carriageways, due to the risk of collision with vehicles.

There are no nationally Threatened Ecological Communities located within 5 km of the proposed road upgrade, and none will be affected by the proposed development.

### 5.5.4 Listed migratory species

Nine migratory species have the potential to utilise the study area. The White-bellied Sea-Eagle (*Haliaeetus leucogaster*) and White-throated Needletail (*Hirundapus caudacutus*) are both unlikely to roost or breed within the study area, but are likely to fly over the study area. Both species are capable of extended flights, including over open water (Higgins 1999), and do not require woodland for movement.

The Black-faced Monarch (*Monarcha melanopsis*), Spectacled Monarch (*Monarcha trivirgatus*), Satin Flycatcher (*Myiagra cyanoleuca*) and Rufous Fantail (*Rhipidura rufifrons*) all utilise denser vegetation types (Frith 1982), however the Spectacled Monarch rarely utilises dry woodlands (Frith 1982). All three are capable of long distance travel and the proposed widening of the existing highway is unlikely to hinder the species' movement.

Regent Honeyeater (*Xanthomyza phrygia*) utilises habitats in the local area as flowering species, such as *Eucalyptus robusta*, flower profusely (Higgins *et al*. 2001). The species is nomadic, usually breeding west of the Great Dividing Range, and frequents open woodland habitats (Higgins *et al*. 2001) and therefore will not be impeded by a widening of the existing highway. Species in which the Regent Honeyeater, is known to forage, including *Eucalyptus robusta* and *E. tereticornis*, will not be significantly affected by the proposed highway upgrade.

Two migratory species, Latham's Snipe (*Gallinago hardwickii*) and the Painted Snipe (*Rostratula benghalensis* s. lat.) both utilise swampy habitats, however the Painted Snipe is usually associated with large swampy habitats dominated by emergent reeds (Marchant and Higgins 1993), a habitat type that is absent from the study area. The Latham's Snipe will potentially utilise the small area of swampy habitat located to the west of the existing highway in the southern part of the study area, as the species is known to roost in a variety of habitats, including tussock grasslands and freshwater meadows, and also readily utilises man made aquatic environments, for example drains with sedges (Higgins and Davies 1996). The area of swampy habitat within the study area is outside of the development footprint.

No migratory species protected by the provisions of the EPBC Act will be significantly affected by the proposed highway upgrade.

### 5.5.5 Nuclear Actions

As discussed in **Section 2.3**, the proposal does not involve any nuclear actions.

### 5.5.6 The Commonwealth marine environment

Commonwealth Marine Area constitutes the waters between three nautical miles (5.556 km) from the coastal baseline to 200 nautical miles (370.4 km) seaward of the coastal baseline. The Commonwealth Marine Area is located outside of the search area and will not be affected by the proposed development.

### 5.5.7 Summary

Based on the above assessment against the EPBC Act administrative guidelines on significance, a referral to the Commonwealth Environment Minister is not required.

## 5.6 Impact Mitigation

While it is unlikely that there will be a significant impact to threatened species potentially occurring within the study area, the proposed highway upgrade has the potential for affecting the local biodiversity through impeding species movement, increased risk of collision with vehicles and weed invasion. In order to mitigate these impacts, the following measures are recommended:

- Provision of overhead crossings for possums at the three identified wildlife corridor crossings shown in **Figure 4**;
- Undertake an assessment of potential use of tree hollows by the Powerful Owl prior to construction activities and implement control measures as appropriate;
- Commence construction activities, such as clearing and earthmoving, prior to the time of owl breeding, so that owls are less likely to lay eggs in nearby tree hollows, thereby reducing the risk of abandonment of eggs or chicks if adult birds are disturbed;
- Wash down all vehicles and equipment used in construction activities to avoid the importation of weeds and soil borne pathogens;
- Control of weeds prior to earth moving activities to minimise their spread;
- Use seed sourced from local *Eucalyptus* sp. and shrubs, particularly species that have abundant nectar and pollen; and
- Protection of the ephemeral habitat to the west of the proposed Failford Road exit from sediment during construction.

# 6 CONCLUSIONS

The study area contains habitats that have been affected by activities such as agriculture, road construction and bushfire hazard reduction. This has resulted in the reduction in area of the natural woodland and forest communities, loss of foraging and roosting opportunities and degradation of habitats through reduced structural diversity and increase in weed influence. Native flora diversity is greatest between Failford Road and Bullocky Way, east of the existing Pacific Highway southbound carriageway. Approximately 15 ha of remnant vegetation in varying condition will be affected by the proposed highway upgrade, with the majority of disturbance occurring between Failford Road and Bullocky Way.

No flora or fauna species protected by the *Threatened Species Conservation Act 1995* or *Environment Protection and Biodiversity Conservation Act 1999* were directly observed within the study area; however there was possible evidence of Powerful Owl breeding activity and foraging activity by glider species. The study area also contains some important habitat requirements for threatened species that utilise hollows within living and dead trees. However, the possible Powerful Owl egg, glider foraging activity and the majority of hollows, including medium to large hollows, identified in this study are all located outside of the proposed development footprint.

The proximity of habitat for threatened species to the proposed development footprint potentially will result in the disruption of the life-cycle of the Powerful Owl and glider species during the construction phase of the proposed highway upgrade. The implementation of suggested mitigation measures will reduce the potential disruption to the life-cycle of significant species and to wildlife movement in general.

# 7 REFERENCES

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# Figures

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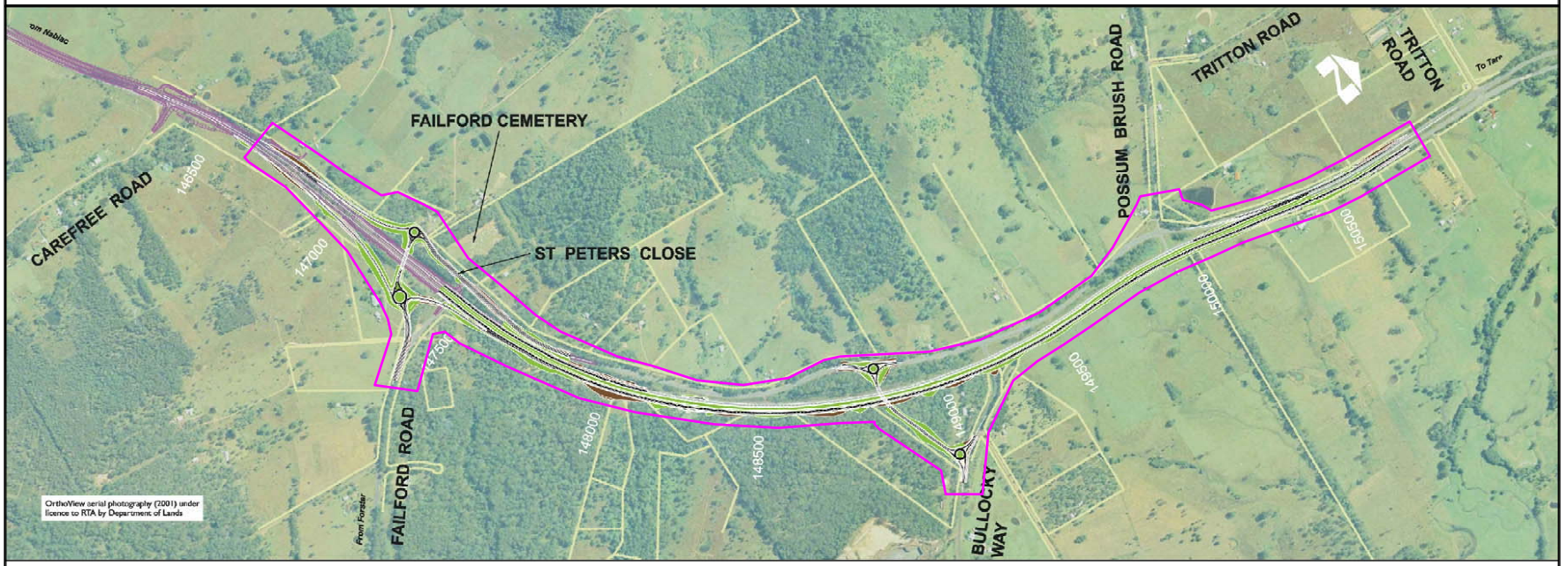



| | |
|---|---|
| PROJECT-FILE NAME | N6033103 |
| DATE | July 2006 |
| DRAWN | SJK |
| APPROVED | NMcE |

**Legend**

Study Area Boundary

0 100 200 300 400 500
Metres

**LOCATION OF PROPOSED WORKS AND STUDY AREA**

**Roads & Traffic Authority**
**Pacific Highway Upgrade**

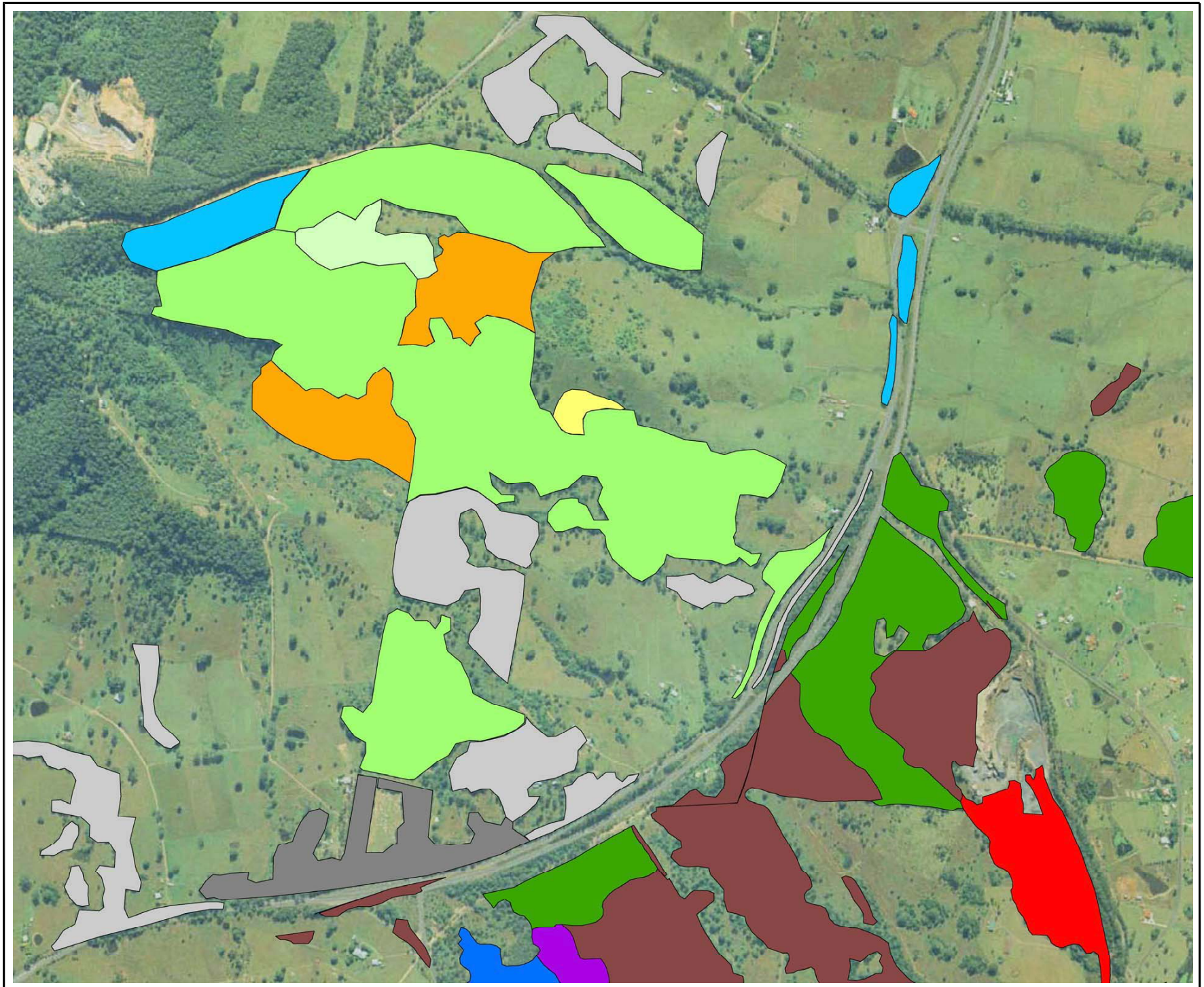
Failford Road to Tritton Road
Possum Brush, NSW

HLA

FIGURE

1

A3



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|---|---|
| PROJECT-FILE NAME | N6033103 |
| DATE | January 2006 |
| DRAWN | amt |
| APPROVED | NMcE |

## Legend

### Greater Taree City Council

- Regrowth Scrub
- Regrowth Scrub Lantana
- Blue Gum with Rainforest understorey
- Dry Tallowwood Mixed Stand
- Small Fruited Grey Gum
- Blackbutt
- 13a Lantana

### Great Lakes Council

- Dry Blackbutt
- Flooded Gum
- Grey Gum / Grey Ironbark / White Mahogany
- Mahogany / Ironbark / Grey Gum / Blackbutt
- Tallowwood / Sydney Blue Gum
- White Mahogany / Red Mahogany / Grey Ironbark / Grey Gum

N

0 100 200 300 400 500

*Metres*

**REMNANT VEGETATION MAPPING**

**Roads & Traffic Authority**
**Pacific Highway Upgrade**

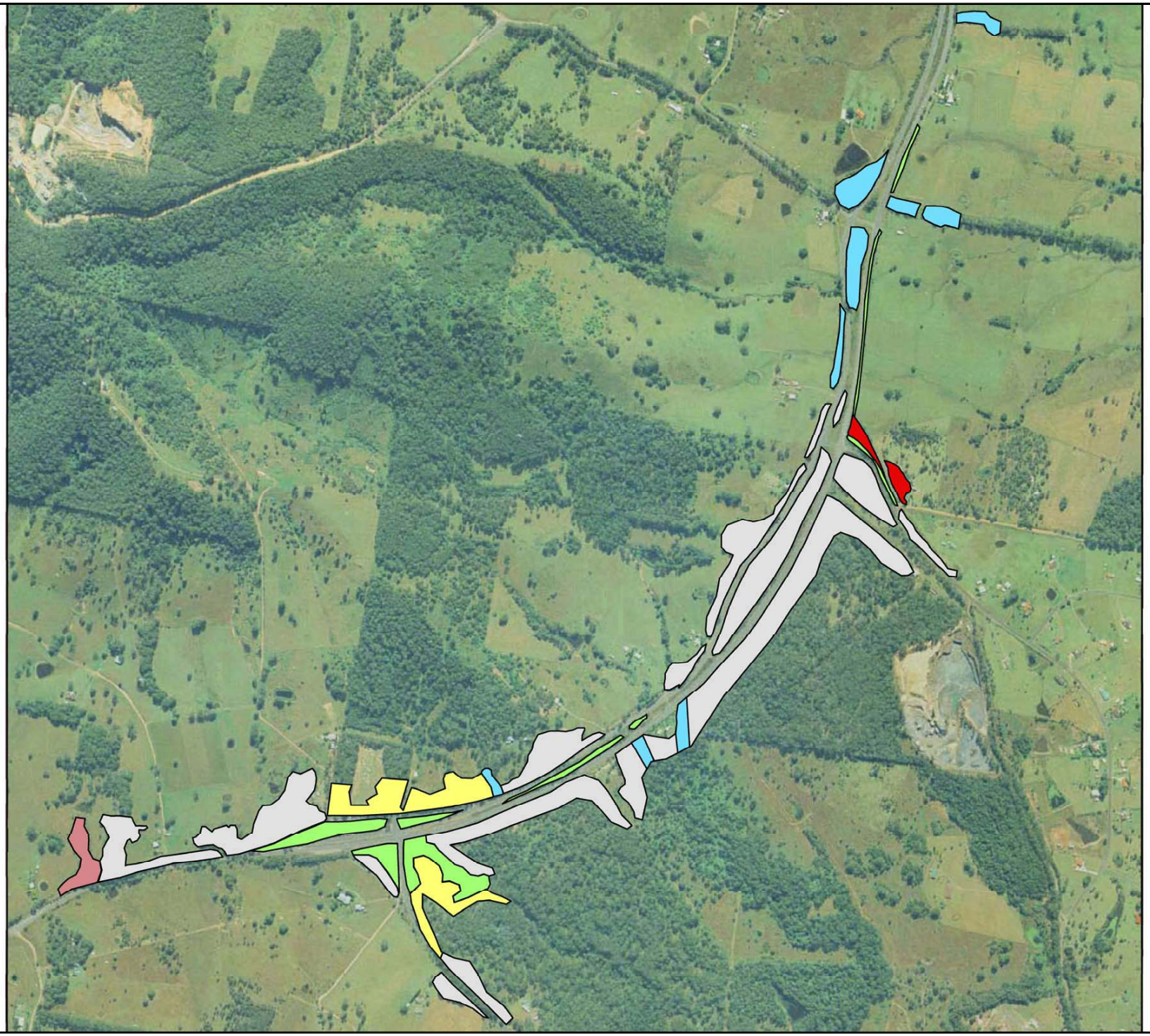
Failford Road to Tritton Road
Possum Brush, NSW

HLA

FIGURE

**2**

A3



| | |
|---|---|
| PROJECT-FILE NAME | N6033103 |
| DATE | January 2006 |
| DRAWN | amt |
| APPROVED | NMcE |

## Legend

- Mahogany / Ironbark / Grey Gum / Blackbutt
- Landscaping / Modified Shrublands
- Grey Gum / Grey Ironbark / White Mahogany
- Tallowwood / Sydney Blue Gum
- Forest Red Gum / Black Oak
- Paperbark / Brush Box / Swamp Oak

N

0 100 200 300 400 500

*Metres*

**VEGETATION COMMUNITIES OF STUDY AREA**

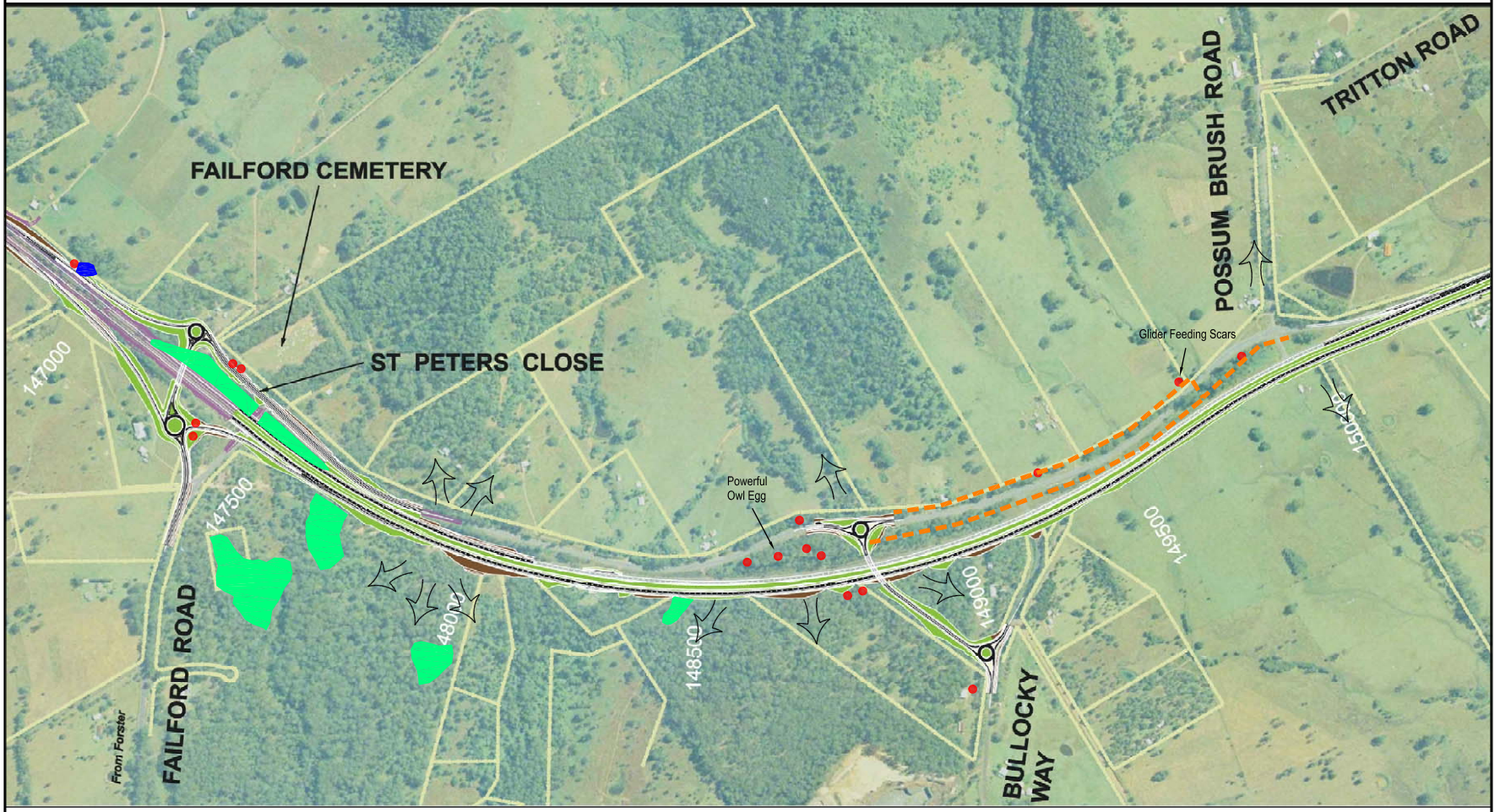
**Roads & Traffic Authority**
**Pacific Highway Upgrade**
Failford Road to Tritton Road
Possum Brush, NSW

HLA

FIGURE

**3**

A3

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|---|---|
| PROJECT-FILE NAME | N6033103 |
| DATE | July 2006 |
| DRAWN | SJK |
| APPROVED | NMcE |

**Legend**

- Habitat Trees
- Suggested Wildlife Corridor
- Black Oak
- Swamp / Tussock Grass
- Wildlife Corridor

0 100 200 300 400 500

Metres

**SIGNIFICANT HABITAT FEATURES**

**Roads & Traffic Authority**
**Pacific Highway Upgrade**

Failford Road to Tritton Road
Possum Brush, NSW

HLA

FIGURE

**4**

# Plates

**Plate 1: Grey Gum/Grey Ironbark/White Mahogany Community**


**Plate 2: Tallowwood/Sydney Blue Gum Community, North of Possum Brush Road**

**Plate 3: Pasture/Cleared Land Community North of Bullocky Way, with Road Reserve Landscaping for Existing Southbound Pacific Highway Carriageway at Right**

**Plate 4: Modified Shrubland Community within the Road Reserve Landscaping/Modified Shrubland Community**

**Plate 5: Forest Red Gum/Black Oak Community, former Bullocky Way Route**

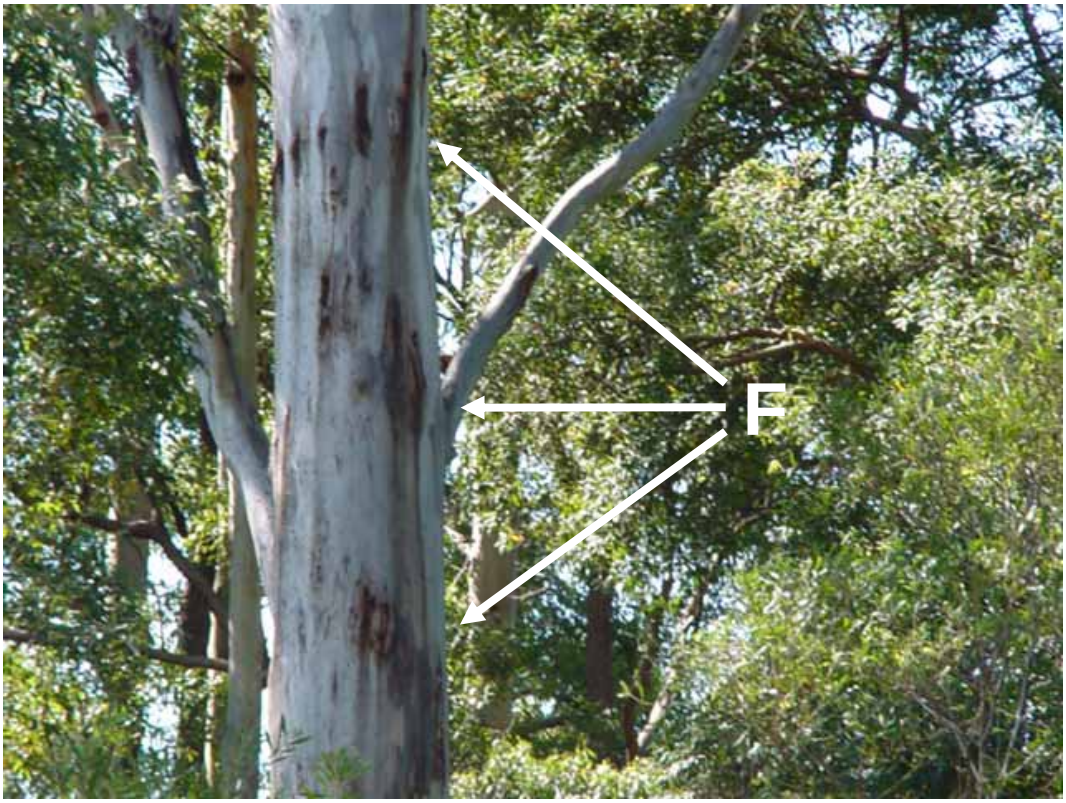


**Plate 6: Glider Feeding Scars (F) within Tallowwood/Sydney Blue Gum Community**


**Plate 7: Potential Owl Roost/Nest (N) between Existing North and Southbound Carriageways**

**Plate 8: Dead Tree within Southern Part of the Bullocky Way Road Reserve**

# Appendices

# Appendix 1: Fauna of the Local Area

NSW Status – Status as per *Threatened Species Conservation Act 1995* (TSC Act) and *National Parks and Wildlife Act* 1975 (NPW Act).
- P - Protected (NPW Act)
- U - Unprotected / feral (NPW Act)
- E1 - Endangered (Schedule 1, TSC Act)
- V - Vulnerable (Schedule 2, TSC Act)

Record Origin of record
- WA- DEC Atlas of NSW Wildlife)
- PS Present Study
  - o Observed
  - f Tracks/scratchings
  - y Bone or teeth
  - w Heard call
  - m Miscellaneous
  - ? Likely identification

Class: *Amphibia*

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Anura*<br>Family: *Hylidae* | | | | |
| *Litoria caerulea* | Green Tree Frog | P | N | WA- |
| *Litoria chloris* | Red-eyed Tree Frog | P | N | WA- |
| *Litoria dentata* | Bleating Tree Frog | P | N | WA- |
| *Litoria fallax* | Eastern Dwarf Tree Frog | P | N | WA-,PSw |
| *Litoria freycineti* | Freycinet's Frog | P | N | WA- |
| *Litoria latopalmata* | Broad-palmed Frog | P | N | WA- |
| *Litoria lesueuri* | Lesueur's Frog | P | N | WA- |
| *Litoria pearsoniana/phyllochroa* | Leaf Green Tree Frog species complex | P | N | WA- |
| *Litoria peronii* | Peron's Tree Frog | P | N | WA- |
| *Litoria phyllochroa* | Leaf Green Tree Frog | P | N | WA- |
| *Litoria tyleri* | Tyler's Tree Frog | P | N | WA-,PSw |
| *Litoria verreauxii* | Whistling Tree Frog | P | N | WA- |
| Order: *Anura*<br>Family: *Myobatrachidae* | | | | |
| *Adelotus brevis* | Tusked Frog | P | N | WA- |
| *Crinia signifera* | Common Eastern Froglet | P | N | WA-,PSw |
| *Crinia tinnula* | Wallum Frog | V | N | WA- |
| *Limnodynastes dumerilii* | Eastern Banjo Frog | P | N | WA- |
| *Limnodynastes peronii* | Brown-striped Frog | P | N | WA- |
| *Limnodynastes tasmaniensis* | Spotted Grass Frog | P | N | WA- |
| *Paracrinia haswelli* | Haswell's Frog | P | N | WA- |
| *Pseudophryne bibronii* | Brown Toadlet | P | N | WA- |
| *Pseudophryne coriacea* | Red-backed Toadlet | P | N | WA- |
| *Uperoleia laevigata* | Smooth Toadlet | P | N | WA- |

Class: *Aves*

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Anseriformes*<br>Family: *Anatidae* | | | | |
| *Anas superciliosa* | Pacific Black Duck | P | N | WA- |
| *Aythya australis* | Hardhead | P | N | WA- |
| *Chenonetta jubata* | Australian Wood Duck | P | N | WA-,PSo |
| Order: *Anseriformes*<br>Family: *Anhingidae* | | | | |
| *Anhinga melanogaster* | Darter | P | N | WA- |
| Order: *Apodiformes*<br>Family: *Apodidae* | | | | |
| *Apus pacificus* | Fork-tailed Swift | P | N | WA- |
| *Hirundapus caudacutus* | White-throated Needletail | P | N | WA- |
| Order: *Caprimulgiformes*<br>Family: *Aegothelidae* | | | | |
| *Aegotheles cristatus* | Australian Owlet-nightjar | P | N | WA- |
| Order: *Caprimulgiformes*<br>Family: *Caprimulgidae* | | | | |
| *Eurostopodus mystacalis* | White-throated Nightjar | P | N | WA- |
| Order: *Caprimulgiformes*<br>Family: *Podargidae* | | | | |
| *Podargus strigoides* | Tawny Frogmouth | P | N | WA- |
| Order: *Charadriiformes*<br>Family: *Charadriidae* | | | | |
| *Charadrius ruficapillus* | Red-capped Plover | P | N | WA- |
| *Vanellus miles* | Masked Lapwing | P | N | WA-,PSo |
| Order: *Charadriiformes*<br>Family: *Haematopodidae* | | | | |
| *Haematopus fuliginosus* | Sooty Oystercatcher | V | N | WA- |
| *Haematopus longirostris* | Pied Oystercatcher | V | N | WA- |
| Order: *Charadriiformes*<br>Family: *Lardidae* | | | | |
| *Sterna albifrons* | Little Tern | E1 | N | WA- |
| *Sterna bergii* | Crested Tern | P | N | WA- |
| *Larus novaehollandiae* | Silver Gull | P | N | WA- |
| Order: *Ciconiiformes*<br>Family: *Ardeidae* | | | | |
| *Ardea alba* | Great Egret | P | N | WA- |
| *Ardea ibis* | Cattle Egret | P | N | WA- |
| *Ardea pacifica* | White-necked Heron | P | N | WA- |
| *Botaurus poiciloptilus* | Australian Bittern | V | N | WA- |
| *Egretta novaehollandiae* | White-faced Heron | P | N | WA- |
| *Ixobrychus flavicollis* | Black Bittern | V | N | WA- |
| *Nycticorax caledonicus* | Nankeen Night Heron | P | N | WA- |
| Order: *Ciconiiformes*<br>Family: *Ciconiidae* | | | | |
| *Ephippiorhynchus asiaticus* | Black-necked Stork | E1 | N | WA- |

Class: *Aves* - Continued

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Ciconiiformes*<br>Family: *Threskiornithidae* | | | | |
| *Threskiornis molucca* | Australian White Ibis | P | N | WA- |
| *Platalea regia* | Royal Spoonbill | P | N | WA- |
| *Threskiornis spinicollis* | Straw-necked Ibis | P | N | WA- |
| Order: *Columbiformes*<br>Family: *Columbidae* | | | | |
| *Chalcophaps indica* | Emerald Dove | P | N | WA- |
| *Columba leucomela* | White-headed Pigeon | P | N | WA- |
| *Geopelia humeralis* | Bar-shouldered Dove | P | N | WA- |
| *Lopholaimus antarcticus* | Topknot Pigeon | P | N | WA- |
| *Leucosarcia melanoleuca* | Wonga Pigeon | P | N | WA- |
| *Macropygia amboinensis* | Brown Cuckoo-Dove | P | N | WA- |
| *Phaps chalcoptera* | Common Bronzewing | P | N | WA-,PSo |
| *Phaps elegans* | Brush Bronzewing | P | N | WA- |
| *Ocyphaps lophotes* | Crested Pigeon | P | N | WA-,PSo |
| *Streptopelia chinensis* | Spotted Turtle-Dove | U | E | WA- |
| Order: *Coraciiformes*<br>Family: *Alcedinidae* | | | | |
| *Alcedo azurea* | Azure Kingfisher | P | N | WA- |
| *Dacelo novaeguineae* | Laughing Kookaburra | P | N | WA-,PSo |
| *Todiramphus macleayii* | Forest Kingfisher | P | N | WA- |
| *Todiramphus sanctus* | Sacred Kingfisher | P | N | WA- |
| Order: *Coraciiformes*<br>Family: *Coraciidae* | | | | |
| *Eurystomus orientalis* | Dollarbird | P | N | WA- |
| Order: *Coraciiformes*<br>Family: *Meropidae* | | | | |
| *Merops ornatus* | Rainbow Bee-eater | P | N | WA- |
| Order: *Cuculiformes*<br>Family: *Centropodidae* | | | | |
| *Centropus phasianinus* | Pheasant Coucal | P | N | WA- |
| Order: *Cuculiformes*<br>Family: *Cuculidae* | | | | |
| *Cacomantis flabelliformis* | Fan-tailed Cuckoo | P | N | WA- |
| *Cacomantis variolosus* | Brush Cuckoo | P | N | WA- |
| *Cuculus pallidus* | Pallid Cuckoo | P | N | WA- |
| *Scythrops novaehollandiae* | Channel-billed Cuckoo | P | N | WA- |
| Order: *Falconiformes*<br>Family: *Accipitridae* | | | | |
| *Accipiter fasciatus* | Brown Goshawk | P | N | WA- |
| *Aquila audax* | Wedge-tailed Eagle | P | N | WA-,PSo |
| *Aviceda subcristata* | Pacific Baza | P | N | WA- |
| *Circus approximans* | Swamp Harrier | P | N | WA- |
| *Elanus axillaris* | Black-shouldered Kite | P | N | WA-,PSo |
| *Haliastur sphenurus* | Whistling Kite | P | N | WA- |

Class: *Aves* - Continued

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Falconiformes* - continued<br>Family: *Accipitridae* | | | | |
| *Haliaeetus leucogaster* | White-bellied Sea-Eagle | P | N | WA- |
| *Hieraaetus morphnoides* | Little Eagle | P | N | WA- |
| *Lophoictinia isura* | Square-tailed Kite | V | N | WA- |
| *Pandion haliaetus* | Osprey | V | N | WA- |
| Order: *Falconiformes*<br>Family: *Falconidae* | | | | |
| *Falco berigora* | Brown Falcon | P | N | WA- |
| Order: *Galliformes*<br>Family: *Megapodiidae* | | | | |
| *Alectura lathami* | Australian Brush-turkey | P | N | WA- |
| Order: *Galliformes*<br>Family: *Phasianidae* | | | | |
| *Coturnix chinensis* | King Quail | P | N | WA- |
| *Coturnix pectoralis* | Stubble Quail | P | N | WA- |
| *Coturnix ypsilophora* | Brown Quail | P | N | WA- |
| Order: *Galliformes*<br>Family: *Rallidae* | | | | |
| *Gallinula tenebrosa* | Dusky Moorhen | P | N | WA- |
| *Gallirallus philippensis* | Buff-banded Rail | P | N | WA- |
| *Porphyrio porphyrio* | Purple Swamphen | P | N | WA- |
| *Porzana tabuensis* | Spotless Crake | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Acanthizidae* | | | | |
| *Acanthiza lineata* | Striated Thornbill | P | N | WA- |
| *Acanthiza pusilla* | Brown Thornbill | P | N | WA- |
| *Acanthiza nana* | Yellow Thornbill | P | N | WA- |
| *Gerygone mouki* | Brown Gerygone | P | N | WA- |
| *Gerygone olivacea* | White-throated Gerygone | P | N | WA- |
| *Sericornis citreogularis* | Yellow-throated Scrubwren | P | N | WA- |
| *Sericornis frontalis* | White-browed Scrubwren | P | N | WA- |
| *Sericornis magnirostris* | Large-billed Scrubwren | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Artamidae* | | | | |
| *Artamus cyanopterus* | Dusky Woodswallow | P | N | WA- |
| *Cracticus nigrogularis* | Pied Butcherbird | P | N | WA- |
| *Cracticus torquatus* | Grey Butcherbird | P | N | WA-,PSo |
| *Gymnorhina tibicen* | Australian Magpie | P | N | WA-,PSo |
| *Strepera graculina* | Pied Currawong | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Campephagidae* | | | | |
| *Coracina novaehollandiae* | Black-faced Cuckoo-shrike | P | N | WA-,PSo |
| *Coracina tenuirostris* | Cicadabird | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Climacteridae* | | | | |
| *Cormobates leucophaeus* | White-throated Treecreeper | P | N | WA- |

Class: *Aves* - Continued

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Passeriformes* Family: *Corcoracidae* | | | | |
| *Corcorax melanorhamphos* | White-winged Chough | P | N | WA- |
| Order: *Passeriformes* Family: *Corvidae* | | | | |
| *Corvus coronoides* | Australian Raven | P | N | WA-,PSo |
| *Corvus orru* | Torresian Crow | P | N | WA- |
| *Corvus tasmanicus* | Forest Raven | P | N | WA- |
| Order: *Passeriformes* Family: *Dicaeidae* | | | | |
| *Dicaeum hirundinaceum* | Mistletoebird | P | N | WA- |
| Order: *Passeriformes* Family: *Dicruridae* | | | | |
| *Dicrurus bracteatus* | Spangled Drongo | P | N | WA- |
| *Grallina cyanoleuca* | Magpie-lark | P | N | WA- |
| *Monarcha trivirgatus* | Spectacled Monarch | P | N | WA- |
| *Monarcha melanopsis* | Black-faced Monarch | P | N | WA- |
| *Myiagra rubecula* | Leaden Flycatcher | P | N | WA- |
| *Rhipidura fuliginosa* | Grey Fantail | P | N | PSo |
| *Rhipidura leucophrys* | Willie Wagtail | P | N | WA-,PSo |
| *Rhipidura rufifrons* | Rufous Fantail | P | N | WA- |
| Order: *Passeriformes* Family: *Estrildidae* | | | | |
| *Lonchura castaneothorax* | Chestnut-breasted Mannikin | P | N | WA- |
| *Neochmia temporalis* | Red-browed Finch | P | N | WA-,PSo |
| *Taeniopygia bichenovii* | Double-barred Finch | P | N | WA- |
| Order: *Passeriformes* Family: *Eupetidae* | | | | |
| *Psophodes olivaceus* | Eastern Whipbird | P | N | WA- |
| Order: *Passeriformes* Family: *Hirundinidae* | | | | |
| *Hirundo neoxena* | Welcome Swallow | P | N | WA-,PSo |
| Order: *Passeriformes* Family: *Maluridae* | | | | |
| *Malurus cyaneus* | Superb Fairy-wren | P | N | WA-,PSo |
| *Malurus lamberti* | Variegated Fairy-wren | P | N | WA- |
| Order: *Passeriformes* Family: *Meliphagidae* | | | | |
| *Acanthorhynchus tenuirostris* | Eastern Spinebill | P | N | WA-,PSo |
| *Anthochaera carunculata* | Red Wattlebird | P | N | WA- |
| *Anthochaera chrysoptera* | Little Wattlebird | P | N | WA- |
| *Lichenostomus chrysops* | Yellow-faced Honeyeater | P | N | WA- |
| *Lichenostomus leucotis* | White-eared Honeyeater | P | N | WA-,PSo |
| *Lichenostomus penicillatus* | White-plumed Honeyeater | P | N | WA- |
| *Lichmera indistincta* | Brown Honeyeater | P | N | PSo |
| *Manorina melanocephala* | Noisy Miner | P | N | WA-,PSo |
| *Manorina melanophrys* | Bell Miner | P | N | WA- |

Class: *Aves* - Continued

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Passeriformes* - continued<br>Family: *Meliphagidae* | | | | |
| *Meliphaga lewinii* | Lewin's Honeyeater | P | N | WA-,PSo |
| *Melithreptus lunatus* | White-naped Honeyeater | P | N | WA- |
| *Myzomela sanguinolenta* | Scarlet Honeyeater | P | N | WA- |
| *Philemon corniculatus* | Noisy Friarbird | P | N | WA- |
| *Phylidonyris nigra* | White-cheeked Honeyeater | P | N | WA- |
| *Phylidonyris novaehollandiae* | New Holland Honeyeater | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Menuridae* | | | | |
| *Menura novaehollandiae* | Superb Lyrebird | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Muscicapidae* | | | | |
| *Cisticola exilis* | Golden-headed Cisticola | P | N | WA- |
| *Zoothera dauma* | Ground Thrush | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Neosittidae* | | | | |
| *Daphoenositta chrysoptera* | Varied Sittella | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Oriolidae* | | | | |
| *Sphecotheres vieilloti* | Australasian Figbird | P | N | WA- PSo |
| *Oriolus sagittatus* | Olive-backed Oriole | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Pachychephalidae* | | | | |
| *Colluricincla harmonica* | Grey Shrike-thrush | P | N | WA- |
| *Falcunculus frontatus* | Crested Shrike-tit | P | N | WA- |
| *Pachycephala pectoralis* | Golden Whistler | P | N | WA- |
| *Pachycephala rufiventris* | Rufous Whistler | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Pardalotidae* | | | | |
| *Pardalotus punctatus* | Spotted Pardalote | P | N | WA- |
| *Pardalotus striatus* | Striated Pardalote | P | N | WA- PSo |
| Order: *Passeriformes*<br>Family: *Passeridae* | | | | |
| *Passer domesticus* | House Sparrow | U | E | WA- |
| Order: *Passeriformes*<br>Family: *Petrocidae* | | | | |
| *Eopsaltria australis* | Eastern Yellow Robin | P | N | WA- PSo |
| *Microeca fascinans* | Jacky Winter | P | N | WA- PSo |
| *Petroica rosea* | Rose Robin | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Pittidae* | | | | |
| *Pitta versicolor* | Noisy Pitta | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Ptilonorhynchinae* | | | | |
| *Ailuroedus crassirostris* | Green Catbird | P | N | WA- |
| *Sericulus chrysocephalus* | Regent Bowerbird | P | N | WA- |
| *Ptilonorhynchus violaceus* | Satin Bowerbird | P | N | WA- |

Class: *Aves* - Continued

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Passeriformes*<br>Family: *Sturnidae* | | | | |
| *Acridotheres tristis* | Common Myna | U | E | WA- |
| Order: *Passeriformes*<br>Family: *Sylviidae* | | | | |
| *Megalurus timoriensis* | Tawny Grassbird | P | N | WA- |
| Order: *Passeriformes*<br>Family: *Zosteropidae* | | | | |
| *Zosterops lateralis* | Silvereye | P | N | WA-PSo |
| Order: *Pelecaniformes*<br>Family: *Pelecanidae* | | | | |
| *Pelecanus conspicillatus* | Australian Pelican | P | N | WA- |
| Order: *Pelecaniformes*<br>Family: *Phalacrocoracidae* | | | | |
| *Phalacrocorax carbo* | Great Cormorant | P | N | WA- |
| *Phalacrocorax sulcirostris* | Little Black Cormorant | P | N | WA- |
| *Phalacrocorax varius* | Pied Cormorant | P | N | WA- |
| Order: *Psittaciformes*<br>Family: *Cacatuidae* | | | | |
| *Calyptorhynchus funereus* | Yellow-tailed Black-Cockatoo | P | N | WA- |
| *Calyptorhynchus lathami* | Glossy Black-Cockatoo | V | N | WA- |
| *Cacatua galerita* | Sulphur-crested Cockatoo | P | N | WA- |
| *Cacatua sanguinea* | Little Corella | P | N | WA- |
| Order: *Psittaciformes*<br>Family: *Psittacidae* | | | | |
| *Alisterus scapularis* | King Parrot | P | N | WA- PSo |
| *Glossopsitta concinna* | Musk Lorikeet | P | N | WA- |
| *Glossopsitta pusilla* | Little Lorikeet | P | N | WA- |
| *Platycercus elegans* | Crimson Rosella | P | N | WA- |
| *Trichoglossus chlorolepidotus* | Scaly-breasted Lorikeet | P | N | WA- |
| *Trichoglossus haematodus* | Rainbow Lorikeet | P | N | WA- |
| Order: *Strigiformes*<br>Family: *Strigidae* | | | | |
| *Ninox connivens* | Barking Owl | V | N | WA- |
| *Ninox strenua* | Powerful Owl | V | N | WA- PSm? |
| Order: *Strigiformes*<br>Family: *Tytonidae* | | | | |
| *Tyto novaehollandiae* | Masked Owl | V | N | WA- |
| *Tyto tenebricosa* | Sooty Owl | V | N | WA- |

Class: *Mammalia* (*Eutheria*)

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Artiodactyla*<br>Family: *Bovidae* | | | | |
| *Bos taurus* | Cattle | U | E | WA- |
| Order: *Cetacea*<br>Family: *Delphinidae* | | | | |
| *Tursiops truncatus* | Bottlenose Dolphin | P | N | WA- |
| *Delphinus delphis* | Common Dolphin | P | N | WA- |
| Order: *Cetacea*<br>Family: *Physeteridae* | | | | |
| *Kogia breviceps* | Pygmy Sperm Whale | P | N | WA- |
| Order: *Chiroptera*<br>Family: *Molossidae* | | | | |
| *Mormopterus norfolkensis* | Eastern Little Mastiff-bat | V | | WA- |
| *Mormopterus sp.* | Long Penis Form | P | N | WA- |
| *Nyctinomus australis* | White-striped Mastiff-bat | P | N | WA- |
| Order: *Chiroptera*<br>Family: *Pteropodidae* | | | | |
| *Pteropus sp.* | Flying Fox | P | N | WA- |
| *Pteropus poliocephalus* | Grey-headed Flying-fox | V | N | WA- |
| *Pteropus scapulatus* | Little Red Flying-fox | P | N | WA- |
| Order: *Chiroptera*<br>Family: *Rhinolophidae* | | | | |
| *Rhinolophus megaphyllus* | Eastern Horseshoe-bat | P | N | WA- |
| Order: *Chiroptera*<br>Family: *Vespertilionidae* | | | | |
| *Chalinolobus gouldii* | Gould's Wattled Bat | P | N | WA- |
| *Chalinolobus morio* | Chocolate Wattled Bat | P | N | WA- |
| *Miniopterus australis* | Little Bent-wing Bat | V | N | WA- |
| *Nyctophilus gouldi* | Gould's Long-eared Bat | P | N | WA- |
| *Nyctophilus geoffroyi* | Lesser Long-eared Bat | P | N | WA- |
| *Nyctophilus sp.* | Long-eared Bat | P | N | WA- |
| *Scotorepens orion* | Eastern Broad-nosed Bat | P | N | WA- |
| *Vespadelus darlingtoni* | Large Forest Bat | P | N | WA- |
| *Vespadelus pumilus* | Eastern Forest Bat | P | N | WA- |
| *Vespadelus regulus* | King River Eptesicus | P | N | WA- |
| *Vespadelus vulturnus* | Little Forest Eptesicus | P | N | WA- |
| Order: *Fissipedia*<br>Family: *Canidae* | | | | |
| *Vulpes vulpes* | Fox | U | E | WA- |
| Order: *Fissipedia*<br>Family: *Felidae* | | | | |
| *Felis catus* | Cat | U | E | WA- |
| Order: *Lagomorpha*<br>Family: *Leporidae* | | | | |
| *Lepus capensis* | Brown Hare | U | E | WA- |
| *Oryctolagus cuniculus* | Rabbit | U | E | WA- |

Class: *Mammalia* (*Eutheria*) - Continued

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Perrisodactyla*<br>Family: *Equidae* | | | | |
| *Equus caballus* | Horse | U | E | WA- |
| Order: *Rodentia*<br>Family: *Muridae* | | | | |
| *Mus musculus* | House Mouse | U | E | WA- |
| *Pseudomys novaehollandiae* | New Holland Mouse | P | N | WA- |
| *Rattus fuscipes* | Bush Rat | P | N | WA- |
| *Rattus lutreolus* | Swamp Rat | P | N | WA- |
| *Rattus rattus* | Black Rat | U | E | WA- |
| *Rattus sp.* | Rat | P | N | WA- |

Class: *Mammalia* (*Marsupialia*)

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Dasyuromorphia*<br>Family: *Dasyuridae* | | | | |
| *Antechinus flavipes* | Yellow-footed Antechinus | P | N | WA-,PSo |
| *Antechinus stuartii* | Brown Antechinus | P | N | WA-,PSo |
| *Dasyurus maculatus* | Tiger Quoll | V | N | WA- |
| *Phascogale tapoatafa* | Brush-tailed Phascogale | V | N | WA- |
| *Sminthopsis murina* | Common Dunnart | P | N | WA- |
| Order: *Diprodonta*<br>Family: *Burramyidae* | | | | |
| *Acrobates pygmaeus* | Feathertail Glider | P | N | WA- |
| Order: *Diprodonta*<br>Family: *Macropodidae* | | | | |
| *Macropus giganteus* | Eastern Grey Kangaroo | P | N | WA-,PSo |
| *Macropus rufogriseus* | Red-necked Wallaby | P | N | WA- |
| *Thylogale thetis* | Red-necked Pademelon | P | N | WA- |
| *Wallabia bicolor* | Swamp Wallaby | P | N | WA-,PSo |
| Order: *Diprodonta*<br>Family: *Petauridae* | | | | |
| *Petauroides volans* | Greater Glider | P | N | WA- |
| *Petaurus australis* | Yellow-bellied Glider | V | N | WA- |
| *Petaurus breviceps* | Sugar Glider | P | N | WA- |
| *Petaurus norfolcensis* | Squirrel Glider | V | N | WA- |
| *Pseudocheirus peregrinus* | Common Ringtail Possum | P | N | WA- |
| Order: *Diprodonta*<br>Family: *Phalangeridae* | | | | |
| *Trichosurus caninus* | Mountain Brushtail Possum | P | N | WA- |
| *Trichosurus vulpecula* | Common Brushtail Possum | P | N | WA- |
| Order: *Diprodonta*<br>Family: *Phascolarctidae* | | | | |
| *Phascolarctos cinereus* | Koala | V | N | WA- |

Class: *Mammalia* (*Marsupialia*) – Continued

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Peramelina*<br>Family: *Peramelidae* | | | | |
| *Isoodon macrourus* | Northern Brown Bandicoot | P | N | WA- |
| *Perameles nasuta* | Long-nosed Bandicoot | P | N | WA- |

Class: *Mammalia* (*Prototheria*)

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Monotremata*<br>Family: *Ornithorhynchidae* | | | | |
| *Ornithorhynchus anatinus* | Platypus | P | N | WA- |
| Order: *Monotremata*<br>Family: *Tachyglossidae* | | | | |
| *Tachyglossus aculeatus* | Short-beaked Echidna | P | N | WA-,PSf |

Class: *Reptilia*

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Serpentes*<br>Family: *Boidae* | | | | |
| *Morelia spilota* | Carpet or Diamond Python | P | N | WA- |
| *Morelia spilota spilota* | Diamond Python | P | N | WA- |
| Order: *Serpentes*<br>Family: *Elapidae* | | | | |
| *Acanthophis antarcticus* | Common Death Adder | P | N | WA- |
| *Cacophis squamulosus* | Golden Crowned Snake | P | N | WA- |
| *Hemiaspis signata* | Black-bellied Swamp Snake | P | N | WA- |
| *Notechis scutatus* | Eastern Tiger Snake | P | N | WA- |
| *Pseudechis porphyriacus* | Red-bellied Black Snake | P | N | WA- |
| *Pseudonaja textilis* | Eastern Brown Snake | P | N | WA- |
| *Rhinoplocephalus nigrescens* | Eastern Small-eyed Snake | P | N | WA- |
| *Vermicella annulata* | Bandy Bandy | P | N | WA- |
| Order: *Serpentes*<br>Family: *Typhlopidae* | | | | |
| *Ramphotyphlops nigrescens* | | P | N | WA- |
| Order: *Squamata*<br>Family: *Agamidae* | | | | |
| *Amphibolurus muricatus* | Jacky Lizard | P | N | WA- PSo |
| *Hypsilurus spinipes* | Southern Angle-headed Dragon | P | N | WA- |
| *Physignathus lesueurii* | Eastern Water Dragon | P | N | WA- |
| *Pogona barbata* | Bearded Dragon | P | N | WA- |
| Order: *Squamata*<br>Family: *Pygopodidae* | | | | |
| *Pygopus lepidopodus* | Common Scaly-foot | P | N | WA- |

Class: *Reptilia* - Continued

| Scientific Name | Common Name | NSW Status | Origin | Record |
|---|---|---|---|---|
| Order: *Squamata*<br>Family: *Scincidae* | | | | |
| *Calyptotis ruficauda* | | P | N | WA- |
| *Cryptoblepharus virgatus* | Wall Lizard | P | N | WA- |
| *Ctenotus robustus* | Striped Skink | P | N | WA- |
| *Ctenotus taeniolatus* | Copper-tailed Skink | P | N | WA- |
| *Egernia major* | Land Mullet | P | N | WA- |
| *Eulamprus murrayi* | | P | N | WA- |
| *Eulamprus quoyii* | Eastern Water Skink | P | N | WA- |
| *Lampropholis delicata* | Grass Skink | P | N | WA- PSo |
| *Lampropholis guichenoti* | Garden Skink | P | N | WA- |
| *Saproscincus mustelinus* | Weasel Skink | P | | |
| *Tiliqua scincoides* | Eastern Blue-tongued Lizard | P | N | WA- |
| Order: *Squamata*<br>Family: *Varanidae* | | | | |
| *Varanus varius* | Lace Monitor | P | N | WA-PSo |
| Order: *Testudinata*<br>Family: *Chelidae* | | | | |
| *Chelodina longicollis* | Eastern Long-necked Turtle | P | N | WA- |

# Appendix 2: Flora of the Local Area

Nomenclature follows Harden (1992, 1993, 2000 and 2002) and subsequent recent revisions.
N/I – Indicates species origin
- N - native to local area
- I - not native to Australia and includes species native to Australia but not to local area
- I? - Likely to be not native to Australia

NSW Status
- U - Unprotected
- P13 - Listed on Schedule 13 of National Parks and Wildlife Act 1975
- Nx - Indicates species listed as Noxious.

Class: *Filicopsida*

| Scientific Name | Common | N/I | NSW Status |
|---|---|---|---|
| Family: *Adiantaceae* | | | |
| *Adiantum hispidulum* | Rough Maidenhair | N | P13 |
| Family: *Blechnaceae* | | | |
| *Doodia aspera* | | N | U |
| Family: *Dennstaedtiaceae* | | | |
| *Pteridium esculentum* | Bracken | N | U |
| Family: *Lindsaeaceae* | | | |
| *Lindsaea microphylla* | Lacy Wedge Fern | N | U |
| Family: *Polypodiaceae* | | | |
| *Platycerium bifurcatum* | Elkhorn | N | P13 |
| Family: *Sinopteridaceae* | | | |
| *Cheilanthes sieberi subsp. sieberi* | Mulga Fern | N | U |

Class: *Magnoliopsida* (*Liliidae*)

| Scientific Name | Common | N/I | NSW Status |
|---|---|---|---|
| Family: *Arecaceae* | | | |
| *Livistona australis* | Cabbage Palm | N | P13 |
| Family: *Asteliaceae* | | | |
| *Cordyline stricta* | Narrow-leaved Palm Lily | N | U |
| Family: *Commelinaceae* | | | |
| *Commelina cyanea* | | N | U |
| Family: *Cyperaceae* | | | |
| *Carex appressa* | | N | U |
| *Lepidosperma laterale* | | N | U |
| Family: *Dioscoreaceae* | | | |
| *Dioscorea transversa* | Native Yam | N | U |
| Family: *Lomandraceae* | | | |
| *Lomandra longifolia* | Spiny-headed Mat-rush | N | U |
| *Lomandra multiflora subsp. multiflora* | Many-flowered Mat-rush | N | U |
| Family: *Luzuriagaceae* | | | |
| *Eustrephus latifolius* | Wombat Berry | N | U |
| *Geitonoplesium cymosum* | Scrambling Lily | N | U |
| Family: *Orchidaceae* | | | |
| *Caladenia carnea var. carnea* | Pink Fairy | N | U |
| *Cymbidium suave* | Snake Orchid | N | P13 |

Class: *Magnoliopsida* (*Liliidae*)

| Scientific Name | Common | N/I | NSW Status |
|---|---|---|---|
| Family: *Philydraceae* | | | |
| *Philydrum lanuginosum* | Frogsmouth | N | U |
| Family: *Phormiaceae* | | | |
| *Dianella caerulea var. producta* | | N | U |
| Family: *Poaceae* | | | |
| *Andropogon virginicus* | Whiskey Grass | I | U |
| *Aristida vagans* | Threeawn Speargrass | N | U |
| *Briza major* | Quaking Grass | I | U |
| *Chloris gayana* | Rhodes Grass | I | U |
| *Cymbopogon refractus* | Barbed Wiregrass | N | U |
| *Echinopogon caespitosus var. caespitosus* | | N | U |
| *Entolasia marginata* | Boardered Panic | N | U |
| *Erogrostis sp.* | | N | U |
| *Imperata cylindrica var. major* | Blady Grass | N | U |
| *Melinis repens* | Red Natal Grass | I | U |
| *Panicum simile* | Two Colour Panic | N | U |
| *Paspalum dilatatum* | Paspalum | I | U |
| *Pennisetum clandestinum* | Kikuyu | I | U |
| *Setaria sp.* | | I | U |
| *Sporobolus sp.* | | I? | U |
| *Themeda australis* | Kangaroo Grass | N | U |
| Family: *Smilacaceae* | | | |
| *Smilax australis* | Sarsaparilla | N | U |

Class: *Magnoliopsida* (*Magnoliidae*)

| Scientific Name | Common | N/I | NSW Status |
|---|---|---|---|
| Family: *Apocynaceae* | | | |
| *Parsonsia straminea* | Common Silkpod | N | U |
| Family: *Araliaceae* | | | |
| *Polyscias sambucifolia subsp .A* | Elderberry Panax | N | U |
| Family: *Asteraceae* | | | |
| *Ageratina adenophora* | Crofton Weed | I | U,Nx |
| *Bidens pilosa* | Pitchfolks | I | U |
| *Cassinia aureonitens* | | N | U |
| *Hypochaeris radicata* | Flatweed | I | U |
| *Ozothamnus diosmifolius* | White Dogwood | N | U |
| *Senecio madagascariensis* | Fireweed | I | U |
| *Tagetes minuta* | Stinking Roger | I | U |
| *Vernonia cinerea var. cinerea* | | N | U |
| Family: *Casuarinaceae* | | | |
| *Allocasuarina littoralis* | Black Oak | N | U |
| *Allocasuarina torulosa* | Forest Oak | N | U |
| *Casuarina glauca* | Swamp Oak | N | U |
| Family: *Celastraceae* | | | |
| *Maytenus silvestris* | Narrow-leaved Orangebark | N | U |

Class: *Magnoliopsida* (*Magnoliidae*) - continued

| Scientific Name | Common | N/I | NSW Status |
|---|---|---|---|
| Family: *Chenopodiaceae* | | | |
| *Einadia hastata* | Berry Saltbush | N | U |
| Family: *Convolvulaceae* | | | |
| *Dichondra repens* | Kidney Weed | N | U |
| Family: *Dilleniaceae* | | | |
| *Hibbertia obtusifolia* | | N | U |
| *Hibbertia scandens* | Climbing Guinea Flower | N | U |
| Family: *Epacridaceae* | | | |
| *Leucopogon juniperinus* | | N | U |
| *Trochocarpa laurina* | Tree Heath | N | U |
| Family: *Euphorbiaceae* | | | |
| *Breynia oblongifolia* | Coffee Bush | N | U |
| *Glochidion ferdinandi var. ferdinandi* | Cheese Tree | N | U |
| Family: *Fabaceae* (*Faboideae*) | | | |
| *Hardenbergia violacea* | False Sarsaprilla | N | U |
| *Daviesia ulicifolia subsp. ulicifolia* | Gorse Bitter Pea | N | U |
| *Glycine microphylla* | | N | U |
| *Hardenbergia violacea* | False Sarsaprilla | N | U |
| *Indigofera australis* | | N | U |
| *Jacksonia scoparia* | | N | U |
| *Kennedia rubicunda* | Red Running Pea | N | U |
| *Pultenaea villosa* | | N | U |
| Family: *Fabaceae* (*Mimosoideae*) | | | |
| *Acacia brownii* | Heath Wattle | N | U |
| *Acacia decora* | Western Golden Wattle | N | U |
| *Acacia falcata* | | N | U |
| *Acacia irrorata* | Green Wattle | N | U |
| *Acacia myrtifolia* | Red-stemmed Wattle | N | U |
| *Acacia ulicifolia* | Prickly Moses | N | U |
| Family: *Goodeniaceae* | | | |
| *Goodenia heterophylla subsp. heterophylla* | | N | U |
| Family: *Lauraceae* | | | |
| *Cinnamomum camphora* | Camphor Laurel | I | U,Nx |
| Family: *Lobeliaceae* | | | |
| *Pratia purpurascens* | White Root | N | U |
| Family: *Malvaceae* | | | |
| *Sida rhombifolia* | Paddy's Lucerne | I | U |
| Family: *Meliaceae* | | | |
| *Melia azedarach* | White Cedar | N | U |
| Family: *Menispermaceae* | | | |
| *Stephania japonica var. discolor* | Snake Vine | N | U |
| Family: *Moraceae* | | | |
| *Maclura cochinchinensis* | Cockspur Thorn | N | U |
| Family: *Myrtaceae* | | | |
| *Baeckea diosmifolia* | | N | U |
| *Callistemon salignus* | Sweet Willow Bottlebrush | N | U |

Class: *Magnoliopsida* (*Magnoliidae*) - continued

| Scientific Name | Common | N/I | NSW Status |
|---|---|---|---|
| Family: *Myrtaceae* - continued | | | |
| *Corymbia intermedia* | Pink Bloodwood | N | U |
| *Corymbia maculata* | Spotted Gum | N | U |
| *Eucalyptus acmenoides* | White Mahogany | N | U |
| *Eucalyptus microcorys* | Tallowwood | N | U |
| *Eucalyptus pilularis* | Blackbutt | N | U |
| *Eucalyptus propinqua* | Grey Gum | N | U |
| *Eucalyptus robusta* | Swamp Mahogany | N | U |
| *Eucalyptus saligna* | Sydney Blue Gum | N | U |
| *Eucalyptus siderophloia* | Grey Ironbark | N | U |
| *Eucalyptus tereticornis* | Forest Red Gum | N | U |
| *Lophostemon confertus* | Brush Box | N | U |
| *Melaleuca linariifolia* | Paperbark | N | U |
| *Melaleuca quinquenervia* | Paperbark | N | U |
| *Melaleuca styphelioides* | Prickly-leaved Teatree | N | U |
| *Melaleuca thymifolia* | | N | U |
| *Syzygium oleosum* | Blue Lilly Pilly | N | U |
| *Syncarpia glomulifera subsp. glomulifera* | Turpentine | N | U |
| *Waterhousea floribunda* | Weeping Lilly Pilly | N | U |
| Family: *Oleaceae* | | | |
| *Ligustrum sinense* | Small-leaved Privet | I | U,Nx |
| *Notelaea longifolia f. longifolia* | Large Mock-olive | N | U |
| Family: *Oxalidaceae* | | | |
| *Oxalis perennans* | | N | U |
| Family: *Pittosporaceae* | | | |
| Billardiera scandens var. sericata | Appleberry | N | U |
| *Pittosporum undulatum* | Pittosporum | N | U |
| Family: *Plantaginaceae* | | | |
| *Plantago lanceolata* | Flaxleaf Plantain | I | U |
| Family: *Proteaceae* | | | |
| *Persoonia linearis* | Narrow-leaved Geebung | N | U |
| Family: *Ranunculaceae* | | | |
| *Clematis glycinoides var. glycinoides* | Headache Vine | N | U |
| *Ranunculus inundatus* | | N | U |
| Family: *Rhamnaceae* | | | |
| *Alphitonia excelsa* | Red Ash | N | U |
| Family: *Rosaceae* | | | |
| *Rubus discolor* | Blackberry | I | U,Nx |
| Family: *Rubiaceae* | | | |
| *Pomax umbellata* | | N | U |
| Family: *Rutaceae* | | | |
| *Zieria smithii* | Sandfly Zieria | N | U |
| Family: *Santalaceae* | | | |
| *Exocarpos cupressiformis* | Native Cherry | N | U |
| Family: *Sapindaceae* | | | |
| *Dodonaea triquetra* | | N | U |

Class: *Magnoliopsida* (*Magnoliidae*) - continued

| Scientific Name | Common | N/I | NSW Status |
|---|---|---|---|
| Family: *Scrophulariaceae* | | | |
| *Veronica persica* | Creeping Speedwell | I | U |
| Family: *Solanaceae* | | | |
| *Solanum mauritianum* | Wild Tobacco Bush | I | U |
| *Solanum nigrum* | Black-berry Nightshade | I | U |
| Family: *Thymelaeaceae* | | | |
| *Pimelea linifolia subsp. linifolia* | | N | U |
| Family: *Ulmaceae* | | | |
| *Trema tomentosa* | Poison Peach | N | U |
| Family: *Verbenaceae* | | | |
| *Lantana camara* | Lantana | I | U,Nx |
| *Verbena rigida* | Veined Verbena | I | U |
| Family: *Violaceae* | | | |
| *Viola hederacea* | Ivy-leaved Violet | N | U |

# Appendix 3: TSC Act Section 94 Assessment: Significant effect on threatened species, populations or ecological communities, or their habitats

An assessment under Section 94 of the TSC Act, to determine whether an action proposed is likely to significantly affect threatened species, populations or ecological communities, or their habitats, is required when the proposed action is not on land that is critical habitat and the application is not accompanied by a species impact statement. The following is the assessment of impact to species, identified in **Section 5.3**, considered likely to have habitat present within the study area.

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

**Glossy Black-Cockatoo (*Calyptorhynchus lathami*) – Vulnerable**
This species was not recorded within the study area, either directly through observation or indirectly through evidence of foraging. The Glossy Black-cockatoo is dependant on the presence of *Allocasuarina* species as it is a specialist forager of the seeds of these species. Given the species breeds during autumn and winter, and assuming the species would be foraging nearby, it is expected the characteristic discarded remains of *Allocasuarina* sp. follicles would be present. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Square-tailed Kite (*Lophoictinia isura*) – Vulnerable**
This species was not recorded within the study area. No large raptor nests were observed. It is therefore unlikely that a viable local population is reliant on habitats adjacent to the existing highway.

**Barking Owl (*Ninox connivens*) – Vulnerable**
The Barking Owl did not respond to the playback of territorial calls and was not observed within the study area. It is unlikely the species utilises the study area significantly. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Powerful Owl (*Ninox strenua*) – Vulnerable**
A large egg, potentially laid by a Powerful Owl, was observed within the study area. However the species was not observed emerging from the tree with hollows where the egg was found. The tree was observed up to half an hour from dusk and there was no response to the playback of territorial calls. It is unlikely the species utilises the study area significantly or, if breeding does occur within the tree that the young had already fledged and left the nest. Breeding usually takes place from mid-autumn to mid-winter (Higgins 1999). The tree where the egg was observed is located between the existing northbound and southbound carriageways of the Pacific Highway. Noise and movement disturbances are likely to decrease after the completion of the proposed highway upgrade as the existing northbound carriageway will be restricted to local traffic only. However, noise and movement disturbances near the potential nest site are likely to increase during the construction phase, particularly during the construction of the Bullocky Way overpass of the Pacific Highway and intersection with the present northbound carriageway.

Confirmation of the presence of this species should be undertaken prior to construction activities. If it is present, clearing, earthmoving and use of other heavy plant in the island between the existing Pacific Highway carriageways should, if possible, be undertaken prior to the identified breeding period (Higgins 1999). If the species is found to be breeding within the island remnant, control measures such as establishing a 500 m buffer between trees used for breeding and construction activities involving clearing and earth moving should be considered. It is unlikely there will be an adverse effect on the life cycle of a viable population by the proposed highway upgrade if the timing of the construction activities acknowledges the nesting period of the owl.

**Grass Owl (*Tyto capensis*) – Vulnerable**
This species was not recorded within the study area. Preferred habitat types for this species are limited to a small area of woodland with a wet tussock grass groundcover, west of the proposed Failford Road exit from the Pacific Highway. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Masked Owl (*Tyto novaehollandiae*) – Vulnerable**
The Masked Owl did not respond to the playback of territorial calls and was not observed within the study area. It is unlikely the species utilises the study area significantly. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Spotted-tailed Quoll (*Dasyurus maculatus*) – Vulnerable**
This species was not recorded within the study area. There are few potential den sites within the study area and it is therefore unlikely the species utilises the study area significantly. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Little Bentwing-bat (*Miniopterus australis*) – Vulnerable**
The Little Bent-wing Bat requires specific nursery sites in subterranean locations to raise young, the southern most being in the Macleay River catchment (Dwyer 1998a), approximately 100 km to the north of the study area. There are no subterranean habitats within the study area that would be utilised for roosting, apart from minor culverts. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Eastern Bentwing-bat (*Miniopterus schreibersii* oceanensis) – Vulnerable**
The roost sites for this species includes underground mine workings, caves, stormwater culverts and occasionally buildings, however nursery caves have specific temperature and humidity regimes (Dwyer 1998b). There are no subterranean habitats within the study area that would be utilised for roosting, apart from minor culverts. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Eastern Freetail-bat (*Mormopterus norfolkensis*) – Vulnerable**
The species mainly roosts in trees, although it has been know to utilise man-made structures (Allison and Hoye 1998). There are potential roosts within the study area that will be removed as part of the proposed development, however there is unlikely to be a significant reduction compared to the hollows and dead trees located to the east of the proposed southbound carriage way and along Possum Brush Road. It is recommended that tree hollows that are lost be replaced with artificial roosts, located within the present remnants between the existing north and southbound carriageways. These islands are likely to have fewer large predators such as Lace Monitors that may damage the roost boxes when searching for food. There is no information regarding the timing of breeding (Allison and Hoye 1998; Churchill 1998). However other *Mormopterus* sp. that occur in eastern and southern Australia give birth between November and January, and do not carry young while foraging (Churchill 1998). If possible, trees should be removed between March and May or September and October, when young are not left in hollows or adults are not hibernating. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade if the removal of trees with hollows takes place outside of the breeding period.

**Yellow-bellied Glider (*Petaurus australis*) – Vulnerable**
This species was not positively recorded within the study area, however there is scarring caused by gliders within the study area and potential den sites within the hollows of larger trees. The scarring is unlikely to be caused by the Yellow-bellied Glider, as they were not 'V' shaped incisions, typical of the species (Triggs 1998). The species is described as the most vocal of gliders (Russell 1998), however the species did not respond to territorial call playback. It is

unlikely the species would spend a significant amount of time in the habitats near the Pacific Highway due the light, noise and movement of vehicles. It is therefore unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Squirrel Glider (*Petaurus norfolcensis*) – Vulnerable**
There is scarring caused by gliders within the study area and potential den sites within tree hollows. It is unlikely the species will utilise hollows near the existing Pacific Highway due to disturbance from vehicles, while the width of the existing highway is likely to impede the movement of the species in the local area. Most trees with hollows and trees with significant foraging scarring are located outside of the footprint of the proposed development. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Brush-tailed Phascogale (*Phascogale tapoatafa*) – Vulnerable**
The species will utilise tree hollows, stumps and even globular bird nests during the day (Soderquist 1998), habitat that is present within the study area. The species is unlikely to utilise habitats near the existing highway due to the risk collision of collision with vehicles, particularly during the dispersal phase of the species life cycle, in spring (Soderquist 1998). It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Koala (*Phascolarctos cinereus*) – Vulnerable**
This species was not recorded within the study area, however is known to occur within a 6 km radius of the study area to the north, east, south-east and south-west. Despite there being no record of Koalas within the study area, there is potential for the species to utilise the study area when moving between known habitats. The habitat utilisation is likely to be low as there are no records of Koala, including injured or killed, within the study area or the adjacent wooded remnants. It is expected injured or killed Koalas would be regularly recorded if a population existed within the study area due to the traffic volume of the Pacific Highway. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable**
This species is particularly dependant on wintering camps (NSW Scientific Committee 2001). No camps, including abandoned camps typified by canopy branches stripped of foliage, were identified within the study area. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

**Common Blossom-bat (*Syconycteris australis*) – Vulnerable**
This species was not recorded within the study area. The diet of species in the southern part of its' range is mostly nectivorous, where *Melaleuca* swamps are critical feeding habitats (Law and Spencer 1998) and roost in rainforests up to 50 km away from the foraging location (Churchill 1998). No rainforest exists within the study area however there is wet sclerophyll forest with dense vines present within the riparian vegetation to the west of the existing former Pacific Highway, and within the remnant between the northbound and southbound carriageways south of the Possum Brush Road intersection with the Pacific Highway, these will not be affected by the proposed highway upgrade. It is unlikely there will be an adverse effect to the life cycle of a viable population by the proposed highway upgrade.

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

The following Endangered Populations occur within the Greater Taree City Council LGA or Great Lakes LGA:

- *Dromaius novaehollandiae* Emu population in the NSW North Coast Bioregion and Port Stephens LGA; and
- *Eucalyptus seeana* population in the Greater Taree LGA.

Emus have been recorded within the North Coast Bioregion within the Port Stephens LGA and north of Coffs Harbour. The species has not been recorded with the Great Lakes LGA or Greater Taree City Council LGA and was not observed during the present study. The Emu population in the NSW North Coast Bioregion and Port Stephens LGA will not be affected by the proposed highway upgrade.

The *Eucalyptus seeana* population within the Greater Taree City Council LGA will not be affected by the proposed highway upgrade. The mapped occurrence of the population is located to the north of Taree. No occurrences of this species were identified within the study area.

Neither Endangered Population will be affected by the proposed upgrade of the Pacific Highway.

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

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

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

The following endangered ecological communities listed under Schedule 3 of the TSC Act occur within the North Coast Bioregion:

- Byron Bay Dwarf Graminoid Clay Heath Community.
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions.
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion.
- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps Bioregions.
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

- Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- *Themeda* grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney basin and South East Corner Bioregions.

There is a small remnant dominated by Forest Red Gum (*Eucalyptus tereticornis*) occurring in a gently sloping area to the north of the bund constructed for the Bullocky Way. The remnant is located in the former reserve for Bullocky Way and as such has elements of the former road within it and is surrounded by the Pasture/Cleared Land Community. The understorey is a mix of exotic species from the surrounding area with patches of Spiny-headed Mat-rush present.

The remnant differs from the description of the Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions as the remnant is located within an area with underlying Devonian geology, while the description of community in the Final Determination identifies the underlying geology for the endangered ecological community as being of Permian origin. Additionally, broad-scale remnant vegetation mapping by the Greater Taree City Council and Great Lakes Council have not identified ecological communities in the local area dominated by Forest Red Gum, indicating that the communities dominated by Forest Red Gum have not been present within the local area. It is considered that the remnant is not within the description of the Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions endangered ecological community.

None of the listed endangered ecological communities were identified within the study area.

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

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

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

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

**Glossy Black-Cockatoo (*Calyptorhynchus lathami*) – Vulnerable**
The Glossy Black-Cockatoo is dependant on the presence of *Allocasuarina* species as it is a specialist forager of the seeds of these species. The Glossy Black-Cockatoo prefers woodland that has mature *Allocasuarina* as an understorey below *Angophora* and *Eucalyptus*, *Allocasuarina* spp. lined watercourses and stony ridges. Nesting occurs in a hollow of a tall tree that can be living or dead (Higgins 1999). Potential foraging habitat, in the form of Black Oak (*Allocasuarina littoralis*), is present within the study area, as is potential foraging habitat. The majority of the Black Oak, including patches dominated by the species, is located within 500 m of Failford Road, to the east of the proposed southbound carriageway. These patches are not within the footprint of the proposed highway upgrade. Black Oak is also present in the landscape plantation between the former Pacific Highway Route and the present northbound carriageway of the Pacific Highway. The majority of this area will not be affected by the proposed development. It is estimated that 0.125 ha of this habitat type will be affected by the proposed highway upgrade. No trees with large or medium sized hollows were identified within the footprint of the proposed highway upgrade. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Square-tailed Kite (*Lophoictinia isura*) – Vulnerable**
In NSW the habitats preferred by the Square-tailed Kite are typically ridge and gully habitats, dominated by *Eucalyptus longifolia*, *Corymbia maculata*, *E. elata* and *E. smithii*, with a shrubby understorey. While dominant tree species are absent, there is a mosaic of canopy densities and areas with shrubby understories. The species' hunting technique is to dive on smaller birds in the open from high perches at the edge of forests and woodlands (Higgins 1993a). This technique would make the species vulnerable to colliding with vehicles along the existing highway. The proposed highway upgrade will widen the easement, by approximately 10 m in width along the eastern side of the study area, and require some clearing for the proposed interchanges. This will result in approximately 15 ha of wooded remnant and 1 ha of cleared or partially cleared land to be removed. The clearing is highly unlikely to isolate the species from moving between habitats as the species occurs in landscapes with a mosaic of woodland and open areas, where they feed on passerines, foliage insects and small terrestrial vertebrates (Marchant and Higgins 1993). The proposed widening is unlikely to significantly increase the potential for collisions between the species and vehicles if the traffic volume does not increase. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Barking Owl (*Ninox connivens*) – Vulnerable**
The habitat for the Barking Owl includes areas containing many large trees for roosting and breeding within dry sclerophyll forest and woodlands, and also partly cleared land including farmland (Marchant and Higgins 1993). The study area has potential habitat for the Barking Owl. Approximately 15 ha wooded vegetation, the majority of which does not contain suitable nest sites, will be removed and approximately 1 ha of cleared or partly cleared agricultural land will be removed. The clearing is unlikely to isolate other potential habitats as the clearing will widen an existing clearing by approximately 10 m in width and that proposed highway upgrade will have similar disturbances as to already exists along the present north and southbound carriageways. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Powerful Owl (*Ninox strenua*) – Vulnerable**
The Powerful Owl inhabits dry sclerophyll forests and woodland, often with dense forest nearby (Higgins 1999). The roost is usually in closed forest and nesting usually occurs in large living *Eucalyptus* species trees (Higgins 1999). A large egg, possibly that of a Powerful Owl, was found within the study area adjacent to a tree with a large hollow, shown in **Photograph 7**. This species specialises on feeding on medium to large arboreal prey (Higgins 1999). There is evidence of medium to large arboreal mammals within the study area, including scarring of trees by gliders and possum faecal matter. However the 15 ha of trees to be removed is approximately 10 per cent of the woodland and forest that occur within 1 km of the study area. In addition, this will be lost as a relatively thin linear strip. It is unlikely that the removal of 15 ha of relatively young trees, with few potential den sites, will reduce the number of arboreal mammals significantly. Therefore it is unlikely that the potential habitat to be removed or modified is important to the long-term survival of this species in the locality.

**Grass Owl (*Tyto capensis*) – Vulnerable**
Preferred habitat types for this species is open tussock grasslands, with densities higher in rank pastures on fertile soils rather than infertile soils associated with heaths or sedgelands (Higgins 1999). There is approximately 0.25 ha of tussock grassland and sedgeland within the study area located to the west of the proposed Failford Road exit. The proposed exit may result in the pooling of water within the habitat, potentially increasing the area of tussock grassland and sedgeland, however the footprint of the proposed development is unlikely to directly affect the habitat. The Pacific Highway is located downstream, to the east of the habitat, and the proposed Failford Road exit will not further isolate this habitat from other habitats to the east of the proposed development. The existing habitat is small and is likely to afford little protection from

foxes or other terrestrial predators. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Masked Owl (*Tyto novaehollandiae*) – Vulnerable**
Known habitat types for this species include tall dense forest, open forest and woodland, with a sparse understorey. Breeding takes place in near vertical hollows, in tall, often prominent trees (Higgins 1999). Two large trees with vertical hollows are present within the study area. One, shown in **Plate 8**, is located near the proposed Bullocky Way deviation and the other, shown in **Plate 7**, is located between the existing northbound and southbound carriageways of the Pacific Highway near the proposed intersection of Bullocky Way and the proposed local traffic road. Prey items are mainly terrestrial mammals. Most records are within 300 m of lowland sclerophyll forest, lowland forest and valley floor forest (Higgins 1999). The potential foraging habitat is present in the cleared pasture and areas of remnant woodland where the understorey has been cleared for bushfire hazard reduction, particularly where these are located near dense understorey that would provide diurnal shelter for terrestrial animals that do not burrow. Approximately 15 ha of woodland with varying understorey density will be cleared as part of the proposed highway upgrade. This represents approximately 10 per cent of woodland and less than 1 per cent of cleared agricultural land within 1 km of the study area. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Spotted-tailed Quoll (*Dasyurus maculatus*) – Vulnerable**
The Spotted-tailed Quoll is a partly arboreal and mostly nocturnal species inhabiting a wide variety of habitats, including woodlands (Edgar and Belcher 1998). Den sites include caves, crevices and also hollow logs (Edgar and Belcher 1998). The species is unlikely to have den sites within the study area. There is potential foraging habitat to the east of the Pacific Highway, where there is a well developed understorey and dense ground cover, particularly to the north of Failford Road. Approximately 15 ha of woodland with varying understorey density will be cleared as part of the proposed highway upgrade, representing approximately 10 per cent of woodland within 1 km of the study area. The construction of the proposed southbound carriageway is unlikely to further isolate a potential Spotted-tailed population through increased mortality resulting from collision, as traffic volumes will not increase as a result of the construction of the proposed southbound carriageway. Local traffic will be diverted to the existing northbound carriageway, resulting in a decrease in traffic volume for this section of road. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Little Bentwing-bat (*Miniopterus australis*) – Vulnerable**
The Little Bentwing-bat roosts in subterranean locations (Dwyer 1998a). With the exception of pipes managing flows below the Pacific Highway, there is no roosting habitat within the study area. These will not be removed and an additional culvert will be required to manage flows forages beneath proposed carriageway. The species forages under the canopy of dense forest and woodlands (Dwyer 1998a), and therefore will potentially forage within the study area. Approximately 15 ha of woodland will be cleared as part of the proposed highway upgrade, representing approximately 10 per cent of woodland within 1 km of the study area. The foraging habitat of the species will not be isolated as the clearing of an additional 10 m wide strip of woodland will not restrict the flight to the species. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Eastern Bentwing-bat (*Miniopterus schreibersii* oceanensis) – Vulnerable**
The roost sites for this species includes underground mine workings, caves, stormwater culverts and occasionally buildings (Dwyer 1998b). With the exception of pipes managing flows below the Pacific Highway, there is no roosting habitat within the study area. The culverts will not be removed and an additional culvert will be required to manage flows forages beneath proposed carriageway. The species forages under the canopy of dense forest and woodlands (Dwyer

1998b), and therefore will potentially forage within the study area. Approximately 15 ha of woodland will be cleared as part of the proposed highway upgrade, representing approximately 10 per cent of woodland within 1 km of the study area. The foraging habitat of the species will not be isolated as the clearing of an additional 10 m wide strip of woodland will not restrict the flight to the species. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Eastern Freetail-bat (*Mormopterus norfolkensis*) – Vulnerable**
Little is known about the habitat preferences for this species, however it is assumed to include dry sclerophyll forest and woodland east of the Great Dividing Range (Churchill 1998). It has also been recorded in rainforests, flying over a creek (Allison and Hoye 1998). It mainly roosts in trees, although it has been know to utilise manmade structures (Allison and Hoye 1998). There are potential roosts and foraging habitat within the study area. Trees and dead trees with hollow development were observed within the study area, however all were observed outside of the footprint of the proposed highway upgrade, as shown in **Figure 4**. Approximately 15 ha of woodland will be cleared as part of the proposed highway upgrade, representing approximately 10 per cent of woodland within 1 km of the study area. The foraging habitat of the species will not be isolated as the clearing of an additional 10 m wide strip of woodland will not restrict the flight to the species. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Yellow-bellied Glider (*Petaurus australis*) – Vulnerable**
This species inhabits tall, mature wet eucalypt forest, where it mainly forages on eucalypt sap and insect exudates, while eucalypt blossom, arthropods and pollen provide important nutriment (Russell 1998). Sap is obtained by scarring the trunk of a tree (Russell 1998). Tree species within the study area that are known to be used for obtaining sap include *Corymbia intermedia*, *Corymbia maculata*, *Eucalyptus pilularis*, *Eucalyptus propinqua*, *Eucalyptus saligna*, *Eucalyptus tereticornis* and *Lophostemon confertus* (NPWS 2003). Diurnal dens are usually hollows in large living smooth barked *Eucalyptus* spp. (Russell 1998). Habitat for the species is present within the study area, particularly where trees are larger, for example within the drainage line, located approximately 200 m of the Failford Road intersection with the Pacific Highway, and remnant near the proposed Bullocky Way intersection with the present northbound carriageway of the Pacific Highway. The proposed widening of the highway to accommodate the proposed southbound carriageway is unlikely to reduce foraging or denning opportunities for the species, however it may stop the species from attempting to cross the highway or expose the species to an increased risk from predators or collision with vehicles when forced to cross the highway at ground level. This risk can be mitigated by the provision of a suspended crossing at the potential wildlife corridors and by creating a future wildlife corridor by establishing trees between the proposed Bullocky Way intersection and Possum Brush Road to facilitate movement in the local area. The suggested locations of the suspended crossings and potential wildlife corridor are shown in **Figure 4**.

**Squirrel Glider (*Petaurus norfolcensis*) – Vulnerable**
This species was not recorded within the study area. The Squirrel Glider utilises dry sclerophyll habitats and woodlands where it dens in tree hollows. It feeds on insects, nectar, pollen, sugary insect exudates and sap (Suckling 1998). There is potential foraging and breeding habitat within and adjacent to the study area. The proposed widening of the highway to accommodate the proposed southbound carriageway is unlikely to reduce foraging or denning opportunities for the Squirrel Glider, however it is likely to expose the species to an increased risk from predators or collision with vehicles when forced to cross the highway at ground level. This risk can be mitigated by the provision of a suspended crossing at the potential wildlife corridors, and by creating a future wildlife corridor by establishing trees between the proposed Bullocky Way intersection and Possum Brush Road to facilitate movement in the local area. The suggested locations of the suspended crossings and potential wildlife corridor are shown in **Figure 4**.

**Brush-tailed Phascogale (*Phascogale tapoatafa*) – Vulnerable**
The Brush-tailed Phascogale is mainly arboreal, feeding on nectar, insects, spiders, small vertebrates and ants in large trees (Soderquist 1998). Mating and the raising of young take place in a tree hollow (Soderquist 1998). The species will utilise tree hollows, stumps and even globular bird nests during the day (Soderquist 1998). Approximately 15 ha of woodland will be cleared as part of the proposed highway upgrade, representing approximately 10 per cent of woodland within 1 km of the study area. The construction of the proposed southbound carriageway is unlikely to further isolate a potential population of the species, as traffic volumes will remain the same after the construction of the proposed southbound carriageway. Local traffic will be diverted to the existing northbound carriageway. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of this species in the locality.

**Koala (*Phascolarctos cinereus*) – Vulnerable**
Tree species that occur within the study area that are known foraging species include Forest Red Gum (*E. tereticornis*), Swamp Mahogany (*E. robusta*) and Tallowwood (*E. microcorys*) and *Melaleuca quinquinerva* (Schedule 2, SEPP 44). Approximately 15 ha of woodland will be cleared as part of the proposed highway upgrade, representing approximately 10 per cent of woodland within 1 km of the study area. The construction of the proposed southbound carriageway is unlikely to further isolate a potential Koala population, as traffic volumes will remain the same after the construction of the proposed southbound carriageway. Local traffic will be diverted to the existing northbound carriageway, reducing the potential for collision with vehicles along this section of road. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable**
The species forages on a wide variety of flowers and fruits, such as figs, palms (Tidemann 1998) and commercial crops as well as nectar and pollen from flowering Myrtaceous species including *E. microcorys* (Eby 1995, cited in Benson and McDougall 1997). Tallowwood (*E. microcorys*) common within the study area, and therefore the species is likely to forage within and adjacent to the study area where similar vegetation communities occur. Approximately 15 ha of woodland will be cleared as part of the proposed highway upgrade, representing approximately 10 per cent of woodland within 1 km of the study area. The foraging habitat of the species will not be isolated as the clearing of an additional 10 m wide strip of woodland will not restrict the flight of the species. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

**Common Blossom-bat (*Syconycteris australis*) – Vulnerable**
The diet of species in the southern part of its' range is mostly nectivorous, where *Melaleuca* swamps are critical feeding habitats (Law and Spencer 1998). Approximately 1 ha of *Melaleuca quinquinerva* dominated community is present to the west of Pacific Highway, in the extreme southern part of the study area. The habitat occurs outside of the footprint of the proposed highway upgrade. The proposed clearing is unlikely to restrict the species movement between this small area of habitat and other potential habitats that occur outside of the study area. It is unlikely the potential habitat to be removed or modified is important to the long-term survival of the species in the locality.

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

No declared critical habitat will be affected by the proposed highway upgrade, either directly or indirectly.

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

The only finalised recovery plan prepared for a threatened species that potentially may occur within 10 km of the proposed highway upgrade is for the Yellow-bellied Glider (NPWS 2003b). Some of the actions listed in the recovery plan are:

- To reduce edge effects, minimise foraging distances, increase types of resources available and reduce the linear nature of habitat; and
- Ensure that appropriate consideration is given in the design of roads and easement corridors, and to consider mitigation measures, such suspended crossings, where linear gaps as narrow as 50 m are created when retention of vegetation is not possible.

The combination of low trees and widening of the road reduce the distance gliders can travel through the air. As the Pacific Highway is a major transport route, there is a high potential for the species to collide with vehicles. It is therefore necessary to consider the addition of suspended crossings to mitigate against the proposed widening of the highway easement.

There are also three recovery plans that are pending finalisation, these being for:

- the Barking Owl;
- large forest owls; and
- the Koala.

***Barking Owl***
The recovery plan for the Barking Owl includes the objective of undertaking threat abatement and mitigation. Threats to the species include clearing, removal of dead wood, competition with feral honey bees and collision with vehicles (NPWS 2003c). Clearing is unlikely to remove a significant area of owl habitat, and no trees with suitable hollows were observed in areas to be cleared. Traffic volumes, while potentially increasing as a result of regional growth, are unlikely to increase as a result of the proposed highway upgrade. Therefore it is unlikely the species will be placed at greater risk from collision with vehicles.

***Large forest owls***
Two of the species that are included within the recovery plan for large forest owls, the Powerful Owl and the Masked Owl, may potentially utilise the study area. While habitat exists for both species, a large egg, possibly that of the Powerful Owl, was observed within the study area. A specific recovery objective is to reduce clearing in large forest owl habitat and to protect nest sites (DEC 2005b). The large tree where the egg was found is to the south of the proposed Bullocky Way route. The short term future road use is unlikely to present additional disturbance to this tree as it presently exists between the existing northbound and southbound carriageways of the Pacific Highway. The disturbance is expected to be lower as the present northbound carriageway will have only local traffic use. Significant disturbance may occur during construction, when clearing and earthmoving plant will result in increased noise and movement during construction hours. Confirmation of the presence of this species is required before appropriate mitigating measures can be developed.

***Koala***
The recovery plan for the Koala includes the objective of the development of appropriate road design in Koala habitat (NPWS 2003d). An action by the NSW DEC is to create a register of Koala black spots and recommend appropriate management measures to reduce the incidence of death or injury to koalas from collision with vehicles (DEC 2003d). While the study area contains Koala habitat, there are no records of Koalas being injured or killed in the section that it is proposed to upgrade. Another action is to advise that new roads avoid known Koala habitat (DEC 2003d). The proposed highway upgrade, while involving the widening of the highway

corridor will not affect known Koala habitat, and will not have the effect of bisecting Koala habitat significantly.

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

The following Key Threatening Processes (KTP) may occur or may increase as a result of the proposed highway upgrade:

- Clearing of native vegetation.
- Invasion of native plant communities by exotic perennial grasses.
- Removal of dead wood and dead trees.
- Invasion, establishment and spread of Lantana.

The potential for each of these to occur is discussed below.

***Clearing of native vegetation (Final Determination)***
The clearing of native vegetation may result in the loss of local populations of individual species, and is the major cause of the loss of biological diversity. For species of restricted distribution, clearing of native vegetation may result in total extinction, for more widespread species there may be loss of local genotypes (NSW Scientific Committee 2004a). Processes that may result from the clearing of native vegetation are discussed below.

**Fragmentation**
The proposed highway upgrade will result in the widening of the existing southbound carriageway, increasing the width of cleared habitat that animals and plant genetic material must cross. The widening will result in a reduction of 20 per cent of wooded habitat within 1 km to the east of existing highway, resulting in a remnant in excess of 60 ha. It is unlikely that this will result in the extinction of any species presently occurring within the remnant due to a stochastic event.

**Expansion of dryland salinity**
There is no evidence of salinity, for example scalding or areas that are dominated by salt tolerant plant species, within or adjacent to the study area. It is unlikely that there will be an expansion of dryland salinity as a result of the proposed highway upgrade.

**Riparian zone degradation**
The riparian zones within the study area are restricted to intermittently flowing drainages with minor pooling. Most drainage lines have already been degraded by sedimentation caused by agricultural run-off. It is unlikely there will be a significant degradation in water quality as a result of the proposed road construction if standard sediment capture practices are used.

**Increased greenhouse gas emissions**
It is unlikely the proposed development will result in a significant increase in greenhouse emissions, or result in the significant reduction of absorption of greenhouse gases.

**Increased habitat for invasive species**
There is the potential for invasive species to increase in diversity and density within the areas presently dominated by native species, particularly between Bullocky Way and Failford Road. Areas adjacent to the existing road pavement are dominated by exotic species, for example Lantana and Kikuyu, with many other exotic species present, for example Crofton Weed dominating drainages. Careful management of the soil and proposed roadside vegetation will be required to reduce the potential of the further spread of exotic species in areas presently dominated by native species.

**Loss of leaf litter layer**
There will be a loss of leaf litter in the area of road pavement and adjacent grassy areas. There will be some accumulation of leaf litter in areas where regeneration or landscaping allows a modified tree and shrub community to develop. It should be noted that much of the land within the study area presently has little leaf litter as a result of agricultural activity or management for fire fuel reduction.

**Loss or disruption of ecological function**
There is expected to be a loss of native ecological function in areas developed for the road pavement and adjacent areas where low grasses and herbaceous species will be managed by slashing. These areas tend to have increased exotic species density and diversity. Some ecological function can be potentially retained by the use of species that provide a foraging resource to animals, for example profusely flowering eucalypt species that are naturally endemic to an area that also assist the dispersal of animals and pollen.

Disruption of ecological processes may continue long after initial clearing of native vegetation has occurred, with consequent continued decline in biological diversity. In cleared and/or fragmented landscapes there may be an extinction debt where, as a consequence of reduction in population size and disturbance to population structure, future local population extinction is inevitable.

**Changes to soil biota**
The clearing for the proposed highway upgrade is likely to result in changes to the soil biota, including the removal of most macro invertebrates in areas under the road pavement, to a reduction in organisms where the surface has been reshaped and to a lesser extent where only the vegetation has been cleared.

***Invasion of native plant communities by exotic perennial grasses (Final Determination)***
Some species of exotic grasses have vigorous growth, prolific seed production and effective seed dispersal, enabling many exotic perennial grasses to compete strongly with, or in some places displace, native vegetation (NSW Scientific Committee 2004b). The final determination notes that the dense monocultures of perennial grasses that develop after invasion threaten local vegetation, potentially resulting in local and regional declines of many native species and communities. Disturbances that may lead to the establishment of invasive perennial exotic grasses species include road works and management of roadside areas.

Invasive perennial grasses that were observed within the study area and which are listed as species that invade native plant communities include Whisky Grass (*Andropogon virginicus*), Rhodes Grass (*Chloris gayana*), and Kikuyu (*Pennisetum clandestinum*). If these species are controlled prior to earthworks that may assist in their spread and invasive exotic perennial grasses are not used in revegetation works, it is unlikely that this KTP will occur as a result of the proposed highway upgrade.

***Removal of dead wood and dead trees (Final Determination)***
Woody debris and standing dead trees are an important component of the structure of forest and woodland and helps determine the habitat value for a wide range of fauna, with 120 species of vertebrate in NSW dependant on tree hollows for breeding or denning (NSW Scientific Committee 2004c). The Final Determination for the Removal of dead wood and dead trees reviews the impacts of the removing standing dead trees and woody debris on the ground. The impacts include the reduction of the availability of hollows over time and the input of material to the litter layer. This process is exacerbated by the failure of regeneration of these plant communities and the resulting reduction in natural accumulation of dead wood. Dead wood provides habitat for many insect species, which in turn form important components of the diet of many species, such as birds (Fitri and Ford 1997). The proposed highway upgrade will result in the removal of woody debris, however the majority of the study area, with the exception of the

property to the north of the Failford Road intersection, is managed for fire fuel reduction, including the removal of fallen timber, while much of existing easement is typified by young tree and shrub regeneration that has not reacted a stage where woody debris have accumulated. The proposed highway widening will not result in the significant reduction of woody debris.

***Invasion, establishment and spread of Lantana (Lantana camara L. sens. lat) (Preliminary Determination)***

The 'Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. lat)' has been proposed as a key threatening process (NSW Scientific Committee 2006). Lantana is thought to be allelopathic, able to inhibit or suppress by chemical means the germination and/or growth of other plant species. The preliminary determination notes that eucalypt seedlings generally fail to establish under Lantana, thereby allowing Lantana to form dense thickets due to reduced competition. The thickets may adversely affect the richness of some soil faunal assemblages, for example ants, and provide habitat for declared vermin and other pests.

While the proposed highway upgrade will not involve the planting of Lantana, there is potential for the spread of the species in disturbed areas through the movement of soil containing stem and seed material. Lantana will have to be controlled within the road reserve to ensure that this species is not allowed to create infestations and be a source of invasion for adjacent lands.