

7C Working Paper

Arrawarra Interchange Flora and Fauna Assessment

Connell Wagner Pty Ltd
ABN 54 005 139 873
Advanced Technology Centre
Callaghan
New South Wales 2308 Australia

Telephone: +61 2 4941 5415
Facsimile: +61 2 4941 5489
Email: cwntl@conwag.com
www.conwag.com

Flora and Fauna Report Arrawarra Interchange Pacific Highway Upgrade - Sapphire to Woolgoolga Roads and Traffic Authority

8 August 2007
Reference 1093
Revision 1

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1. Introduction

1.1 Background to the Study and Proposal

Connell Wagner Pty Ltd was engaged by the NSW Roads and Traffic Authority (RTA) to undertake ecological investigations for the proposed Arrawarra Interchange, to the north of Woolgoolga on the north coast of NSW. The Arrawarra Interchange is to form a part of the RTA's proposed Pacific Highway upgrade between Sapphire and Woolgoolga.

The proposed interchange and rest area consists of entry and exit ramps, truck and car parking areas, amenities blocks and shelters and tables. The interchange and rest area would be located immediately south of the existing Arrawarra turnoff on the eastern side of the existing highway.

As the Arrawarra Interchange was not part of the original project design, flora and fauna surveys undertaken in 2005 for the project did not cover this area. This report documents the findings of flora and fauna surveys undertaken during March 2007 and discusses potential impacts of the proposal.

1.2 Study Objectives

The objectives of the flora and fauna assessment were to:

- Describe the plant communities and faunal habitats within the study area
- Document the animal and plant species recorded within the study area, highlighting any species listed on the *Threatened Species Conservation Act 1995* (TSC Act) and/or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Investigate potential flora and fauna links extending from the study area to adjacent natural areas
- Undertake an assessment of Koala habitat, including connectivity with other areas of potential or known koala habitat according to SEPP 44 - Koala Habitat Protection
- Map the location of any significant species or ecological communities identified in relation to the study area
- Outline likely impacts of the proposed Arrawarra Interchange project

2. Methodology

Ecological survey methods that were undertaken as part of the Arrawarra Interchange ecological study included literature review, flora/vegetation surveys and several fauna survey techniques that are described below. All field investigations were undertaken between 20 and 24 March 2007. Weather conditions experienced during the field investigation were recorded and are detailed in the results section.

2.1 Literature and Database Review

A review of relevant information sources and previous investigations in the area was undertaken. The literature review included the following sources:

- DEC Wildlife Atlas for TSC Act listed threatened fauna and flora records in the local area
- Bionet database for TSC Act listed threatened fauna and flora records in the local area
- EPBC Act Protected Matters search for items listed under the EPBC Act in the local area
- Ecotone (2005) – Preliminary Terrestrial Flora and Fauna Assessment for GHD on behalf of the RTA
- Connell Wagner (2001) – Supplementary REF for the Halfway Creek duplication section of the Pacific Highway for the RTA
- Connell Wagner (2005) – Flora and Fauna investigations for Sapphire to Woolgoolga section of the Pacific Highway
- Ecos Environmental Pty (2005) *Vegetation Survey Of The Preferred Route For The Upgrade Of The Pacific Highway Between Sapphire To Woolgoolga*, Connell Wagner
- Department of Environment and Conservation (2004) *Threatened Biodiversity Survey and Assessment: guidelines for developments and activities, working draft*, DEC
- Relevant recovery plans and species information sources

2.2 Flora Survey

Flora surveys were undertaken during the field investigation period between 20 and 24 March 2007. The aim of the flora survey was to:

- identify and describe the plant communities occurring within the study area
- compile a list of plant species occurring in the study area
- assess the suitability of habitat for threatened plant species
- conduct targeted searches for threatened species

2.2.1 Walking Transects

Flora survey sites are illustrated in Figure 2.1. Seven walking transects were conducted within the study area and involved traverses on foot and recording plant species that occurred within one metre of the transect. This method allowed for the location of specific vegetation communities and their boundaries, which were later mapped via GPS and ArcGIS. During the walking transects, targeted searches for threatened flora were undertaken in suitable habitat.

2.2.2 Quadrat Sampling

Sampling quadrats enabled quantitative examination of species distribution and abundance across the study area. Seven quadrats (20m x 20m) were strategically positioned and located with GPS to sample an adequate representation of the native vegetation communities within the study area. The location of each quadrat is shown in Figure 2.1. The plant species within each quadrat were recorded, along with an approximate abundance of each species. Other information recorded during quadrat sampling included:

- **Structural attributes** - The dominant species, height and percentage foliage cover of each stratum layer
- **Physical attributes** - The landform, elevation, slope, aspect and soil type

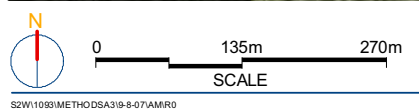
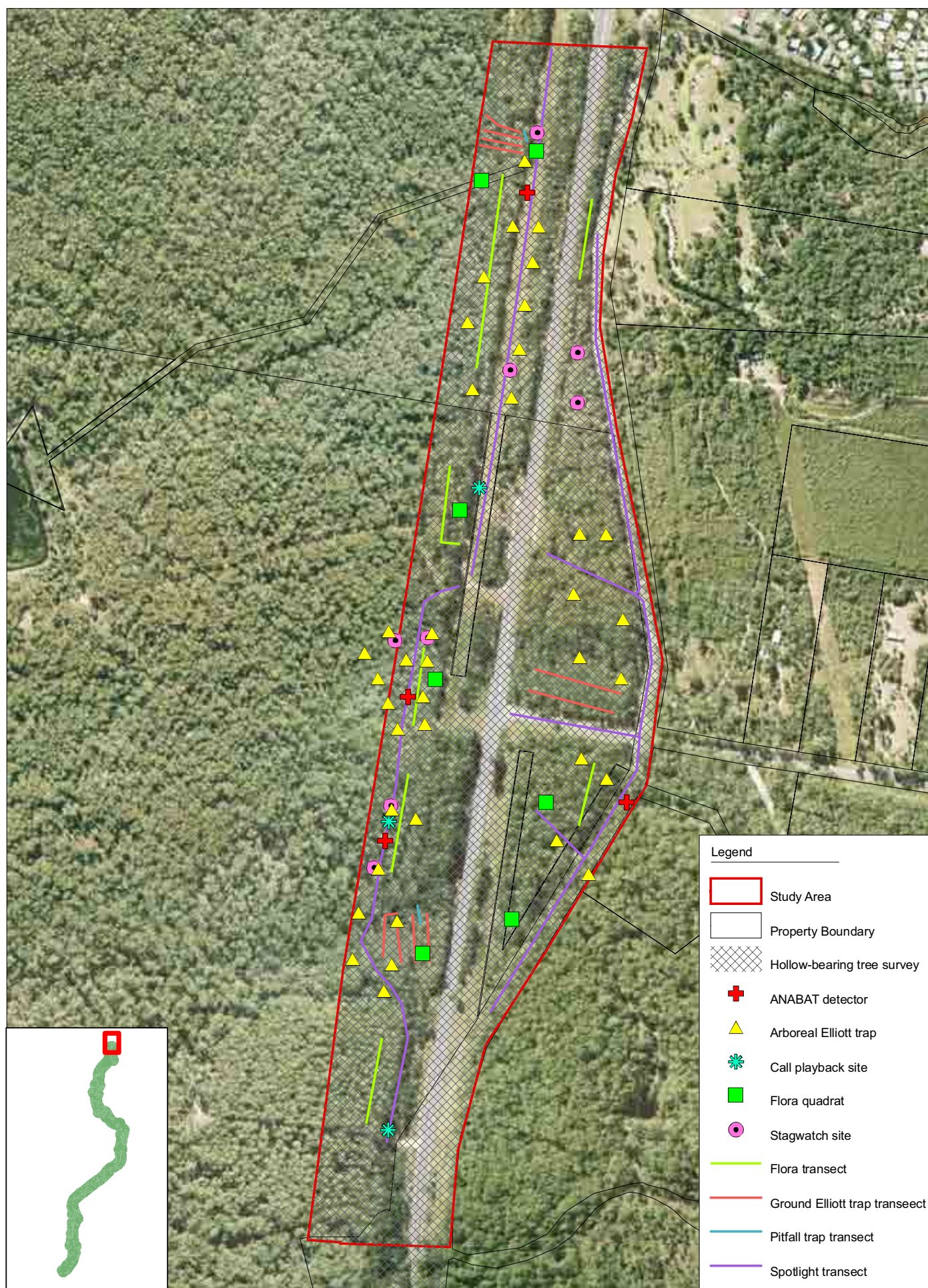


Figure 2.1
Methodology

All species in each quadrat and walking transect were recorded and identified as far as practicable to a species or subspecies level. Those species not able to be identified in the field were keyed out using the Flora of New South Wales (Harden 1993, 2000, 2002a and 2002b) and other reference material, or sent to the Royal Botanic Gardens Sydney Herbarium for identification.

2.3 Fauna Survey

Fauna surveys within the study area were undertaken during the field investigation period between 20 and 24 March 2007. The aims of the fauna survey were to:

- Assess the habitats in the study area and their suitability for threatened species
- Obtain a representative sample of the fauna assemblage in the study area via more detailed fauna survey methodologies

The fauna survey involved direct and indirect techniques, including habitat assessment, diurnal bird survey, arboreal and terrestrial trapping, spotlighting, call playback, opportunistic observations and searches for secondary evidence as discussed in the following sections. Fauna survey sites are illustrated in Figure 2.1.

2.3.1 Habitat Assessment

Data collected for compilation of site descriptions included habitat attributes, such as:

- Structural and floristic characteristics of the vegetation, such as species mix, type and development of vegetation
- Degree and extent of disturbance, eg fire, clearing, sand mining and weed invasion;
- Soil type and suitability
- Presence of water or aquatic habitat
- Size and abundance of hollows and fallen timber
- Availability of shelter, such as rocks, hollows, logs and dense undergrowth
- Wildlife corridors, refuge and proximate and contiguous habitat types
- Forage resources, such as nectar/pollen, gum, sap, mistletoe and seed
- Presence of preferred forage species

The information obtained during the habitat assessment allowed for determination of habitat suitability for threatened species.

2.3.2 Diurnal Bird Census

The recording of bird species within the study area was undertaken using the following methods:

- Three 30 minute diurnal census based on the species-time approach were undertaken within the study area.
- Opportunistic observations made while undertaking other activities in the study area.
- Searches for evidence of the presence of birds, such as whitewash and regurgitation pellets of owls.

Each diurnal bird census was conducted for a minimum of 30 minutes and ceased when no additional species were identified within a subsequent five minute period. Diurnal bird species occurring within the study area were recorded during early morning and afternoon census periods based on the species-time approach. A total of three person hours of diurnal bird census was undertaken within the study area.

2.3.3 Terrestrial Trapping

Elliot A trapping

Ten ground trapping transects comprising two lines of 11 traps and eight lines of 10 Elliot A traps were set over four nights in the study area in areas of suitable habitat (Figure 2.1). Each trap was baited with

a mixture of rolled oats, peanut butter and honey. Traps were checked early in the morning, with captured individuals identified and released at the point of capture.

Elliot A trapping targeted the threatened Common Planigale (*Planigale maculata*) and Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*). A total of 408 ground trap nights were undertaken in the study area.

Pitfall Trapping

Two pitfall trap lines, consisting of five pits connected by drift fence, were positioned in suitable habitat within the study area (Figure 2.1). Each pit consisted of a 20L bucket inserted into an appropriately sized hole with the top rim of the bucket at or just below ground level. Buckets contained floating material and vegetation debris to provide a refuge for trapped animals. Drift fence was supported by wooden pegs and was approximately 30cm high with the lower 5 cm buried into the soil. Traps were checked early each morning and on dusk and animals released following identification. Pits were open for four nights, constituting a total of 40 trap nights.

Pitfall trapping targeted the threatened Common Planigale, Eastern Chestnut Mouse and Wallum Froglet (*Crinia tinnula*).

2.3.4 Arboreal trapping

Eight Elliot B type arboreal trapping transects comprising six transects of five traps and two transects of four traps were set over four nights within the study area where suitable arboreal habitat occurred (Figure 2.1). Traps were mounted on trees with a Diameter at Breast Height (DBH) greater than 30cm, approximately two metres above the ground and baited with a mixture of rolled oats, peanut butter and honey. The tree trunk was sprayed liberally with a honey-water mix around the trap each afternoon to attract arboreal mammal species. Traps were checked early in the morning, with captured individuals identified and released at the point of capture. A total of 152 trap nights were undertaken in the study area. The primary species targeted were the threatened Squirrel Glider (*Petaurus norfolcensis*) and Brush-tailed Phascogale (*Phascogale tapoatafa*).

2.3.5 Spotlighting and stag watching

Nocturnal spotlighting was undertaken on foot with 55 Watt spotlights for 3 person hours each night for four nights between 20 and 23 March 2007. Spotlighting was carried out in all vegetation associations (Figure 2.1) and targeted arboreal and terrestrial mammal species, nocturnal birds (including owls), amphibians and reptiles that may be active during the night, as well as roosting diurnal birds. Species were either identified visually or by call. A total of 12 person hours of spotlighting was undertaken within the study area during the field survey.

Stagwatching of hollow-bearing trees was undertaken for 30 minutes following dusk on all four evenings of the survey. Given the distribution of hollow-bearing trees across the study area (refer to Figure 3.2), a different tree was surveyed on each night. A total of three person hours of stagwatching was undertaken within the study area during the field survey, with eight hollow-bearing trees watched.

2.3.6 Call playback

Call playback, quiet listening and spotlighting on and after dusk were conducted for a total of two person hours over three nights between 20 and 22 March 2007. A 15W amplifier was used to broadcast calls for approximately five minutes for each target species, followed by a five minute listening and spotlighting period. Species targeted during call playback were the Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*), Barking Owl (*Ninox connivens*), Koala (*Phascolarctos cinereus*) and Yellow-bellied Glider (*Petaurus australis*). Call playback sites are indicated in Figure 2.1.

2.3.7 Ultrasonic echolocation detection

Ultrasonic bat echolocation calls were recorded using an ANABAT II bat detector connected to a digital (ZCAIM) recording device. The unit was left over night in suitable flyways during suitable weather conditions (refer Figure 2.1). A total of four complete nights of bat call recording was undertaken during the survey. Bat call analysis was undertaken by Ray Williams (of Ecotone Ecological Consultants), a recognised expert in bat call analysis.

2.3.8 Amphibian survey

Given only limited rainfall was experienced during the survey period, targeted amphibian surveys were not undertaken. However, opportunistic observations during other field methods were recorded during both nocturnal and diurnal periods. The study area has previously been surveyed for amphibians by Lewis Ecological Surveys during optimum climatic and seasonal conditions, with the results of these surveys presented in the Frog Working Paper.

2.3.9 Secondary evidence

Secondary evidence included evidence obtained opportunistically during other survey activities, such as animal traces, such as scats, tracks and foraging evidence.

3. Results

3.1 Weather conditions

Table 3.1 below indicates the weather conditions experienced at the Coffs Harbour weather station, approximately 40 km to the south of the study area. While there may be some variation in conditions experienced in the study area and at Coffs Harbour, the results below are generally considered to be representative of weather conditions during the field survey.

Table 3.1 Climatic conditions experienced at Coffs Harbour during field survey period (BOM, 2007)

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Evaporation (mm)	Sunshine (hours)	Direction of maximum wind gust	Speed of maximum wind gust (km/h)
18/03/2007	22.5	24.5	4.2	5.2	0	SE	37
19/03/2007	19.6	26.4	6	10.4	4.9	NNE	26
20/03/2007	21.3	29.6	0	1.4	10.3	NNE	50
21/03/2007	20.6	29.9	0	6	10	NNE	43
22/03/2007	21.1	27.5	0	4.8	6.1	NE	28
23/03/2007	18.5	27.6	0	4	10.8	NE	28
24/03/2007	19.3	29.3	0	4	10.8	NNE	54

3.2 Flora

3.2.1 Vegetation association

The study area was found to contain the following four vegetation associations as indicated in Figure 3.1:

- Blackbutt Coastal Hills Moist Open Forest
- Broad-leaved Paperbark Swamp Sclerophyll Forest
- Blackbutt Forestry Plantation
- Swamp Oak Swamp Sclerophyll Forest

Vegetation associations have been classified according to the method adopted by Ecos Environmental Pty (2005) in the Flora Working Paper to ensure consistency and are discussed in more detail below. A list of flora species recorded is provided in Appendix B.

Blackbutt Coastal Hills Moist Open Forest

The Blackbutt Coastal Hills Moist Open Forest vegetation association was recorded in the more elevated locations within the study area (Figure 3.1). The canopy was dominated by Blackbutt (*Eucalyptus pilularis*), with Grey Ironbark (*E. paniculata*), Red Mahogany (*E. resinifera*) and Pink Bloodwood (*Corymbia intermedia*) also occurring. Occasional Tallowood (*E. microcorys*) were also present within the canopy. The midstorey included Black Oak (*Allocasuarina littoralis*), Forest Oak (*A. torulosa*), Swamp Box (*Lophostemon suaveolens*), Red Ash (*Alphitonia excelsa*), Turpentine (*Syncarpia glomulifera*), young eucalypts and scattered Snow in Summer (*Melaleuca linarifolia*).

The shrub layer was characterised by Broad-leaved Hakea (*Hakea dactyloides*), Coffee Bush (*Breynia oblongifolia*), Hop Bush (*Dodonaea triquetra*), Lantana (*Lantana camara*), Lance-leaved Geebung (*Persoonia lanceolata*) and Prickly Beard Heath (*Leucopogon juniperinus*).

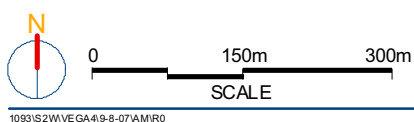
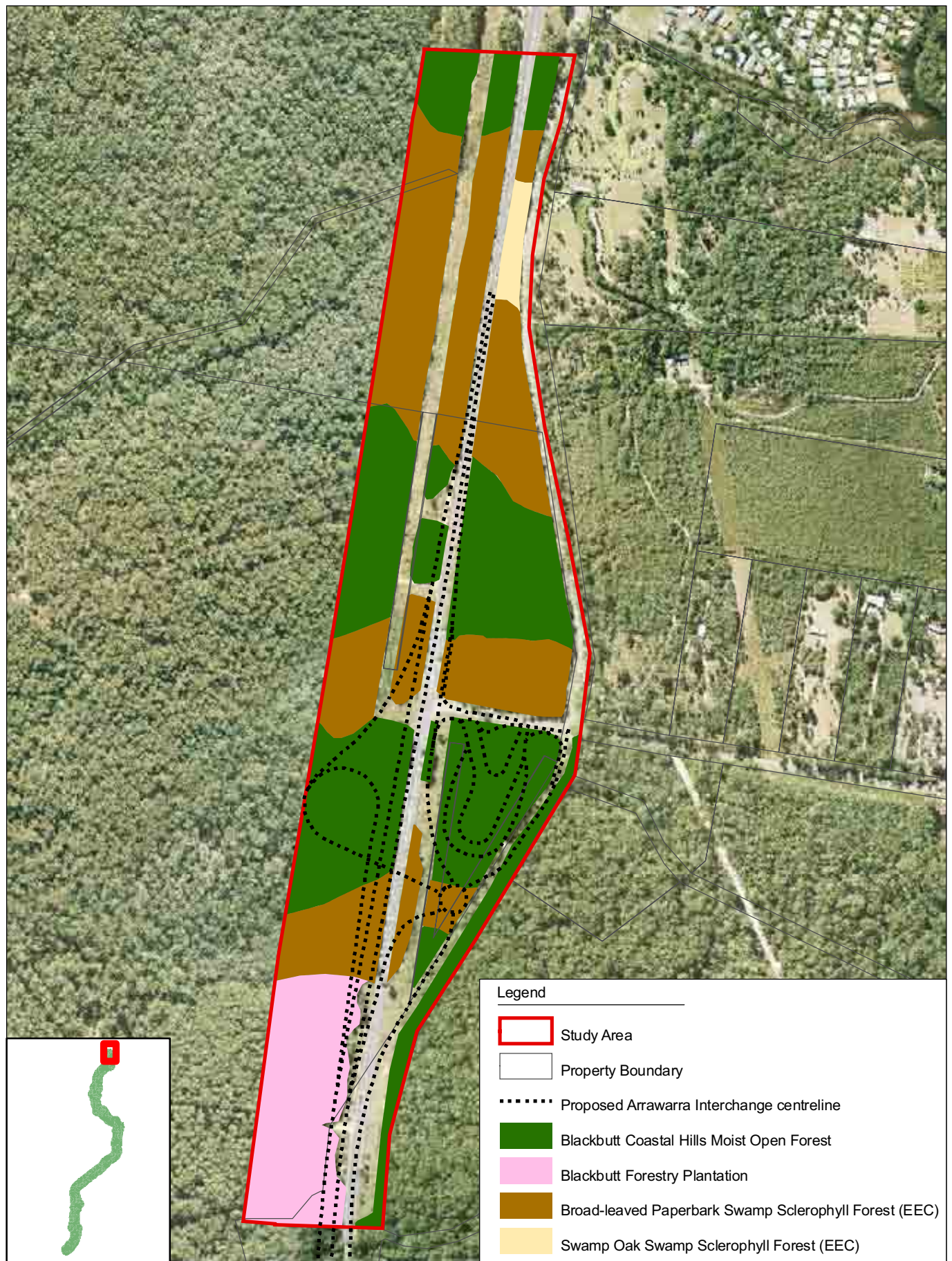


Figure 3.1

Vegetation communities

The ground cover included Blady Grass (*Imperata cylindrica*), Kangaroo Grass (*Themeda australis*), Bordered Panic (*Entolasia marginata*), Wiry Panic (*Entolasia stricta*), Guinea Flower (*Hibbertia diffusa*) and Paspalum (*Paspalum dilatatum*). Vines recorded within this vegetation association included Dusky Coral Pea (*Kennedia rubicunda*), Apple Dumplings (*Billardiera scandens*), Bindweed (*Polymnia calycina*), Snake Vine (*Stephania japonica*) and Common Silkpod (*Parsonsia straminea*).

Broad-leaved Paperbark Swamp Sclerophyll Forest

The Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association occurred in low-lying areas within the study area (Figure 3.1). The canopy was dominated by Broad-leaved Paperbark (*Melaleuca quinquinervia*) with Forest Red Gum (*Eucalyptus tereticornis*) and Swamp Box also occurring. Much less frequently Red Mahogany, Swamp Mahogany (*E. robusta*) and Pink Bloodwood were also recorded as canopy species. The midstorey included Swamp Box, Black Oak, Cheese Tree (*Glochidion ferdinandi*) and Swamp Box.

The shrub layer consisted of Groundsel Bush (*Baccharis halimifolia*), Lance-leaved Geebung and Coffee Bush. The ground layer was typically dominated by Spiky-headed Mat-rush (*Lomandra longifolia*), with Slender Rice Flower (*Pimelea linifolia*), Wiry Panic, Bordered Panic and Blady Grass. Vines recorded include Common Silkpod, Bindweed and Devil's Twine (*Cassytha pubescens*).

Blackbutt Forestry Plantation

The Blackbutt Forestry Plantation vegetation association was located in the southwest of the study area, just north of Little Arrawarra Creek (Figure 3.1). The Blackbutt Forestry Plantation vegetation association has a monoculture canopy of Blackbutt with no mid or shrub understorey. The groundcover consists of Blady Grass and Prickly Beard Heath remnant of the Blackbutt Coastal Hills Moist Open Forest vegetation association that was likely to have been cleared for the plantation.

Swamp Oak Swamp Sclerophyll Forest

The Swamp Oak Swamp Sclerophyll Forest vegetation association was recorded in the northeast of the study site in disturbed or previously cleared areas in the road reserve adjacent to Broad-leaved Paperbark Swamp Sclerophyll forest (Figure 3.1). The Swamp Oak Swamp Sclerophyll Forest vegetation association is likely to be dominated by Swamp Oak rather than Paperbark, because Swamp Oak (*Casuarina glauca*) is a better coloniser of cleared and disturbed ground. The dense canopy of Swamp Oak precludes many shrub species and little groundcover remains

3.2.2 Threatened species

Several threatened flora species have been recorded within 10 km of the study area. An assessment of the likelihood of occurrence of threatened flora species is presented in Appendix A. Whilst no threatened flora species were detected during surveys, one threatened species the Swamp Orchid (*Phaius australis*) is considered likely to occur based on the presence of suitable habitat. Surveys were conducted outside of the species flowering period of September to October when it is most detectable.

3.2.3 Endangered Ecological Communities

The Broad-leaved Paperbark Swamp Sclerophyll Forest and Swamp Oak Swamp Sclerophyll Forest vegetation associations (Figure 3.1) are considered to qualify as Swamp Sclerophyll Forest on Coastal Floodplain in the North Coast Bioregion, an Endangered Ecological Community (EEC), listed on the TSC Act. No EECs listed on the EPBC Act were recorded within the study area.

3.2.4 Disturbance History

The study area is fragmented by powerline easements, the Pacific Highway, local roads (old Pacific Highway) in the east and forestry access trails in the west. The main sources of disturbance within the study area are forestry operations (including logging, frequent hazard reduction burns, access trails and plantation establishment) and the road network (including both historical and current Pacific Highway alignments).

3.3 Fauna

Results of the fauna survey are discussed below, including the threatened species recorded. Fauna species recorded within the study area are listed in Appendix C.

3.3.1 Habitat Assessment

Aquatic Habitat

Aquatic habitat within the study area consists of:

- Arrawarra Creek in the south of the study area
- Arrawarra Gully, a small ephemeral watercourse in the north of the study area
- Swamp Sclerophyll Forest within the study area (short-term ephemeral aquatic habitat)

Arrawarra Creek runs east to west across the southern boundary of the study area and is located just north of Little Arrawarra Creek. Within the study area Arrawarra Creek is heavily degraded and has experienced a high level of weed invasion. The Blackbutt Forestry Plantation is directly adjacent to Arrawarra Creek and few eucalypts with large DBH within the riparian zone of the creek indicates heavy historical logging of the creek.

Arrawarra Gully is a small ephemeral watercourse that runs east to west across the northern portion of the study area through an area of Broad-leaved Paperbark Swamp Sclerophyll Forest. The watercourse has a defined channel approximately two to three metres wide and less than one metre deep, in the far west of the study area. The channel opens up into swamp forest where it forms more of a soak than a defined channel. Within the study area, the drainage line is intersected by:

- the old Pacific Highway in the east of the study area
- the current Pacific Highway
- a powerline easement, approximately 25-30 m wide, located on the west of the Pacific Highway
- a forestry access track in the west

During wet conditions, vehicular movement on both the forestry access track and powerline easement disturb the soil and is likely to increase turbidity within the watercourse. Where the drainage line crosses the powerline easement, an open sedgeland has formed due to removal of swamp forest canopy and mid-storey. This ephemeral drainage line and ditches are likely to provide habitat for the Green-thighed Frog (*Litoria brevipalmata*) a threatened frog species, recorded to the south of Woolgoolga during previous investigations (Lewis Ecological Surveys, 2006) and for Wallum Froglet (*Crinia tinnula*) recorded during this survey.

Swamp Sclerophyll Forest within the study area provides short-term ephemeral aquatic habitat during heavy rain events. The aquatic habitat provided by the Swamp Sclerophyll Forest would consist of temporary shallow sheets of water in lower areas and small pools. Swamp Sclerophyll Forest with abundant sedges in lower areas are likely to provide breeding habitat for the Wallum Froglet.

Terrestrial Habitat

Terrestrial habitats that offer refuge and forage resources for ground dwelling fauna, such as small to medium sized mammals, reptiles and frogs, within the study area include groundcover, logs and fallen timber.

Logs and Fallen Timber

The study area contains medium to large-sized logs scattered throughout the study area that are likely to provide habitat for reptiles and small to medium sized mammals. The frequent fire history of the study area has resulted in most of the logs and fallen timber having been partly burnt, which may homogenise the available resources. Large sized logs occurred more frequently within the Blackbutt Coastal Hills Moist Open Forest and the Broad-leaved Paperbark Swamp Sclerophyll Forest

vegetation associations, with the Blackbutt Forestry Plantation containing only small to medium-sized logs, probably as a result of thinning practices.

Ground Cover, Shrubs and Leaf Litter

Ground cover, shrubs and leaf litter densities vary across the study area. The Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association offers reasonable shrub and ground cover in some areas, such as in the northwest, but is generally quite open with the groundcover dominated by scattered Spiky-headed Mat Rush (*Lomandra longifolia*). The Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association is likely to offer some shelter for small mammals and reptiles.

The Blackbutt Coastal Hills Moist Open Forest vegetation association has a generally open shrub and ground layer that provides some small pockets of shelter for small mammals and reptiles.

Leaf litter cover within the study area was generally reasonable with approximately 10 cm of litter in most locations.

Forage Resources

The study area provides nectar and pollen resources across all seasons, including Autumn and Winter flowering myrtaceous trees that are likely to provide important forage for nectarivore fauna (Table 3.2).

Table 3.2: Flowering species likely to be used as forage resources by nectarivores within the study area

Species	Common Name	Abundance and Vegetation Association	Flowering Season
<i>Callistemon salignus</i>	Willow Bottlebrush	Occasional shrubs across study area	Spring
<i>Eucalyptus microcorys</i>	Tallowwood	Uncommon in Blackbutt Moist Coastal Forest vegetation association	Winter - Spring
<i>E. globboidea</i>	White Stringybark	Uncommon in Blackbutt Moist Coastal Forest vegetation association	Autumn
<i>E. paniculata</i>	Grey Ironbark	Uncommon in Blackbutt Moist Coastal Forest vegetation association	Winter - Spring
<i>E. pilularis</i>	Blackbutt	Dominant in Blackbutt Moist Coastal Forest vegetation association	Spring - Summer
<i>E. resinifera</i>	Red Mahogany	Reasonably common in Blackbutt Moist Coastal Forest vegetation association	Spring - Summer
<i>E. robusta</i>	Swamp Mahogany	Uncommon with a few trees in northwest Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association.	Winter

Species	Common Name	Abundance and Vegetation Association	Flowering Season
<i>E. tereticornis</i>	Forest Red Gum	Reasonably common in Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association	Winter
<i>Corymbia intermedia</i>	Pink Bloodwood	Reasonably common in Blackbutt Moist Coastal Forest vegetation association	Summer
<i>Melaleuca linariifolia</i>	Snow in Summer	Uncommon in Blackbutt Moist Coastal Forest vegetation association	Spring - Summer
<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Dominant in the Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association.	Autumn - Winter
<i>Leptospermum juniperinum</i>	Prickly Tea-tree	Scattered in Blackbutt Moist Coastal Forest vegetation association	Spring

The Blackbutt Moist Coastal Forest vegetation association is likely to be an important foraging resource for nectarivores in Spring and Summer when the Blackbutt is flowering. Conversely the Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association is likely to offer Winter foraging resources when the Broad-leaved Paperbark and Forest Red Gum are flowering.

Winter flowering trees and shrubs provide an important forage resource for nectarivore and insectivore fauna (ie Squirrel Glider), as reliably flowering plants and insects are often limited during the Winter season. In particular, Swamp Mahogany and Forest Red Gum are considered important forage resources, as they are reportedly reliable flowerers (Law *et al.* 2000), unlike some other Winter flowering eucalypts that can have inconsistent and variable flowering depending on climatic and other environmental factors.

Allocasuarina species (Black Oak and Forest Oak) were relatively common in the Blackbutt Moist Coastal Forest vegetation association within the study area and are likely to provide an important forage resource for the locally recorded Glossy Black Cockatoo.

Grass and sedge abundance across the study area was generally moderate, occurring in both the Blackbutt Moist Coastal Forest and Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation associations. While this offers somewhat marginal seed resources for threatened granivore fauna species, the high level of disturbance history generally limits the availability of this resource to native fauna species - as reflected in the ground trapping results.

Arboreal Habitat

Tree Hollows

Hollow bearing trees were relatively common in the study area, with 114 recorded (Figure 3.2). Hollows were observed most commonly in stags (dead trees), Swamp Box being the most common live tree with hollows. Less often hollows were recorded in Forest Red Gums, Broad-leaved Paperbark, Blackbutt, Pink Bloodwood, Narrow-leaved White Stringybark and Tallowwoods. A number of the stags showed evidence of ringbarking, a common forestry practice. Hollows ranged from small cracks in trunks and branches to large hollows in trunks and large branches. It is likely that hollows recorded

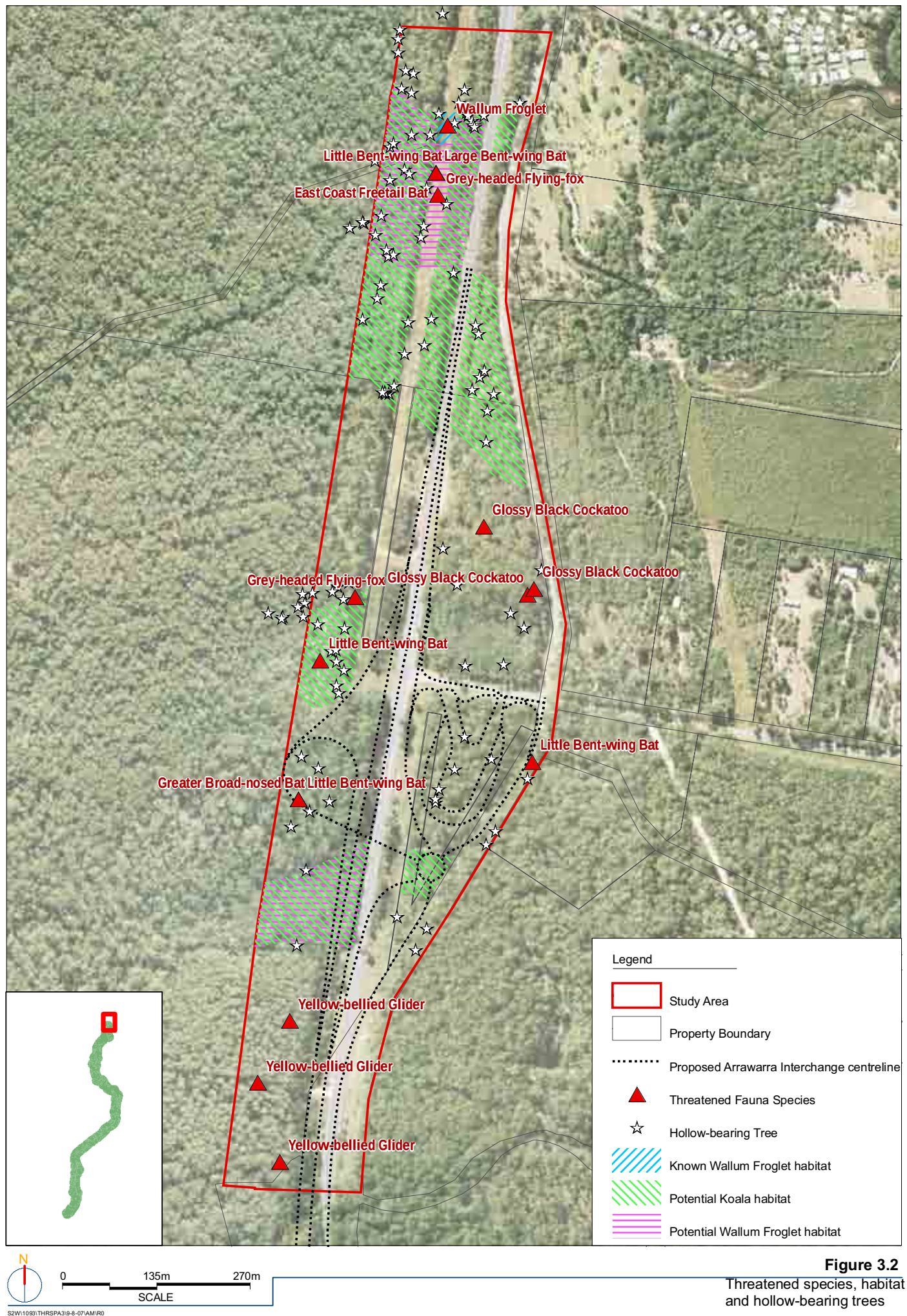


Figure 3.2

Threatened species, habitat and hollow-bearing trees

within the study area are suitable for a wide range of hollow-dependent mammal and bird species, many of which are threatened.

Microchiropteran Bat Foraging Habitat

The structure of vegetation associations in the study area offer foraging resources suitable for over-canopy foraging such as aerial intercept foraging and sub-canopy foraging, suitable for more agile species foraging in the relatively open understorey habitat. The aquatic habitat associated with the Arrawarra creek in the south of the study area offers marginal foraging habitat for the Large-footed Myotis (*Myotis adversus*).

Overall the habitat within the study area is considered to be suitable for the following threatened microchiropteran bat species:

- Hoary Wattled Bat (*Chalinolobus nigrogriseus*)
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Little Bent-wing Bat (*Miniopterus australis*)
- East Coast Freetail Bat (*Mormopterus norfolcensis*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Eastern Cave Bat (*Vespadelus traughtoni*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Large-footed Myotis (*Myotis adversus*).

Wildlife Corridors

Key Habitats and Corridors

Scotts (2003) presents information on key habitats and regional corridor interconnectivity on the north coast of New South Wales, and identifies the study area and adjacent areas of Wedding Bells State Forest as Key Habitat. Scott (2003) also identifies the study area as forming part of a Regional Corridor, intended to link large areas of Key Habitat.

3.3.2 Diurnal Bird Census

A total of 29 bird species were recorded in the study area during field surveys (refer to Appendix C), including a pair of Glossy Black Cockatoos, a Vulnerable species listed on the TSC Act. The Glossy Black Cockatoos recorded within the study area were observed foraging within the Blackbutt Coastal Hills Moist Open Forest vegetation association in the eastern part of the study area.

3.3.3 Terrestrial Trapping

Elliott A Trapping

A total of four species were recorded during terrestrial Elliott A trapping. These were Swamp Rat (*Rattus lutreolus*), Brown Antechinus (*Antechinus stuartii*), one Water Rat (*Hydromys chrysogaster*) and the introduced Black Rat (*R. rattus*). The female Water Rat was captured within the northeast Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association adjacent to a small pond within an ephemeral drainage line. The Brown Antechinus and Swamp Rat were captured within each of the survey blocks (Figure 2.1). Black Rat was recorded within the northwest and southwest survey blocks.

Pitfall Trapping

Pitfall trapping within the northwest Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association recorded three Garden Sun Skinks (*Lampropholis delicata*) and one Friendly Sun Skink (*Lampropholis amicala*). No captures were made within the central west pitfall traps within the Broad-leaved Paperbark Swamp Sclerophyll Forest vegetation association.

3.3.4 Arboreal trapping

A total of three species were recorded during arboreal trapping within the study area. These were Bush Rat (*Rattus fuscipes*), Brown Antechinus and the introduced Black Rat. Bush Rat was recorded within the northwest survey block, Black Rat was recorded at both the northwest and east blocks and Brown Antechinus was recorded within all arboreal trapping blocks within the study area.

3.3.5 Spotlighting and stagwatching

Few fauna species were observed during spotlighting and stagwatching surveys within the study area. Sugar Glider (*Petaurus breviceps*) was observed feeding on sap from a Grey Ironbark on the ecotone between the Broad-leaved Paperbark Swamp Sclerophyll Forest and the Blackbutt Coastal Hills Moist Open Forest vegetation associations. Sugar Glider was also observed within the Blackbutt Coastal Hills Moist Open Forest vegetation association in the north of the central west survey block. Numerous Grey-headed Flying Fox (*Pteropus poliocephalus*) were observed flying over the study area each night shortly after dusk; however, foraging was not observed within the study area at this time. A Tawny Frogmouth (*Podargus strigoides*) was observed within the central west survey block on one occasion. The Red-backed Toadlet (*Psuedophryne coriacea*) was heard calling in the Broad-leaved Paperbark Swamp Sclerophyll Forest in the west of the study area. Only one individual Common Brushtail Possum (*Trichosurus vulpecula*) was observed exiting a hollow-bearing tree during stagwatching in the eastern survey block. No other observations were made during stagwatching surveys.

3.3.6 Call playback

The Yellow-bellied Glider (*Petaurus australis*) responded to call playback of the Powerful Owl and Masked Owl within the Blackbutt Forestry Plantation vegetation association in the southwest of the study area. Calls were heard to the north and the south of the call playback location and an individual was observed adjacent to the call playback location (Figure 3.2).

A possible Powerful Owl (*Ninox strenua*) response to call playback was heard in the northwest of the study area during call playback. High levels of background noise from the Pacific Highway reduced the listening ability of observers and a positive identification was unable to be made.

3.3.7 Ultrasonic echolocation detection

Five microchiropteran bat species were positively identified from bat call recordings within the study area, with a further three species tentatively identified. In addition, calls of the Long-eared Bat genus *Nyctophilus* were also positively identified; however, species level identification is not possible for Long-eared Bats. Of the eight microchiropteran bat species identified through call analysis, four were threatened species listed on the TSC Act. The results of ultrasonic echolocation detection in the study area and call analysis are presented in Table 3.3 below.

Table 3.3: Microchiropteran bats detected in the study area during the survey and reliability of identification.

Reliability of call identification	Scientific Name	Common Name	EPBC Act status	TSC Act status
Definite	<i>Miniopterus australis</i>	Little Bentwing Bat	–	V
Definite	<i>Mormopterus norfolkensis</i>	East Coast Freetail Bat	–	V
Definite	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	–	–
Definite	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	–	–
Definite	<i>Vespedelus pumilis</i>	Eastern Forest Bat	–	–
Definite	<i>Nyctophilus</i> sp.	Long-eared Bat	?	?

Reliability of call identification	Scientific Name	Common Name	EPBC Act status	TSC Act status
Probable	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	–	V
Probable	<i>Miniopterus schreibersii</i>	Large Bentwing Bat	–	V
Probable	<i>Mormopterus sp 2</i>	Freetail Bat	–	–

3.3.8 Secondary evidence

Secondary evidence included the detection of scats and forage evidence. Chewed *Allocasuarina* cones were observed at a number of locations in the eastern survey block, indicating Glossy Black Cockatoo (*Calyptorhynchus lathamii*) foraging activity (Figure 3.2). Scats were observed for the Eastern Grey Kangaroo (*Macropus giganteus*), Brush-tailed Possum and Bush Rat.

3.3.9 Threatened Fauna Species

Several threatened fauna species, listed under the TSC Act were recorded during the field investigations, including:

- Wallum Froglet
- Grey-headed Flying-fox
- Glossy Black Cockatoo
- Yellow-bellied Glider
- Little Bent-wing Bat
- Large Bent-wing Bat
- East Coast Freetail Bat
- Greater Broad-nosed Bat

The Grey-headed Flying Fox is also listed under the EPBC Act. The locations of threatened species recorded within the study area are displayed in Figure 3.2.

Sixteen threatened fauna species additional to those recorded within the study area are considered likely to occur within the study area (Appendix A), based on habitat suitability, local records and the precautionary principle (where there is some uncertainty about the suitability of habitat within the study area). Table 3.4 summarises the habitat requirements of threatened species recorded or considered likely to occur within the study area.

Table 3.4: Habitat requirements for threatened species recorded during surveys or that are considered likely to occur within study area based on Appendix A.

Species	Recorded	Large, contiguous habitats	Winter flowering trees	Tree Hollows	Specialist Habitat
Wallum Froglet (<i>Crinia tinnula</i>)	√				Wallum woodlands and sedgelands
Green-thighed Frog (<i>Litoria brevipalmata</i>)					Ephemeral creeks, soaks and swamp forest
Wallum Sedge Frog (<i>Litoria olongburensis</i>)					Wallum woodlands and sedgelands
Glossy Black-Cockatoo (<i>Calyptorhynchus lathamii</i>)	√			√	<i>Allocasuarina</i> sp.
Emu (<i>Dromaius novaehollandiae</i>)					Grasslands, woodlands, shrublands, forest
White-eared Monarch (<i>Monarcha leucotis</i>)		√			

Species	Recorded	Large, contiguous habitats	Winter flowering trees	Tree Hollows	Specialist Habitat
Square-tailed Kite (<i>Lophoictinia isura</i>)					Tropical and temperate forests and woodlands
Osprey (<i>Pandion heliaetus</i>)					Tall stags, shallow estuaries
Powerful Owl (<i>Ninox strenua</i>)				√	
Masked Owl (<i>Tyto novaehollandiae</i>)				√	
Rufous Bettong (<i>Aepyprymnus rufescens</i>)					Forests with sparse, grassy understoreys
Spotted-tailed Quoll (<i>Dasyurus maculatus</i>)		√			Large hollow logs for denning
Squirrel Glider (<i>Petaurus norfolcensis</i>)			√	√	Multiple large tree hollows (den swapping species)
Yellow-bellied Glider (<i>Petaurus australis</i>)	√		√	√	
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)				√	
Koala (<i>Phascolarctos cinereus</i>)					Particular Eucalyptus species for foraging (refer to Table 4.1)
Common Planigale (<i>Planigale maculata</i>)					Dense, particularly mesic groundcover
Long-nosed Potoroo (<i>Potorous tridactylus</i>)					Heath and forests with dense cover and adjacent more open areas
Black Flying-Fox (<i>Pteropus alecto</i>)			√		Camps/roosts
Grey-headed Flying-Fox (<i>Pteropus poliocephalus</i>)	√		√		Camps/roosts
Hoary Wattled Bat (<i>Chalinolobus nigrogriseus</i>)				√	also rock crevices and buildings for roosts
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)				√	also buildings for roosts
Golden-tipped Bat (<i>Kerivoula papuensis</i>)					Rainforest habitat; roost within the pendulous nests of scrubwens and gerygones
Large-footed Myotis (<i>Myotis adversus</i>)					Water bodies, roost sites in culverts & under bridges
Little Bent-wing Bat (<i>Miniopterus australis</i>)	√				Roost sites in culverts & under bridges
Large Bent-wing Bat (<i>Miniopterus schreibersii</i>)	√				Roost sites in culverts & under bridges
East Coast Freetail Bat (<i>Mormopterus norfolkensis</i>)	√			√	Also buildings for roosts
Eastern Long-eared Bat (<i>Nyctophilus bifax</i>)				√	
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	√			√	
Eastern Cave Bat (<i>Vespadelus troughtoni</i>)					Caves for roosts