BIOSIS
RESEARCH

Flora and Fauna Assessment and Constraints Analysis Lot 24, DP 714096, North Nowra

Final Report

September 2010

Natural & Cultural Heritage Consultants 8 Tate Street Wollongong 2500

Wollongong:
8 Tate Street Wollongong 2500
Ph: (02) 4229 5222 Fax: (02) 4229 5500
email: wollongong@biosisresearch.com.au

Sydney:
18-20 Mandible Street, Alexandria, NSW 2015
Ph: (02) 9690 2777 Fax: (02) 9690 2577
email: sydney@biosisresearch.com.au

Melbourne:
38 Bertie Street Port Melbourne 3207
Ph: (03) 9646 9499 Fax: (03) 9646 9242
email: melbourne@biosisresearch.com.au

Canberra:
Unit 16 / 2 Yallourn Street, Fyshwick ACT 2609
Ph: (02) 6228 1599 Fax: (02) 6280 8752
email: canberra@biosisresearch.com.au

Ballarat:
449 Doveton Street North Ballarat 3350
Ph: (03) 5331 7000 Fax: (03) 5331 7033
email: ballarat@biosisresearch.com.au

Wangaratta:
26a Reid Street, Wangaratta
Ph: (03) 5721 9453 Fax: (03) 5721 9454
Email: Wangaratta@biosisresearch.com.au

Project no: s5793

Authors:

Michael Roberts

Brett Morrisey

Mapping:

Ashleigh Pritchard

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PROJECT	Flora and Fauna Assessment Lot 24, DP 714096, North Nowra
BIOSIS PROJECT NO	s5793
REPORT FOR	Southbank Lands Pty Ltd
REPORT TITLE:	Flora and Fauna Assessment Lot 24, DP 714096, North Nowra
AUTHOR(S):	Michael Roberts and Brett Morrisey

REVISION	*PREPARED*	*INTERNAL REVIEW*	*AMENDED*
Draft	Brett Morrisey Michael Roberts		
Final	Brett Morrisey	Michael Roberts	
Final Rev2	Brett Morrisey		
Final Rev3	Brett Morrisey		

ACKNOWLEDGMENTS

Biosis Research acknowledges the contribution of the following people and organisations in preparing this report:

- Peter Taranto and Alex Pupovac (Southbank Lands Pty Ltd and Huntingdale Developments Pty Ltd.)
- Layla Watson (Technical Assistant, Biosis Research)
- Ashleigh Pritchard (GIS Operator Biosis Research)

ABBREVIATIONS AND COMMON TERMS

Biodiversity	The variety of biological life (plants and animals)
CAMBA	*China-Australia Migratory Bird Agreement*
DECCW	NSW Department of Environment, Climate Change and Water (formerly NSW Department of Environment and Climate Change)
DEWHA	Department of the Environment, Water, Heritage and the Arts (formerly Department of Environment and Water Resources)
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act* 1979
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999
EPI	Environmental Planning Instrument
JAMBA	*Japan-Australia Migratory Bird Agreement*
LEP	Local Environmental Plan
LGA	Local Government Area
Locality	10 km radius of Subject Site
NPWS	NSW National Parks and Wildlife Service (now part of the DECCW)
ROKAMBA	*Republic of Korea-Australia Migratory Bird Agreement*
SCC	Shoalhaven City Council
SoE	State of Environment
Study Area	An approximate 1 km buffer surrounding the Subject Site.
Subject Site	Lot 24, DP 714096, North Nowra
TSC Act	*Threatened Species Conservation Act* 1995
sp.	species (singular)
spp.	species (plural)
ssp.	subspecies
var.	variety

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1.0 INTRODUCTION

Biosis Research has been engaged by Southbank Lands Pty Ltd and Huntingdale Developments Pty Ltd to prepare a flora and fauna assessment at Lot 24, DP 714096, North Nowra in the Shoalhaven Local Government Area (LGA), herein referred to as the Subject Site (Figure 1). The Subject Site, just under 74ha, is currently zoned for agricultural uses and is being investigated by the land owners for its suitability for rezoning to accommodate residential development. Further to the current zoning of the Subject Site, Shoalhaven City Council (SCC) has prepared a revised draft Local Environmental Plan (LEP) according to the 'Standard Instrument' gazetted by the NSW Government in 2006. Zoning maps accompanying the draft *Shoalhaven Local Environmental Plan 2009* (SCC, 2009) propose a conservation zoning over the majority of the Subject Site but include an area of general residential development in the northeast corner.

This flora and fauna assessment has been prepared to provide a detailed analysis of the ecological significance of the Subject Site and identify areas that would be suitable for residential development within acceptable limits. Accordingly the assessment focuses on the conservation significance of flora and fauna on the Subject Site and the potential for threatened species, populations (and their habitats) or ecological communities that either occur on utilise or that may be reliant on the Subject Site. Conservation significance is determined according to the NSW *Threatened Species Conservation Act* 1995 (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and other relevant environmental planning instruments (EPI's).

For the purposes of this assessment, the following definitions are used:

- **Subject Site** – the entirety of Lot 24, DP 714096, North Nowra, including all areas that would likely be subject to disturbance as a result of a potential residential development.
- **Study Area** – the Subject Site and any additional areas of potentially affected as a result of a possible residential redevelopment (e.g. sedimentation, noise). For this assessment, the Study Area includes a 1 km buffer surrounding the Subject Site.
- **Locality** – 10km area surrounding the Subject Site.

1.1 Aims

The general aim of this project is to undertake a terrestrial flora and fauna assessment of the Subject Site and Study Area and to determine the presence of, or potential for threatened species, populations (and their habitats) or ecological communities that either occur on, utilise or that may be reliant on the Subject Site.

The specific aims of this preliminary assessment are to:

- Conduct a literature review and database searches for the Locality;
- Determine and describe the characteristics and condition of the vegetation communities and the terrestrial flora and fauna and their habitats on the Subject Site;
- Identify significant flora and fauna or their habitats on the Subject Site and in the Study Area, focusing on threatened terrestrial species, populations and ecological communities listed under the schedules of the TSC and/or EPBC Acts that are known or likely to occur within the Study Area; and
- Provide a terrestrial biodiversity constraints analysis to guide the rezoning investigations; and
- Provide recommendations for further assessments that would need to be undertaken to determine the likelihood of impacts on threatened terrestrial species, populations or ecological communities or their habitat as a result of future development applications and subsequent residential development.

2.0 LEGISLATION SUMMARY

Commonwealth and NSW legislation and planning policies relevant to the protection of biodiversity or their habitats are listed below. These statutory instruments provide conditions, matters for consideration and requirements to seek authorisation (licences and approvals) to undertake various actions and activities. These include but are not limited to:

- EPBC Act.
- TSC Act.
- *Environmental Planning and Assessment Act 1979.*
- *National Parks and Wildlife Act 1974*.
- *Fisheries Management Act 1994.*
- *Native Vegetation Act 2003.*
- *Water Management Act 2000*.
- *Noxious Weeds Act 1993.*
- *State Environmental Planning Policy No. 44 – Koala Habitat Protection*

3.0 METHODS

This flora and fauna assessment included searches of databases for previous records of threatened species in the Locality, as well as field surveys of the Study Area. This section outlines the specific methods used during the survey to assess biodiversity within and surrounding the Subject Site.

3.1 Desktop

A list of documents reviewed in the preparation this report is provided in the *References* section. Specifically, this assessment included a review of:

- A previous preliminary flora and fauna assessment of the subject site by BES (2004);
- Topographic maps and aerial photographs of the Study Area;
- The broad scale regional vegetation mapping *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. Version 1.0*. (SCIVI) by Tozer *et al* (2006);
- SCC State of Environment maps including vegetation and bushfire mapping (SCC 2004); and
- State and Commonwealth databases as detailed below.

Records of threatened species, populations and communities were obtained from the NSW Department of Environment, Climate Change and Water (DECCW) Atlas of NSW Wildlife within the 10 km radius of the Subject Site and these are mapped in Figures 5 and 6. Records of threatened species, populations and ecological communities listed on the EPBC Act within a 10 km radius of the Subject Site were obtained from the DEWHA EPBC Database EPBC Act database records are not mapped herein. Database searches were conducted in March and April 2010.

3.2 Field Surveys

Terrestrial diurnal and nocturnal flora and fauna surveys were carried out on the Subject Site and immediate surrounds of the Study Area between the 12th and 14th April 2010. The general condition of the Subject Site and Study Area was assessed and observations were made of plant communities, plant and animal species and flora and fauna habitats.

Moon phase, temperature and rainfall records immediately before and during the survey period are provided in Table 1. Weather conditions during the site inspection were cool to mild and clear. Minimum air temperatures ranged between 8.2 and 17.2ºC and maximum air temperatures ranged between 19.8 and 27ºC. There was no rainfall during the survey period, but high rainfall occurred in the days preceding the survey.

Table 1: Temperature, rainfall and moon phase information

Date	Temperature (ºC)		Rainfall (mm)	Moon phase
	Min	Max		
7/4/2010	16.3	24.8	1.4	Last quarter
8/4/2010	17.2	27.0	0	-
9/4/2010	13.2	23.0	21.4	-
10/4/2010	12.3	27.0	0	-
11/4/2010	14.9	25.5	0	-
12/4/2010	8.2	22.8	0	-
13/4/2010	9.5	19.8	0	-
14/4/2010	8.2	24.0	0	New Moon

Source: Bureau of Meteorology (2010) – temperature and rainfall data collected from Nowra RAN Air Station. Survey dates are in bold.

3.2.1 Flora Survey

Flora surveys involved a combination of 20m*20m quadrats, transects, spot locations and random meanders throughout the Subject Site to formulate a species inventory and to assess the distribution of plant communities. Brief inspections of nearby areas of remnant vegetation and conservation reserves were also carried out. Formal flora surveys on the Subject Site were carried in the following stratification units;

- Cleared and disturbed areas;
- Shrublands;
- Open woodlands; and
- Open forests on drainage lines.

Threatened flora species previously recorded in the Study Area, on the Subject Site and with potential to occur on the Subject Site and immediate surrounds were targeted in the quadrats and random meanders including at locations of previous records on the Subject Site. An inventory of the native and exotic flora species recorded for each plant community was compiled (Appendix 1).

Flora habitat assessments focused on the potential for threatened flora species to occur on the Subject Site and the presence or absence of threatened ecological communities. The general condition of the vegetation was assessed based on disturbance history, the degree of infestation by exotic species, structure and overall resilience.

This survey generally adopts the naming convention of the SCC broad vegetation types identified in the on-line 2006 SoE reporting due to the local relevance and vegetation type coverage estimates (SCC 2006).

3.2.2 Fauna Survey

Systematic survey locations were selected using a random stratified design according to the major habitat types that were present across the Subject Site (Figure 4). This was done to ensure that the full complement of potential fauna habitats and vegetation types were sampled. In this way, the Subject Site was divided into two major stratification units; open woodland and open forest on drainage lines. The survey techniques that were undertaken at each of the systematic locations included arboreal and ground trapping, spotlighting, deployment of Anabat devices and remote motion activated infrared cameras, call playback, bird and herpetological surveys. Each of these survey methods are discussed in more detail below.

The presence of fauna species on the Subject Site was also determined through consideration of suitable habitats, with species of animal present on the site recorded opportunistically during the course of habitat assessments and other routine surveys through incidental sightings, aural recognition of calls, and observing indirect evidence of species' presence, such as scats, feathers, hair, tracks, diggings, sap feeding incisions in trees and burrows.

The field survey techniques utilised in the current surveys were based on the recommendations by DEC (2004).

Elliot A and Cage Traps

Elliot A and cage traps were baited with a mixture of peanut butter, rolled oats and tuna oil and were positioned in each of the stratification units. Traps were left out for two nights and were checked shortly after dawn each morning for the presence of any animals. Eighty-five Elliot A trap nights were conducted across the Subject Site, comprising 45 Elliot A trap nights in open woodland and 40 Elliot A trap nights in open forest on drainage lines. In addition, a total of 26 arboreal Elliot A trap nights were conducted across the Subject Site, including 14 in open woodland and 12 in open forest on drainage lines. Thirty-nine cage traps were distributed across the Subject Site, comprising 23 cage trap nights in open woodland and 16 cage trap nights in open forest on drainage lines.

Ultrasonic Bat Detectors (Anabat)

During the survey, one Anabat Z-CAIM Detector (Titley Electronics) were set for two nights in each of the two habitat types to record microbat echolocation calls. The Anabat devices were positioned in potential microbat flyway or foraging areas (near streams).The graphic signature of the microbat calls was examined in the program ANALOOK and these were compared against a reference library of calls to determine the species present (Churchill 2008).

Call Playback

Nocturnal call playback was conducted over two nights in each of the stratification units. The calls played included Powerful Owl *Ninox strenua*, Masked Owl *Tyto novaehollandiae*, Sooty Owl *Tyto tenebricosa*, Yellow-bellied Glider *Petaurus australis* and Koala *Phascolarctos cinereus*.

An initial listening period was carried out for 20 minutes, followed by 15 minutes of spotlighting. The calls of each of the aforementioned target species were played intermittently for 5 minutes, followed by a further 10 minute listening period. Finally, 15 minutes of spotlighting was conducted after call playback was completed.

Spotlighting

Spotlighting was conducted throughout the Subject Site over two nights. Spotlighting was done using a 75W spotlight at each of the systematic survey locations for one hour on foot using a hand-held spotlight and from a vehicle traversing vehicular tracks. Foot and vehicle traverses involved two observers within each stratification unit at a speed not exceeding 5 km/h.

Motion Sensing Cameras

One motion activated camera was positioned in areas of high fauna activity (e.g. diggings, pads, water access) in each of the stratification units for two nights. The camera was directed at buried bait containing rolled oats and peanut butter, with the surrounding trees, shrubs and ground sprayed with honey water to assist in attracting fauna.

Bird surveys

A 30-minute bird survey was conducted along the trapping transects in each of the stratification, shortly after dawn for two days. Birds were recognised by calls, flight patterns and plumage.

Herpetological surveys

A 1-hour diurnal reptile and amphibian survey was conducted in areas of potential sheltering, foraging, basking, breeding and roosting habitat such as riparian zones and rock outcrops. In addition, a 30-minute searching and listening period was conducted in riparian zones for amphibians on one night.

3.2.3 Fauna Habitat Assessment

Fauna habitats were assessed by examining the following characteristics of the Study Area;

- Structure and floristics of the canopy;
- Understorey and ground cover vegetation;

- Size range of hollows and fissures in trees;
- Structure and composition of the litter layer;
- Rock outcrops, overhangs and crevices;
- Disturbances, including weed invasion, clearing, rubbish dumping or fire;
- Potential foraging, nesting or roosting resources; and
- Connectivity to off site habitats.

The following criteria were used to evaluate habitat values:

Good: Good condition endemic vegetation supporting a full range of fauna habitat components are usually present (e.g. hollow bearing trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.

Moderate: Some fauna habitat components are missing (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.

Poor: Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

3.3 Likelihood of occurrence assessment

The likelihood of occurrence assessment for threatened flora and fauna and migratory fauna species was based on previous records collected from database searches, field surveys, the current (known) distribution range of these species, and the presence and condition of suitable habitat in the Study Area. The likelihood of occurrence assessments for threatened flora and fauna are provided in Appendix 2.

The criteria used to assess the likelihood of threatened or migratory species to occur within the Study Area is presented in Table 2.

Table 2: Likelihood of occurrence criteria for threatened or migratory species

Likelihood of occurrence	Assessment Criteria
Low	Species considered to have a low likelihood of occurrence include species not recorded in the field surveys that fit one or more of the following criteria: • Have not been recorded previously in the study area or locality and the study area is beyond the known distribution or range.

Likelihood of occurrence	Assessment Criteria
	• Are dependent on a narrow range or specific habitats that do not or are not likely to occur in the study area. • Are considered locally extinct. • Are a non-cryptic perennial flora species that were targeted during field surveys. • Are flora species that have a very limited range and highly specific dispersal mechanisms.
Moderate	Species considered to have a moderate likelihood of occurrence include species not recorded in the field surveys that fit one or more of the following criteria: • There are infrequent records for the species in the study area and locality. • Preferential habitats of the species are present in the study area but these are mainly in a poor or modified condition. • May use or occur in habitats within the study area opportunistically during seasonal migration but are unlikely to be present on permanent basis as a populations or vagrant individuals. • Are cryptic flowering flora species that were not seasonally targeted during surveys.
High	Species considered to have a high likelihood of occurrence include species recorded during the field surveys or species not recorded that fit one or more of the following criteria: • Have a high incidence of previous records in the study area and locality. • Preferentially use habitats that are present in the study area which are abundant and/or in good condition. • Resident populations are known in the study area or locality. • Are known to regularly use habitats of the site or locality or are highly likely to visit the site during seasonal dispersal or migration.

3.4 Limitations

The survey effort was based on the scope and aims of the project and landscape context of the Subject Site. All reasonable attempts were made to ensure that the level of recommended survey effort as described in the *Threatened Biodiversity Survey and Assessment; Guidelines for Developments and Activities: Working Draft* (DEC 2004) was followed.

In relation to the amount of survey effort and its timing, a reasonable sample of the spectrum of flora and fauna species and assessment of the ecological processes that are likely to occur on the Subject Site and in the Study Area have been made from desktop assessments, background research and the site inspection. However, the full spectrum of flora and fauna species and ecological processes likely to occur on the Subject Site and in the Study Area cannot be fully quantified or described in this report. Also, it is recognised that conditions, including the presence of threatened species can change with respect to time. These limitations have been addressed by identifying potential habitats for flora and fauna species and assessing

the likelihood for these species to occur on the Subject Site and within the Study Area and Locality based on previous records, the type and condition of habitats present, the land use throughout the Study Area and the landscape context at the Locality scale. Where surveys have been undertaken outside the optimal time for detecting a particular species (e.g. flowering time of flora or migratory patterns of fauna) a precautionary approach has been utilised and it has been assumed that a species is likely to be present in consideration of suitable habitat and a likelihood of occurrence.

More than one vegetation mapping and classification scheme are referenced in this assessment. Accordingly the limitations of the reference vegetation surveys and mapping applies to an extent to this assessment.

This assessment has relied on threatened species data requested from DECCW for assessment and mapping purposes. DECCW state in the data provided that it is only indicative and cannot be considered as a comprehensive inventory and may contain errors and omissions providing an approximate guide only.

4.0 RESULTS

4.1 Plant Species

A total of 160 plant species were recorded from quadrat sampling, transects, random meanders and spot locations on the Subject Site during the current survey. The flora species inventory includes 138 locally occurring native species and 22 introduced species (Appendix 1). Of the introduced species, four are listed as noxious under Order 20 of the NSW *Noxious Weeds Act 1993* for the Shoalhaven LGA.

No threatened plant species were recorded in the current surveys. The high proportion of native to exotic species is a reflection of the condition of the bushland over the majority of the Subject Site and regeneration following the Bangalee Scout Camp fire of 2004. Percentage cover of exotic species is generally low throughout with exotic perennial grasses and herbs dominating the weed suite. Weed infestations are present in bushland that has been subject to earthworks through the northern and eastern areas of the Subject Site. The eastern cleared areas are dominated by exotic grasses. Minor weed infestations are present on the drainage lines, fire breaks and informal tracks. Further detail on the distribution of plant species on the Subject Site is provided in the following section.

4.2 Plant Communities

4.2.1 Previous Vegetation Mapping

SCIVI Mapping

In summary the *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. Version 1.0* (Tozer 2006) study and accompanying mapping provide a uniform classification of native vegetation for south-eastern NSW as a basis for regional conservation and management of native vegetation. One hundred and eighty nine plant communities were derived from previous vegetation mapping projects and quantitative vegetation samples collected from private and public land over a period of more than 20 years. The 4 006 650 ha study area is bound by the coast from Sydney to the Victorian border and the escarpment and tablelands from the Blue Mountains to Delegate. It comprises all of the Araluen, Batemans Bay, Bega, Braidwood, Burragorang, Cobargo, Eden, Goulburn, Green Cape, Jervis Bay, Katoomba, Kiama, Moss Vale, Narooma, Penrith, Port Hacking, Sydney, Taralga, Ulladulla and Wollongong 1:100 000 scale map sheets, as well as parts of the Craigie, Bombala and Cooma sheets.

The extent of native vegetation was delineated using a compilation of new and existing data derived from aerial photo interpretation. Map Units were derived from a hierarchical and non-hierarchical multivariate analysis. Thirteen rainforests, 33 wet sclerophyll forests, 17 grassy woodlands, 3 grasslands, 68 dry sclerophyll forests, 20 heathlands, 11 freshwater wetlands, 17 forested wetlands and 3 saline wetlands were defined. Of the total number of mapping units 42 were Endangered Ecological Communities (EEC's) listed under the TSC Act, and 6 were EEC's listed under the EPBC Act as at the time of the Tozer *et al* (2006) publication.

The Subject Site, Study Area and Locality are incorporated in this broad scale vegetation mapping of southeast NSW and this is shown in Figure 3. The Subject Site is mapped as supporting Shoalhaven Sandstone Forest over the western arm and southern half of the Subject Site. Apart from an arc of Morton Mallee-Heath in the south-eastern area the remainder of canopy cover is mapped by Tozer *et al* (2006) as Currambene-Batemans Lowland Forest.

Shoalhaven Vegetation Mapping

Vegetation mapping of the Shoalhaven LGA from the SCC website has been reviewed. In summary the SCC (2004) map identifies a Scribbly Gum – Silvertop Ash Forest/Woodland community as the canopy cover through the majority of the eastern half of the Subject Site and on the broad sandstone terrace topography that occurs on the western arm of the Subject Site adjoining Gypsy Point Rd. Grey Gum Forest/Woodland is mapped in the central and south eastern areas with Spotted Gum Forest over the western gully and drainage line.

4.2.2 Scribbly Gum Woodland

Figure 4 shows the distribution of Scribbly Gum Woodland on the Subject Site. This is relatively consistent with the distribution of Scribbly Gum-Silvertop Ash Forest/Woodland in

the Shoalhaven LGA vegetation mapping (SCC 2004). The Scribbly Gum Woodland of the current survey is dominated by a canopy between 10 and 15m of *Eucalyptus sclerophylla* Hard-leaved Scribbly Gum, *Corymbia gummifera* Red Bloodwood with *Eucalyptus agglomerata* Blue-leaved Stringybark sub dominant throughout. There is a midstorey of regenerating canopy species and *Allocasuarina littoralis* Black She-oak and *Banksia serrata* Old-man Banksia are common as well.

The shrub stratum is well developed in the western arm of the Subject Site and has regenerated following the 2004 fire. The degree of development of the shrub stratum in the central and eastern portions of the community is variable and ranges from sparse to patches of moderate cover. Generally the shrub stratum of the Scribbly Gum Woodland is to 2 metres and dominated by *Aotus ericoides*, *Banksia spinulosa* var *spinulosa* Hairpin Banksia, *Hakea sericea* Needlebush, *Lambertia formosa* Mountain Devil, *Leptospermum trinervium* Slender Tea-tree, *Persoonia linearis* Narrow-leaved Geebung, *Phyllota phylicoides* Heath Phyllota and *Platysace linearifolia*. There are some dense stands of *Kunzea ambigua* Tick Bush in the central area and other locations of previous disturbance. The groundcovers are dominated by native grasses, herbs and sedges and species richness is high. Dominant species throughout are *Anisopogon avenaceus* Oat Speargrass, *Caustis flexuosa* Curly Wig, *Cyathochaeta diandra*, *Entolasia marginata* Bordered Panic, *Entolasia stricta* Wiry Panic, *Eragrostis brownii* Brown's Lovegrass, *Goodenia hederacea* ssp *hederacea* Forest Goodenia, *Lepidosperma laterale*, *Patersonia glabrata* Leafy Purple-flag and *Themeda australis* Kangaroo Grass.

Weed species density and species richness is low in this community. Weed infestation are primarily confined to disturbed edges such along the fire break to Lochaven Drive, areas of previous disturbance including where there has been earthworks or deposition of fill in the central and eastern areas of the subject site. The weed suite in the Scribbly-Gum Woodland is mainly composed of exotic perennial grasses and herbs with a minor woody weed infestation in the drainage line below Warrah Road.

Overall resilience of this plant community is assessed as high with some areas that have been subject to previous disturbance such as vegetation clearing, earthworks and introduced fill in a moderate class.

In 2006 SCC estimated that there was 33, 577ha of Scribbly Gum Forest/Woodland in the Shoalhaven LGA and this equated to approximately 8.7% of the total mapped 383,211ha vegetation cover of the Shoalhaven LGA.

4.2.3 Grey Gum Woodland

This plant community is mapped in the current survey over the central and southern drainage lines and adjoining low sandstone terraces (Figure 4). *Corymbia gummifera* Red Bloodwood and *Eucalyptus punctata* Grey Gum are the dominant tree species throughout with several Stringybark species also common. *Eucalyptus piperita* Sydney Peppermint is present in the intergrade to Spotted Gun Forest in the western drainage line and Corymbia maculata Spotted

Gum occurs frequently in the transitional vegetation of the Crams Road drainage line. The midstorey is dominated by recruiting canopy species with *Allocasuarina littoralis* Black She-oak common in drier areas and *Leptospermum trinervium* Slender Tea-tree present through on the channels. The understorey between 1 and 3m is dense in the drainage lines and sparser over the shallower soils of the higher sandstone terraces. Common species are *Acacia longifolia* ssp *longifolia* Sydney Golden Wattle, *Acacia terminalis* ssp *angustifolia* Sunshine Wattle *Banksia spinulosa* var *spinulosa* Hairpin Banksia, *Dodonaea triquetra* Large-leaf Hop-bush, *Kunzea ambigua* Tick Bush, *Lambertia formosa* Mountain Devil and *Persoonia linearis* Narrow-leaved Geebung in drier areas of the community with *Bauera rubioides* River Rose, *Leptospermum trinervium* Slender Tea-tree, *Pimelea linifolia* ssp *linifolia* Slender Rice Flower, *Platysace linearifolia*, *Pultenaea linophylla* and *Sannantha pluriflora* present closer to the damp areas of the channels. The groundcover stratum is dominated by native grasses and herbs. Away from the channels common species are *Anisopogon avenaceus* Oat Speargrass, *Dianella caerulea* var *producta*, *Entolasia marginata* Bordered Panic, *Eragrostis brownii* Brown's Lovegrass, *Gonocarpus tetragynus*, *Lepidosperma laterale*, *Patersonia sericea* Silky Purple-Flag, *Phyllanthus hirtellus* and *Pomax umbellata* Pomax and *Themeda australis* Kangaroo Grass. Commonly recorded species that are often associated with damper soils such as occur along the drainage line channels are *Dichondra repens* Kidney Weed, *Entolasia stricta* Wiry Panic, *Gahnia* sp Saw-sedge, *Goodenia hederacea* ssp *hederacea* Forest Goodenia, *Microlaena stipoides* var *stipoides* Weeping Grass, *Oplismenus aemulus* Oplismenus, *Pteris tremula* Tender Brake and *Schoenus melanostachys*.

Weed percent cover and species richness is low with exotic species generally confined to the banks of the drainage lines. Common exotic grasses and herbs recorded in the current survey are *Ageratina adenophora* Crofton Weed, *Andropogon virginicus* Whisky Grass, *Axonopus fissifolius* Narrow-leafed Carpet Grass and *Taraxacum officinale* Dandelion.

The Grey Gum Woodland of the current survey has a high resilience and supports fully structured native vegetation.

SoE reporting by SCC in 2006 estimated that there was 33, 185ha of Grey Gum Forest/Woodland in the Shoalhaven LGA and this equated to approximately 8.6% of the total 383,211ha mapped vegetation cover of the Shoalhaven LGA.

4.2.4 Spotted Gum Forest

Spotted Gum Forest occurs on the Subject Site in two locations (Figure 4). Canopy of the stand of the community below Lincorn Ave and over the western drainage line is between 25 and 30m including *Corymbia gummifera* Bloodwood, *Corymbia maculata* Spotted Gum, *Eucalyptus eugenioides* Thin-leaved Stringybark, *Eucalyptus piperita* Sydney Peppermint, *Eucalyptus saligna* Sydney Blue Gum and *Syncarpia glomulifera* ssp *glomulifera* Turpentine. The midstorey is comprised of regenerating canopy species and *Allocasuarina littoralis* Black She-oak is common. Percent cover in the understorey is approximately 10% with some dense patches of *Dodonaea triquetra* Large-leaf Hop-bush present in places. Other common species in the understorey are *Acacia longifolia* ssp *longifolia* Sydney Golden Wattle, *Breynia*

oblongifolia Coffee Bush, *Leucopogon lanceolatus* var *lanceolatus*, *Macrozamia communis* Burrawang, *Melaleuca styphelioides* Prickly-leaved Tea Tree and *Persoonia linearis* Narrow-leaved Geebung. The groundcovers are dominated by native grasses, herbs, sub-shrubs and ferns with common species including *Adiantum aethiopicum* Common Maidenhair, *Calochlaena dubia* Soft Bracken, *Centella asiatica* Indian Pennywort, *Dianella caerulea* var *caerulea* Blue Flax-lily, *Entolasia* spp, *Gompholobium pinnatum* Pinnate Wedge Pea, *Imperata cylindrica* Blady Grass, *Lomandra glauca* Pale Mat-rush, *Oplismenus aemulus* Oplismenus and *Pratia purpurascens* Whiteroot.

This community is also present in the southwest corner of the Subject Site between the access track and drainage line. *Corymbia maculata* Spotted Gum dominates with *Corymbia gummifera* Red Bloodwood common. The midstorey consists of regenerating canopy species with *Acacia* spp and *Dodonaea triquetra* Large-leaf Hop-bush dominating the understorey. Other common native shrubs in the understorey are *Daviesia ulicifolia* Gorse Bitter Pea, *Hakea sericea* Needlebush, *Kunzea ambigua* Tick Bush, *Leucopogon juniperinus* Prickly Beard-heath and *Pimelea linifolia* ssp *linifolia* Slender Rice Flower. The groundcover stratum is generally sparse due to the high percent cover of the understorey. Exotic species are virtually absent and native grasses and herbs such as *Anisopogon avenaceus* Oat Speargrass, *Entolasia marginata* Bordered Panic, *Eragrostis brownii* Brown's Lovegrass, *Glycine microphylla* Small-leaf glycine, *Lepidosperma laterale*, *Opercularia diphylla*, *Themeda australis* Kangaroo Grass and *Xanthosia tridentata* Xanthosia. Resilience of the Spotted Gum Forest on the Subject Site is high.

As at 2006 Spotted Gum Forest was estimated to occupy a total of 48, 124ha throughout the Shoalhaven LGA equating to approximately 12.5% of the total 383,211ha mapped vegetation cover of the Shoalhaven LGA (SCC 2006).

4.2.5 Shrubland

This community is dominated by native shrubs that have regenerated following major disturbance of the previous native vegetation cover. Dominant species are *Allocasuarina littoralis* Black She-oak, *Leptospermum polygalifolium* Yellow Tea-tree and *Leptospermum trinervium* Slender Tea-tree with *Hakea salicifolia* Willow-leaved Hakea, *Hakea sericea* Needlebush, *Kunzea ambigua* Tick Bush and *Leucopogon juniperinus* Prickly Beard-heath and *Eucalyptus sclerophylla* Hard-leaved Scribbly Gum is present as an occasional emergent. The groundcovers are a mix of native and exotic grasses and herbs and common species are *Andropogon virginicu*s Whisky Grass, *Aristida ramosa* Purple Wiregrass and *Entolasia stricta* Wiry Panic. The main stand of this plant community is affected by diffuse stormwater runoff discharging from the constructed open drain through the northeast portion of the Subject Site. Resilience is assessed as low to moderate due to percent weed cover and the continuing impacts of stormwater in places.

The SoE reporting of by SCC (2006) estimated 262ha of non-floristically aligned Shrubland across the Shoalhaven LGA and this amounted to approximately 0.07% of the total 383,211ha vegetation cover mapped for the Shoalhaven LGA.

4.2.6 Closed Grassland

A Closed Grassland dominated by exotic perennial grasses and introduced annual and perennial herbs is present in the northeast of the Subject Site. *Andropogon virginicus* Whisky Grass was the dominant species with *Paspalum dilatatum* Paspalum and *Pennisetum clandestinum* Kikuyu Grass having a high percent cover. Other common exotic species are *Anagallis arvensis* Scarlet Pimpernel, *Conyza* sp Fleabane, *Plantago lanceolata* Lamb's Tongues, *Rumex brownii* Swamp Dock, *Setaria gracilis* Slender Pigeon Grass and *Trifolium repens* White Clover. There are occasional native shrubs such as *Acacia mearnsii* Black Wattle, *Hakea salicifolia* Willow-leaved Hakea, *Hakea sericea* Needlebush and *Leptospermum polygalifolium* Yellow Tea-tree and regenerating *Eucalyptus* sp. Native species synonymous with disturbed landscapes are also present in the groundcover stratum including *Centella asiatica* Indian Pennywort, *Cynodon dactylon* Couch, *Eragrostis leptostachya* Paddock Lovegrass, *Hydrocotyle peduncularis* and *Microlaena stipoides* var *stipoides* Weeping Grass. The Closed Grassland has a low resilience and represents a cleared and disturbed landscape.

4.3 Threatened Plants

Searches of the DECCW Wildlife Atlas and DEWHA Protected Matters Search Tool have identified 18 threatened plant species (or their potential habitats) previously recorded in the locality (Table 9, Appendix 2). These records include 18 plant species with a dual listing under the TSC and EPBC Acts, one species solely listed under the TSC Act and two species solely listed under the EPBC Act.

No threatened flora species were recorded in the current surveys. Appendix 2 provides an assessment of the likelihood of the 18 threatened flora species (or their potential habitats) recorded in the locality, to occur on the Subject Site. Based on the habitats present in the Study Area and Subject Site and other considerations including current disturbance regimes and the number and distribution of previous records, these assessments have determined that there is;

- a nil to low likelihood for 12 of these species to be present on the Subject Site or in the Study Area;
- a moderate likelihood for five species to be present on the Subject Site or in the Study Area; and
- a high likelihood for one species to be present on the Subject Site or in the Study Area.

Further discussion of threatened flora is provided in Section of this report.

4.4 Threatened Ecological Communities

No threatened ecological communities are present on the Subject Site or in the immediate surrounds.

4.5 Fauna Habitats

Suitability, size and configuration of vertebrate fauna habitats broadly correlate to the structure, connectivity and quality of local and regional vegetation types. The Subject Site contains a range of microhabitat features including tree hollows, leaf litter, understorey shrubs, fallen logs, sandstone outcrops, damp areas and surface water.

Each of the major fauna habitats that are present within the Subject Site are described below. The fauna species recorded from within the Subject Site are discussed in the following section.

Open Woodland

Open Woodland habitat is common across the Subject Site. It provides perching, nesting, foraging and roosting habitat for birds, and foraging habitat and protection for arboreal and ground-dwelling mammal species. The Open Woodland habitat also comprised logs and fallen trees, high quality myrtaceous and proteaceous foraging resources and rocky outcrops on ridgelines. These features would provide habitat for threatened fauna species such as the Eastern Pygmy-possum *Cercartetus nanus,* Yellow-bellied Glider *Petaurus australis* and the Gang-gang Cockatoo *Callocephalon fimbriatum.* High incidences of Long-nosed Bandicoot *Perameles nasuta* diggings were observed where sandy soils were present in this habitat, which was most notable where this habitat occurred along Crams Road.

Open Woodland had a relatively high number of large and mature trees with an estimated dbh of at least 50 cm and 25 – 30 m in height. Stags are also scattered throughout this habitat. Such trees often contained hollows, splits, fissures or cracks and piping or spouts of various sizes that provide suitable shelter and breeding habitat for a range of hollow-dependent mammals, birds and reptiles. In addition, these microhabitat features would provide habitat for a range of threatened hollow dependent species including the Yellow-bellied Glider, Spotted-tailed Quoll *Dasyurus maculatus maculatus* and hollow-dependent microbats (e.g. Eastern Freetail-bat *Mormopterus norfolkensis* and Greater Broad-nosed Bat *Scoteanax rueppellii*). Larger tree-hollows, required by threatened species such as the Powerful Owl *Ninox strenua*, Masked Owl *Tyto novaehollandiae* and Glossy Black-cockatoo *Calyptorhyncus lathami*, were also abundant across the site.

Some disturbance was notable within this habitat including scramble track creation, four-wheel drive tracks, vegetation clearing and rubbish dumping. Edge effects were most apparent where this habitat abutted existing roads (e.g. Crams Road and Gypsy Point Road) and along property and transmission line easements.

Open Forest on Drainage Lines

Open Forest primarily occurs on the drainage lines and areas of deeper and friable soils on the Subject Site. Consequently, these areas are more conducive to denser ground vegetation and higher canopy vegetation in comparison to Open Woodland. This habitat was found to predominantly accompany drainage lines throughout the Subject Site.

The Open Forest contained a range of microhabitat features including tree hollows, fallen timber (some containing hollow), dense vegetation, thick leaf litter and foraging resources. Such features provide nest sites for birds and roosting for arboreal mammal species that are protected from predators, a variety of foraging substrates, roosting and nesting habitat for ground dwelling mammals, foraging and breeding habitat for amphibian and microbat species. Open Forest provides foraging habitat for the Glossy Black-cockatoo (*Allocasuarina littoralis* – seeds of this species are a favoured food resource for this species) and Swift Parrot *Lathamus discolor* (winter-flowering eucalypts – Spotted Gum *Corymbia maculata*), potential nesting habitat for bandicoots and potoroos, potential denning sites (e.g. tree hollows) for the Spotted-tailed Quoll, Glider sap-trees, foraging and breeding habitat for threatened microbats (e.g. Eastern Freetail-bat, Greater Broad-nosed Bat and Large-footed Myotis) and roosting and breeding habitat for forest owls. This habitat also provides nesting and foraging habitat for the threatened Varied Sittella, through the presence of stringy barked tree species, such as Thin-leaved Stringybark and Blue-leaved Stringybark.

The transition zone between Open Forest and Open Woodland supported rocky sandstone outcrops. These contained no exfoliated sandstone and thus, provided limited resources for fauna species dependent on rock crevices.

Open Forest was more intact and in better condition with limited disturbance in comparison to that present within the Open Woodland habitat.

Grassland

The Grassland habitat consisted of areas devoid of canopy cover and was predominantly featured in the eastern section of the Subject Site. These areas support foraging and browsing habitat for large native mammals including the Eastern Grey Kangaroo *Macropus giganteus*, Swamp Wallaby *Wallabia bicolor*, Red-necked Wallaby *Macropus rufogriseus* and Common Wombat *Vombatus ursinus*. This habitat was also found to support introduced species including the European Rabbit *Oryctolagus cuniculus* and Red Fox *Vulpes vulpes*.

This habitat was highly disturbed and contained limited key fauna habitat elements for threatened species.

Aquatic

There are four unnamed creek lines present within the Subject Site. These flow directly into the Shoalhaven River and supported riparian vegetation consisting of Open Forest, Open Woodland and Grassland habitats. Large pools and fringing vegetation were evident in some

sections of these creek lines (particularly in areas adjacent to Open Forest), but large sections were found to be disturbed in response to surrounding land uses, including from un-sewered residential areas and stormwater runoff. This level of disturbance precluded the suitability of a large proportion of this habitat to support a number of threatened amphibian species. However, in areas containing sandstone rock pools with fringing vegetation and apparently less disturbed, potential habitat existed for Giant Burrowing Frog *Heleioporus australiacus*. A range of other non-threatened species were recorded in this habitat including the Common Eastern Froglet *Crinia signifera* and Dark-flecked Garden Sunskink *Lampropholis delicata.*

4.6 Corridors and connectivity

At broad scale the vegetation present within the Study Area forms a component of an east-west corridor and potential fauna linkage between Morton National Park (to the west) and Seven Mile Beach National Park (to the east) primarily along the Shoalhaven River. This corridor is partially fragmented by urban development in the Locality including through Bangalee, North Nowra and Nowra. The east-west Shoalhaven River corridor is characterised by extensive agriculture supporting very little native tree cover between Nowra and Shoalhaven Heads. The Subject Site falls into a broadly vegetated corridor from Morton National Park to Jervis Bay National Park to the south east that incorporates other conservation reserves and State Forest.

Vegetation present to the south of the Shoalhaven River (including Wogamia Nature Reserve and Triplarina Nature Reserve) creates a localised north-south corridor with the vegetation present in the Subject Site, which may be used by highly mobile species not impeded by the presence of natural barriers.

The vegetation within the western part of the Subject Site is indirectly connected with the vegetation present in the broader Locality. This comprises conservation reserves within the proximity of the Study Area, such as Tapitallee Nature Reserve and Cambewarra Range Nature Reserve. The connectivity between vegetation in the eastern part of the Subject Site is largely limited and disjunct, which is predominantly in response to existing road construction and residential development. Such artificial features present in the landscape would limit faunal dispersal for less mobile mammal species, but would not significantly affect the movement of highly mobile species (e.g. birds).

The unnamed creek lines and riparian vegetation present within the Subject Site provide corridors for fish and amphibian species.

4.7 State Environmental Planning Policy 44 – Koala Habitat Protection

The State Environmental Planning Policy (SEPP) 44 – Koala Habitat Protection is applicable to the Shoalhaven LGA. The Subject Site contained one potential koala feed tree, Grey Gum *Eucalyptus punctata,* which comprised Core Koala Habitat (i.e. greater than 15% Schedule 2 tree species in the canopy) within the Open Forest habitat. No Koalas or Koala scats were identified from within the Subject Site and there are no previous records of this species within

the Locality. Consequently, it is considered unlikely that the Subject Site supports a local population of Koalas.

4.8 Animal Species

Fauna species diversity across the Subject Site is presented in Table 3 and a full inventory of species recorded is presented in Appendix 1. The most abundant fauna group were birds with 54 species recorded followed by mammals with 30 species.

The threatened bird species; Gang-gang Cockatoo and Varied Sittella *Daphoenositta chrysoptera* and the threatened mammal species; Large-eared Pied Bat *Chalinolobus dwyeri*, Eastern Bentwing Bat *Miniopterus schreibersii oceanensis*, Eastern Freetail Bat *Mormopterus norfolkensis*, Large-footed Myotis *Myotis macropus*, Greater Broad-nosed Bat *Scoteanax rueppellii* and Yellow-bellied Glider *Petaurus australis* were recorded on the Subject Site in the current surveys.

Table 3: Summary of fauna recorded during the field survey

Group	Native species	Introduced species	Threatened species	Migratory species
Amphibians	4	0	0	0
Reptiles	1	0	0	0
Birds	52	2	2	1
Mammals	28	2	6	0
TOTAL	**82**	**4**	**8**	**1**

4.9 Threatened Species of Animals

Excluding marine mammals, oceanic and pelagic bird species (shearwaters, petrels and albatrosses), a total of 42 threatened fauna species listed under the TSC Act and EPBC Act have been previously recorded within the Locality (Appendix 2). Of these, all are listed under the TSC Act and 18 are listed under the EPBC Act.[1].

A total of eight threatened fauna species were recorded during the field surveys; comprising six mammal species and two bird species. An additional 15 species were considered likely to occur in the Study Area on the basis of previous records and the presence of suitable habitats (Table 4). Further discussion of threatened fauna species for the current assessment is provided in Section 5 following.

[1] An individual species may be listed under one or both Acts

Table 4: Threatened fauna species likely to occur in the Study Area.

Scientific Name	Common Name	EPBC Act	TSC Act
Heleioporus australiacus	Giant Burrowing Frog	V	V
Callocephalon fimbriatum	**Gang-gang Cockatoo**	**-**	**V**
Lophoictinia isura	Square-tailed Kite	-	V
Calyptorhynchus lathami	Glossy Black-cockatoo	-	V
Daphoenositta chrysoptera	**Varied Sittella**	**V**	**V**
Glossopsitta pusilla	Little Lorikeet	-	V
Lathamus discolor	Swift Parrot	E	E1
Ninox strenua	Powerful Owl	-	V
Tyto novaehollandiae	Masked Owl	-	V
Tyto tenebricosa	Sooty Owl	-	V
Cercartetus nanus	Eastern Pygmy-possum	-	V
Dasyurus maculatus maculatus	Spotted-tailed Quoll (southeastern mainland)	E	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	-	V
Mormopterus norfolkensis	**Eastern Freetail Bat**	**-**	**V**
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E1
Petaurus australis	**Yellow-bellied Glider**	**-**	**V**
Potorous tridactylus	Long-nosed Potoroo	V	V
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Chalinolobus dwyeri	**Large-eared Pied Bat**	**V**	**V**
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	V
Miniopterus schreibersii oceanensis	**Eastern Bentwing Bat**	**-**	**V**
Scoteanax rueppellii	**Greater Broad-nosed Bat**	**-**	**V**
Myotis macropus	**Large-footed Myotis**	**-**	**V**

Notes: Species recorded during the field survey are in **bold**

4.10 Migratory Species

A total of 17 migratory species have been predicted to occur within the Locality (Appendix 2). One migratory species, White-bellied Sea-eagle *Haliaeetus leucogaster* was recorded during field surveys.

Australia is a signatory to international agreements aimed at protecting migratory species. These include the *Japan Australia Migratory Bird Agreement* (JAMBA), the *China Australia Migratory Bird Agreement* (CAMBA), the *Republic* of *Korea Australia Migratory Bird Agreement* (RoKAMBA), and the *Bonn Convention on the Conservation of Migratory Species*

of Wild Animals. Migratory species are considered to be Matters of National Environmental Significance and as such are protected under the EPBC Act.

While migratory species of bird may potentially use the locality (see Appendix 2), the Study Area would not be classed as an 'important habitat' as defined under the *EPBC Act Policy Statement 1.1 Principal Significant Impact Guidelines* (DEWHA 2009b) in that the site does not contain:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;
- Habitat utilised by a migratory species which is at the limit of the species range; and
- Habitat within an area where the species is declining.

5.0 THREATENED SPECIES ASSESSMENT

Twenty-three threatened fauna species have been identified to occur or are considered likely to occur within the Study Area. All of the threatened fauna are listed under the TSC Act and eight are listed under the EPBC Act. No threatened flora species were recorded on the subject Site in the current surveys. However the Subject Site is considered to provide suitable habitat for six threatened flora species previously recorded in the locality and these have been assessed as having a moderate to high likelihood to occur on the Subject Site. All six species are listed under the TSC and EPBC Acts, with five also listed under the EPBC Act.

The following sections provide an assessment of the likelihood for threatened occur on, utilise or be dependant on the habitats of the Subject Site and Study Area.

5.1 Threatened flora

5.1.1 *Cryptostylis hunteriana* Leafless Tongue-orchid

Cryptostylis hunteriana is listed as Vulnerable on both the TSC and EPBC Acts. The species is known from a number of localities along the coast of NSW, Victoria and Queensland. In NSW, it appears to be most common in the Shoalhaven (DEWHA 2008a) area. It does not appear to have well defined habitat preferences and is known from a range of communities(DEC 2005d). Associated soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves (DEWHA 2008a). The species occurs mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest(DEWHA 2008a). The larger populations typically occur in woodland dominated by *Eucalyptus sclerophylla*, *E. sieberi*, *Corymbia gummifera* and *Allocasuarina littoralis*. The species appears to prefer open areas in the understorey of this community and is often found in association with *Cryptostylis subulata* and *Cryptostylis erecta*(DEC 2005d).

Although this species is not recorded on the Subject Site it is known from three records in the locality (Figures 5a and 5b). Habitat for this species on the Subject Site is provided by preferred soils, plant community and plant species associations and these are also present in the Study Area and locality.

5.1.2 *Genoplesium baueri*

Genoplesium baueri is listed as Vulnerable under the TSC Act and the species has been recorded from locations between Ulladulla and Port Stephens, with older records including the Sydney suburbs of Cowan, Asquith, Wahroonga and Gladesville (DEC 2005g).

Genoplesium baueri occurs in sparse sclerophyll forest and moss gardens over sandstone (DEC 2005g). The majority of plants are found in relatively open areas but the largest population is located under a good overstorey and dense ground cover (ANOS 2008). The locations of some previous recordings are likely to now be within conservation reserves including Berowra Valley Regional Park, Royal National Park and Lane Cove National Park (DEC 2005g). The species has been recorded at three locations in the Study Area and one location on the Subject Site (Figures 5a and 5b) in previous surveys. There are seven records of the species between 2005 and 2006 at approximately the location shown in Figure 5b from the NSW Wildlife Atlas Database. The single sighting of the species to the north of the Subject Site in the Study Area was recorded in 1972 and the single record in the southeast of the Study Area is a Royal Botanic Gardens Herbarium Specimen also from 1972.

5.1.3 *Melaleuca deanei*

Melaleuca deanei is listed as Vulnerable under the TSC Act and EPBC Acts. The species is primarily distributed in two distinct areas, the Ku-ring-gai/Berowra and the Holsworthy/Wedderburn areas.(DEC 2005o). There are also more isolated occurrences in the Blue Mountains, Nowra and Central Coast areas(DEWHA 2007). There are approximately 75 known locations of the species with a majority of these containing only a few individuals(DEWHA 2007). The total population is estimated at 1000 to 3000. Some of the population are located in several conservation reserves including Berowra Valley Regional Park, Brisbane Water National Park, Ku-ring-gai Chase National Park, Garigal National Park, Lane Cove National Park, Royal National Park and Heathcote National Park(DEWHA 2007). In the locality the species is known from Colymea SCA.

The species occurs in a wide range of vegetation communities, but is most often found in Coastal Sandstone Ridgetop Woodland(DECC 2005b). Species mostly occupy broad flat ridgetops, dry ridges and slopes(Benson and McDougal 1998). The altitudinal range of *Melaleuca deanei* is between 20 and 410 metres above sea level, and annual rainfall of the species distribution ranges from 1,000 to 1,400 mm(Benson and McDougal 1998). It is strongly associated with sandy loam soils that are low in nutrients, sometime with ironstone present (Benson and McDougal 1998) cited in(DEWHA 2007).

This species is not recorded on the Subject Site or in the Study Area. It is known from Colymea SCA to the south east of the Subject Site (Figure 5a). Habitat for this species on the Subject Site is provided by preferred soils and plant community association which are also present in the Study Area and locality.

5.1.4 *Pterostylis gibbosa* Illawarra Greenhood

Pterostylis gibbosa is listed as an Endangered species on both the TSC and EPBC Acts. *Pterostylis gibbosa* is currently known from five locations: Milbrodale in the Hunter Valley, Yallah (2 sites) and Albion Park in the Illawarra and Nowra in the Shoalhaven. The total known population size of *P. gibbosa* in 2002 was approximately 4,500 plants although this is likely to be higher given the extent of the Milbrodale and Worrigee Nature Reserve populations which have not yet been fully assessed (NPWS 2002).

The species occurs in open forest or woodland on flat or gently sloping land with poorly drained soils. Associated vegetation is usually woodland dominated by *Eucalyptus tereticornis* and *Melaleuca decora* with an open grassy understorey. Near Nowra, *Pterostylis gibbosa* is also associated with open forest dominated by *Corymbia maculata* and *Eucalyptus paniculata* with an open grassy understorey (NPWS 2002).

This species is not recorded on the Subject Site or in the Study Area. It is known from Worrigee Nature Reserve to the south east of the Subject Site (Figure 5a). Habitat for this species on the Subject Site is provided by preferred soils and plant community association which are also present in the Study Area and locality.

5.1.5 *Triplarina nowraensis*

Triplarina nowraensis is listed as an Endangered species on Schedule 1 of the TSC Act and as an Endangered species under the EPBC Act. In 2002 there were five known populations of *Triplarina nowraensis*. Three of these populations occur to the west of Nowra, on Nowra Sandstone. The fourth population occurs in the Boolijong Creek valley approximately 18 km to the southwest of Nowra on Conjola sandstone Formation. The fifth population is located north of the Shoalhaven River confined to the plateau above Bundanon. All five populations are limited in extent; ranging from <1 ha to approximately 15 ha. In addition to the five known populations, there are also records of the Nowra Heath-myrtle having been found at two other locations along Nowra Creek (NSW NPWS 2000).

Populations of *Triplarina nowraensis* are often found on moist soils or poorly drained sites such as water courses and bedrock surfaces with impeded drainage, although two populations are known to occur in drier sites (NSW NPWS 2000). The species is often found in patches that are treeless or with a very open canopy. Populations occur in forest and woodland communities that are dominated by *Eucalyptus punctata, E. aggregata, E. sclerophylla, E. consideniana, E. piperita* and *Corymbia gummifera.* The species may also be found in sandstone sedgeland or shrubland dominated by *Kunzea ambigua*(NSW NPWS 2000). Vegetation communities of the Shoalhaven LGA that the species has been recorded in are

GreyGum-Stringybark Forest/Woodland, Scribbly Gum - Casuarina Forest, Kunzea Shrubland, Sandstone Sedgeland, Peppermint-Bloodwood Forest, Scribbly Gum-Bloodwood Woodland, Scribbly Gum – Grey Gum Woodland, Yertchuk – Bloodwood Woodland and Scribbly Gum – Hakea Open Woodland (NSW NPWS 2000).

This species is not recorded on the Subject Site or in the Study Area. It is known from several conservation reserves to the south of the Subject Site and an area further to the west (Figure 5b). Habitat for this species on the Subject Site is provided by the drainage lines incorporating preferred soils and plant community association. These habitats also present in the Study Area and Locality.

5.1.6 *Zieria baeuerlenii*

Zieria baeuerlenii is listed as an Endangered under both the TSC and EPBC Acts and the species is known only from Bomaderry Creek Regional Park to the north west of Nowra in southern NSW. The total population as of 2002, covered an area of about 0.5 km x 10 km and comprises of 6 geographically distinct groups (DEC 2005).

Zieria baeuerlenii occurs in well-drained, shallow skeletal sandy soils overlaying Nowra sandstone, on a rocky plateau amongst sandstone outcrops. The population occurs within a narrow range of elevations and has no pronounced aspect preference. Of the 43 known colonies, 33 are in forest/woodland communities and the remaining 10 can best be described as closed scrub communities (NSW NPWS 2002). The most common species in the forest/woodland are: *Corymbia gummifera, Eucalyptus punctata, Corymbia maculata, Eucalyptus agglomerata, Syncarpia glomulifera* and *Eucalyptus imitans*. The closed scrub is dominated by *Leptospermum sejunctum* (DEC 2005). Additionally there are two habitat types the species is known from that are disparate from the main habitat types. One site has deeper soils with no outcropping sandstone and supports a low open-forest of *Eucalyptus imitans* Nowra Stringybark, *Corymbia gummifera* Red Bloodwood, and *Eucalyptus sclerophylla* Scribbly Gum. The second area supports *Schoenus melanostachys*, which is a species of damp areas (NSW NPWS 2002).

Seed production has never been observed in the species and all evidence collected to date suggests that the species has lost its capacity to reproduce sexually. Instead, it appears to spread vegetatively, although whether this is by means of stem layering or rhizomatous growth remains unclear. It has been speculated that the lack of seed production may be that the species is a sterile hybrid, however research indicates that the species was once a sexually reproducing species that may have become inbred and sterile. *Zieria baeuerlenii* has been observed to regrow from underground rootstock and aerial stems following fire (NSW NPWS 2002).

This species is not recorded on the Subject Site. There is one record of the species in the Study Area on private property immediately adjoining the north Subject Site (Figure 5a). This record may however be erroneous. Habitat for this species on the Subject Site is provided by

the drainage lines incorporating preferred soils and plant community association. These habitats also present in the Study Area and Locality.

5.2 Threatened fauna

5.2.1 Giant Burrowing Frog

The Giant Burrowing Frog is listed as Vulnerable under the TSC Act and EPBC Act. On the basis of previous records in the Locality and the presence of marginal foraging, sheltering and breeding habitat (four unnamed creek lines) within the Study Area, this species is assessed to have a moderate likelihood of occurrence.

The Giant Burrowing Frog prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks (Daly 1996a, Rescei 1997). Recent studies have suggested that this species may spend up to 97% of its time in naturally vegetated areas (i.e. woodlands, heaths and forests) and travel several hundreds of metres to creek to breed (Penman *et al.* 2005). Whilst in non-breeding habitat, Giant Burrowing Frogs burrow below the soil surface or under leaf litter and occasionally under logs and fallen branches. Breeding habitat generally consists of soaks or pools in first or second order streams and with abundant fringing vegetation (DEC 2005r).

There are no previous records of this species within the Study Area and the most recent record from within the Locality is from 1992, which was collected from Bomaderry Creek Regional Park.

5.2.2 Large Forest Owls

The Powerful, Masked and Sooty Owl have previously been recorded from within the Locality. Tree hollows are particularly important for all three species of owl as they provide habitat for common prey species (e.g. possums and gliders) and nesting habitat. None of these species were recorded during the current field surveys.

Powerful Owl

The Powerful Owl is listed as Vulnerable under the TSC Act. On the basis of the high number previous records, and the presence of suitable foraging and breeding habitat for this species within the Study Area, this species is assessed to have a high likelihood of occurrence.

This species has previously been recorded several times within the Study Area, of which most records are located along the Shoalhaven River. Powerful Owls form monogamous pairs and nesting occurs from late autumn to mid-winter, slightly earlier in north-eastern New South Wales (late summer - mid autumn) (DEC 2005p). Preferred nesting hollows mostly occur in old growth eucalypt trees (diameter at breast height 80-240 cm), which are in close proximity to drainage lines.

Masked Owl

The Masked Owl is listed as Vulnerable under the TSC Act. This species is assessed to have a moderate likelihood of occurrence within the Study Area, on the basis of previous records and the presence of potential breeding and foraging habitat.

Only three previous records exist for the Masked Owl within the Locality and these are located to the east and west of the Study Area (collected in 1992 and 1996, respectively). This species forms monogamous pairs and prefers large tree hollows in moist eucalypt forested gullies.

Sooty Owl

The Sooty Owl is listed as Vulnerable under the TSC Act. This species is assessed to have a moderate likelihood of occurrence within the Study Area, on the basis of previous records and the presence of potential breeding and foraging habitat.

A cluster of thirteen records for the Sooty Owl are located within Cambewarra Range Nature Reserve approximately 5 km from the Study Area (most recent is from 2007). This species prefers large tree hollows in rainforest and other wetter forest types with a dense understorey layer (DEC 2005b; DEC 2005p; DEC 2005m; DEC 2005u).

5.2.3 Parrots and Cockatoos

Gang-gang Cockatoo

The Gang-gang Cockatoo is listed as Vulnerable under the TSC Act. On the basis of previous records, current field surveys and presence of foraging habitat within the Study Area, this species was assessed to have a high likelihood of occurrence.

The Gang-gang Cockatoo was recorded during the current field surveys in the Open Woodland habitat along Crams Road (Figure 6b). There are three additional previous records of this species within the Study Area. Nineteen previous records of this species occur within the broader Locality.

The Study Area provides foraging habitat for the Gang-gang Cockatoo in the form of seed, fruit-bearing trees and leaf-gall larvae. Despite the presence of suitably sized hollow-bearing trees in the Study Area, it is unlikely to provide prime or core breeding habitat as more preferential breeding habitats would occur at higher altitudes in heavily timbered and mature montane wet sclerophyll forest to the west of the Study Area.

Glossy Black-cockatoo

The Glossy Black-cockatoo is listed as Vulnerable under the TSC Act. On the basis of previous records and presence of foraging and breeding habitat for this species within the Study Area, this species was assessed to have a high likelihood of occurrence.

The Glossy Black-cockatoo or their feeding activity (i.e. chewed cones) was not recorded during the current field surveys. However a high concentration of Glossy Black-cockatoo records exists within the Study Area and broader Locality.

The Study Area supports foraging and breeding habitat for this species, in the form of suitably sized hollow-bearing trees and the presence of *Allocasuarina littoralis* Black She-oak. These resources predominantly occur within the Open Forest habitat.

Swift Parrot

The Swift Parrot is listed as Endangered under the TSC Act and EPBC Act. The Swift Parrot is assessed to have a moderate likelihood of occurrence within the Study Area. There are no previous records of this species within the Study Area or Locality, but the Study Area supports potential foraging habitat (i.e. winter-flowering eucalypt species such as Spotted Gum and Red Bloodwood) for this species. The nearest records of this species are located at Wollumboola, Coonemia Creek and Shoalhaven Heads.

Within New South Wales, the Swift Parrot mostly occurs on the coast and south-west slopes. It breeds exclusively in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia. From March to October the Swift Parrot can be found throughout New South Wales and Victoria, the eastern parts of South Australia and south-eastern Queensland.

Little Lorikeet

The Little Lorikeet is listed as Vulnerable under the TSC Act. On the basis of previous records and presence of potential foraging and breeding habitat for this species within the Study Area, this species was assessed to have a moderate likelihood of occurrence.

There are no previous records of this species within the Study Area, but there are a few records present within the broader Locality (one record is located in Cambewarra Range Nature Reserve). Potential foraging and breeding habitat for this species exists within the Study Area. Little Lorikeets occur in dry, open eucalypt forests and woodlands. They are gregarious, usually foraging in small flocks, often with other species of lorikeet. They feed primarily on nectar and pollen in the tree canopy (flowering eucalypts), but also on a variety of other species including, melaleucas and mistletoes. A majority of breeding records for this species originate from the western slopes of New South Wales due to the presence of known breeding trees including *Eucalyptus viminalis* Manna Gum, *E. blakelyi* Blakely's Red Gum and *E. dealbata* Tumbledown Gum that occur in these areas.

5.2.4 Square-tailed Kite

The Square-tailed Kite is listed as Vulnerable under the TSC Act. This species was considered to have a moderate likelihood of occurrence within the Study Area.

The Square-tailed Kite inhabits a range of timbered habitats including dry woodlands and open forests with a particular preference for timbered watercourses. In New South Wales, they are known to occur in ridge and gully forests dominated by *Eucalyptus longifolia*, *Corymbia maculata*, or peppermints such as *E. elata* and *E. smithii*. It is a summer breeding migrant to the south-east, including the New South Wales south coast, arriving in September and leaving by March (DEC 2005w).

There are no previous records of this species within the Study Area, but there are several recent records within the Locality (centred on the Shoalhaven River).

5.2.5 Varied Sittella

The Varied Sittella is listed as Vulnerable under the TSC Act and EPBC Act. This species was recorded during field surveys (Figure 6b) and was assessed to have a high likelihood of occurrence within the Study Area. Previous records of this species exist within the Study Area, which are located to the west of the Subject Site and one record is within Tapitallee Nature Reserve.

The Varied Sittella is a co-operatively breeding species which lives and breeds in groups ranging from several individuals to occasionally up to 30 (Morcombe 2006). During the breeding season in spring and summer a single breeding pair may be attended by several helpers within the group. A deep open cup nest of bark, plant fibres and spider web is built within the fork or branch of a rough or string-barked tree. The same nesting tree may be used from year to year (NSW Scientific Committee 2010). They feed by gleaning within foliage or along tree trunks or branches searching for insects and arthropods.

5.2.6 Spotted-tailed Quoll

The Spotted-tailed Quoll is listed as Vulnerable under TSC Act and as Endangered on the EPBC Act. This species was assessed to have a moderate likelihood of occurrence within the Study Area. The Study Area provides potential foraging habitat and marginal breeding habitat (i.e. fallen logs and hollow-bearing trees) for this species.

The habitat requirements of the Spotted-tailed Quoll include suitable den sites (such as hollow logs, tree hollows, rock outcrops or caves) and an abundance of food ranging from invertebrates, bandicoots, gliders and possums (NPWS 1999h). Individuals require large areas of relatively intact vegetation through which to forage, and usually traverse their ranges (180 – 5000 ha) along densely vegetated creek lines.

There are several previous records of the Spotted-tailed Quoll within the Study Area and numerous records of the species within the broader Locality. The nearest record is located 375 m to the south the Subject Site (collected in 1992 and again in 1999) and there are a cluster of more recent records of this species within Cambewarra Range Nature Reserve.

5.2.7 Yellow-bellied Glider

The Yellow-bellied Glider is listed as Vulnerable under the TSC Act. The Yellow-bellied Glider was assessed to have a high likelihood of occurrence within the Study Area. Evidence of feeding activity by this species in the form sap-feeding incisions were observed on Red Bloodwood trees within the Open Woodland habitat throughout the Subject Site (Figure 6b).

The Yellow-bellied Glider lives in hollows of large mature eucalypt trees and occupies home ranges from 20 ha up to 85 ha depending on the quality of the habitat. This species feeds on a range of food resources including pollen, insects, nectar, sap, honeydew and manna (NPWS 1999j).

This species (or their foraging and breeding habitat) has been previously recorded over 60 times within the Subject Site and over 95 times in the Study Area. Other records exist within the Locality, including in Bomaderry Creek Nature Reserve to the north-east of Subject Site and also south and west of the Study Area.

5.2.8 Eastern Pygmy-possum

The Eastern Pygmy-possum is listed as Vulnerable under the TSC Act. This species was assessed to have a high likelihood of occurrence within the Study Area, on the basis of previous records and the presence of suitable foraging and breeding habitat. This species has been previously recorded four times in 2006 within the Study Area and has not been recorded elsewhere in the Locality.

In New South Wales, the species is found in coastal areas and at higher elevation in the south, but north of Newcastle at higher elevations only. Although the Eastern Pygmy-possum is broadly distributed, within its range the species appears to be patchily distributed and its overall abundance is low. A compounding issue in the studying the ecological dynamics of this species is that they can be difficult to capture and detect (Harris *et al.* 2007). They forage along escarpments and gullies within woodlands, heath and forests containing Banksias or other Proteaceous or Myrtaceous shrubs, feeding largely on nectar and pollen. Insects and soft fruits are eaten when flowers are less available.

Eastern Pygmy-possums will often nest and shelter in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Common Ringtail Possum *Pseudocheirus peregrinus* dreys, or thickets of vegetation (e.g. grass-tree skirts) and they can also construct their own nest (Turner and Erskine 1997). Because of its small size, the species is able to utilise a range of hollow sizes including very small hollows (Gibbons and Lindenmayer 1997).

5.2.9 Long-nosed Potoroo

The Long-nosed Potoroo is listed as Vulnerable under the TSC Act and as Vulnerable on the EPBC Act. This species was assessed to have a moderate likelihood of occurrence within the Study Area.

Dense understorey with occasional open areas is an essential part of habitat of the Long-nosed Potoroo, which may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas (DEC 2005l). A sandy loam soil is also a common habitat feature (DEC 2005l). The Long-nosed Potoroo is sedentary and tends to be solitary, although it would also aggregate in small groups for shared predator vigilance. Individuals are predominantly non-territorial and have home range sizes ranging between 2-5 ha (DEC 2005l). Potential foraging and nesting habitat for the Long-nosed Potoroo exists in the Study Area within both the Gully Forest and Open Woodland, where a denser understorey is present.

There are approximately 30 records of this species within the broader Locality. The most recent of these records was in 2009, which was located in Cambewarra Range Nature Reserve. The nearest record of this species to the Subject Site was at Watersleigh, Tapitallee in 1980.

5.2.10 Southern Brown Bandicoot

The Southern Brown Bandicoot is listed as Endangered under the TSC Act and EPBC Act. This species was assessed to have a moderate likelihood of occurrence within the Study Area. The Study Area supports potential nesting and foraging habitat for this species. A single record of this species exists within the Locality from 1989.

Southern Brown Bandicoots are generally only found in heath or open forest with a heathy understorey (dense understorey) on sandy or friable soils (DEC 2005v). A mosaic of post fire vegetation is an important component of habitat for this species (Maxwell *et al.* 1996b). They nest during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material (DEC 2005v)

5.2.11 Cave-dwelling microbats

The Large-eared Pied Bat and Eastern Bentwing Bat are listed as Vulnerable under the TSC Act and the Large-eared Pied Bat is also listed as Vulnerable under the EPBC Act. Both of these species were recorded during the field survey (Figure 6b). The Study Area supports good quality foraging habitat for this species. These species utilise caves and derelict mines as their primary roosting habitat (Churchill 2008) and thus, roosting habitat is likely to occur outside the Study Area within the sandstone escarpment above the Shoalhaven River.

Large-eared Pied Bat

The Large-eared Pied Bat typically inhabits dry open forests and woodlands with gullies. This species has a relatively slow flight and forages within the canopy (Churchill 2008). Groups of 20-40 females raise young in maternity roosts from November through to January in roof domes of sandstone caves. They have high maternity roost fidelity over several years.

There are four previous records for the Large-eared Pied Bat within the Locality and the closest to the Study Area is located in Bangalee, which was collected in 2006.

Eastern Bentwing-bat

Eastern Bentwing-bat utilises rainforest, wet and dry sclerophyll forests, open woodland and open grasslands. It generally has fast flight and forages above the canopy in forested areas. Breeding and roosting colonies range from 100 – 150,000 individuals. A confirmed maternity colony exists in Bungonia. Colonies will exhibit high fidelity to maternity caves which have specific thermoregulatory properties making them appropriate to rear young over spring and summer.

There are nine previous records of the Eastern Bentwing-bat within the Locality, with the nearest record to the Study Area located at West Nowra (Flatrock Creek), which was collected in 2008.

5.2.12 Forest microbats

The Eastern False Pipistrelle, Greater Broad-nosed Bat, Eastern Freetail-bat and the Yellow-bellied Sheathtail Bat are all listed as Vulnerable under the TSC Act. The Eastern Freetail-bat and the Greater Broad-nosed Bat were recorded during the current field surveys (Figure 6b). The Eastern False Pipistrelle and Yellow-bellied Sheathtail-bat were assessed to have a moderate likelihood of occurrence within the Study Area. The Study Area supports foraging and breeding habitat for all of these microbat species.

Eastern False Pipistrelle

The Eastern False Pipistrelle forages for beetles, moths, weevils and other flying insects either above or just below the tree canopy. It is found in moist timbered habitats, typically with trees taller than 20 m. The Eastern False Pipistrelle usually roosts in eucalypt hollows, but has also been recorded beneath exfoliating bark or in buildings. This species is known to have a home range of up to 136 ha and they are known to move 3.5 km between roosts (Churchill 2008).

Two previous records of this species exist within the Locality (collected in 1998), which are located within Cambewarra Range Nature Reserve.

Greater Broad-nosed Bat

Greater Broad-nosed Bats occupy a range of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. It hunts low (3-6 m) along creek and river corridors for beetles and other large slow flying insects (DEC 2005h). This species roosts in tree hollows but has also been found in man-made structures. Females congregate in tree hollow maternity roosts where they raise their young over summer (DEC 2005h).

There are seven previous records of this species within the Locality and the nearest record to the Study Area is located at North Nowra (collected in 2004).

Eastern Freetail-bat

The Eastern Freetail-bat utilises tree hollows as primary roosting and maternity habitat (other structures may provide similar microhabitat components) and are therefore dependent upon them for their survival. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught flying low over a rocky river flowing through rainforest and wet sclerophyll forest (Hoye and Hall 2008). The species roosts in hollow spouts of large mature eucalypts (including paddock trees), although one individual has also been recorded in the roof of a hut. Foraging generally occurs within a few kilometres of the roosting site (Hoye and Hall 2008).

There are seven records of the Eastern Freetail-bat within the Locality and the nearest record to the Subject Site is located at Bernie Regan Sporting Complex, North Nowra (collected in 2005).

Yellow-bellied Sheathtail Bat

The Yellow-bellied Sheathtail Bat roosts singly or in groups of up to six, in tree hollows and buildings and in treeless areas they are known to utilise mammal burrows (DEC 2005~). When foraging for insects, the Yellow-bellied Sheathtail-bat flies high and fast over the forest canopy, but lower in more open country (Churchill 2008).

There are five previous records of the Yellow-bellied Sheathtail Bat within the Locality and the nearest record is Abernethys Creek (adjacent to Bomaderry Creek Regional Park) which was collected in 2007.

5.2.13 Large-footed Myotis

The Large-footed Myotis is listed as Vulnerable under the TSC Act. It was recorded during the current field surveys (Figure 6b). The Study Area supports foraging and breeding resources (i.e. tree hollows) for this species. It has not been recorded previously within the Study Area and a single record exists within the broader Locality (Jaspers Creek, Meroo Meadow).

The Large-footed Myotis is primarily found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers (DEC 2005k). They roost in caves and tree hollows, among vegetation and artificial structures such as under bridges, in mines, tunnels and road culverts in close proximity to surface water (Churchill 2008). While aquatic insects make up most of its diet, the Large-footed Myotis also forages aerially on moths, beetles and other insects (Churchill 2008). It is for this reason that this species has a strong association with larger permanent water bodies, and that it is usually found in areas that are vegetated rather than cleared (Anderson *et al.* 2006; Churchill 2008)

5.2.14 Grey-headed Flying Fox

The Grey-headed Flying-fox is listed as Vulnerable under the TSC Act and the EPBC Act. This species was assessed to have a moderate likelihood of occurrence within the Study Area.

The Grey-headed Flying-fox is a canopy-feeding frugivore, blossom-eater and nectarivore of rainforests, open forests, woodlands, *Melaleuca* swamps and *Banksia* woodlands (Eby 1995). Their major food source is Myrtaceae blossom (mostly eucalypt) and fruits such as native figs (*Ficus* spp.) and cultivated fruit orchards (Churchill 2008). Bats commute daily to foraging areas, usually within 15 km of the day roost (Strahan 1995), although some individuals may travel up to 70 km. Grey-headed Flying-foxes seasonally congregate in large camps of up to 200,000 individuals (Churchill 2008). The availability of blossom in the surrounding area influences the number of bats in a camp (Churchill 2008).

Pregnant Grey-headed Flying-foxes congregate in maternity camps, giving birth to a single young a couple of weeks later (Churchill 2008). Several Grey-headed Flying-fox colonies have been recorded in the Shoalhaven LGA (DECCW 2009). One is located at Comerong, Near Nowra. This camp has been found to be occupied intermittently and has contained up to 100,000 individuals at any one time (Eby 1991). Breeding is unlikely to occur within the Study Area as there has been no record of camps (which are generally noisy and conspicuous) in the Study Area.

Given the close proximity of known camps to the Study Area; the Study Area is likely to be utilised on a regular basis by this species when blossom and/or fruit is available. There are 25 previous records of this species in the Locality, five of which occur in Bangalee within the Study Area.

6.0 CONSTRAINTS ANALYSIS

This section outlines the constraints to be considered in further planning and design of the rezoning investigations of the Subject Site. The constraints assessment is a guide that identifies areas most suitable for development and retention of natural landscapes. The constraints analysis applies information collected from the field surveys and consideration of EPI's to inform the concept planning to manage native flora and fauna in view of a possible future urban development. The accompanying constraints mapping is presented in Figure 7.

6.1 High Constraint Areas

Areas identified to be of high constraint have a high conservation value due to the presence of the broadest range of significant or threatened biodiversity or its potential habitat. High constraint areas consider the DWE (2008) guidelines for the determination and management of riparian zones. In this instance the high constraint areas have identified the drainage lines of the Subject Site as Category 1 streams and this is determined from the Berry 1:25, 000

topographic map (9028-3N). As such the high constraint class over the riparian zone consists of;

- a Core Riparian Zone (CRZ) of 20m either side of a channel (totalling a 40m width);
- a vegetated buffer either side of the CRZ of 10m; and
- a nominal 20m Asset Protection Zone either side of the 10m vegetated buffer.

High constraint areas on the Subject Site are considered to form the minimum area and network of vegetated corridors to maintain wildlife corridor functions within the Subject Site, extending to the Study Area and more broadly through the Locality.

Whilst the presence of significant or threatened biodiversity does not necessarily preclude all development a considered approach should be exercised. This will include an earnest attempt to plan, design, construct and operate the development in a manner that is compatible with ESD and conservation outcomes as far as possible.

6.2 Medium Constraint Areas

Areas of medium ecological constraint have been identified to have conservation value primarily in relationship to the presence of, or habitat for, threatened flora and fauna either known, predicted to occur on, or with a moderate to high likelihood to utilises the habitats of the Subject Site. Areas identified as medium constraint could potentially support residential development provided TSC and EPBC Act impact assessments for threatened species identified in Section 5 were carried out. Medium constraint areas would be the focus for mitigation measures implemented to avoid and minimise potential impacts on biodiversity.

Within the Subject Site areas of medium ecological constraint comprise Woodland and Forest areas.

6.3 Low Constraint Areas

Areas of low ecological constraint have low conservation value, but support some habitat values. These values may comprise scattered trees, man made structures and derived or disturbed vegetative cover. Characteristically these areas are dominated by infestations of weeds, have been subject to significant previous or continuing disturbance and represent low fauna habitat values.

7.0 CONCLUSIONS

This report assesses the ecological significance of the general and threatened plant and animal species, endangered populations and endangered ecological communities that occur, or have the potential to occur, within the Study Area and Subject Site of the current assessment. The Subject Site which forms the core of the Study Area is being investigated for rezoning to support residential development.

Eight threatened fauna species were recorded during the field surveys comprising six mammal species and two bird species. Based on habitat assessments, the presence of key indicator fauna habitat elements and the number and distribution of previous records, there is moderate to high likelihood for a further 15 threatened fauna species to occur within the Study Area.

No threatened plant species, plant populations or ecological communities were recorded on the Subject Site during field surveys. Based on habitat assessments and the number and distribution of previous records, there is a medium to high likelihood for six threatened plant previously recorded in the Locality to; be present on the Subject Site or in the immediately adjoining Study Area; or to be reliant on the habitats of the Study Area.

Threatened flora and fauna are known from the Study Area and the Subject Site may support habitat and other features important to the long term survival of these species in the locality. However, no assessments of significance according to the provisions of s.5A of the EP&A Act or the EPBC Act guidelines (DEWHA 2009a) have been prepared herein. It is appropriate that detailed impact assessments would be prepared in conjunction with future development applications. At this strategic planning phase it is sufficient to determine the suitability of the Subject Site to support residential development based on assessment of the general biodiversity and threatened species issues. This assessment has been undertaken in the form of a constraints analysis that has described the general criteria for high medium and low constraint classes.

In summary high constraint areas are those that support optimal habitat for and known locations of the broadest range of threatened species; riparian zones incorporating the areas considered necessary to maintain stream flow function; and vegetation corridors that will provide habitat connectivity within the Subject Site and extending off the Subject Site to the Study Area and broader Locality. High constraint areas should be excluded from most development but may support some ancillary functions such as open space and passive recreational opportunities, infrastructure that primarily considers ESD principles and initiatives that assist in conservation outcomes. High constraint areas are highlighted in Figure 7.

Medium constraint areas support habitat for and known locations of a narrower range of threatened species and flora and fauna habitat resources and are areas that adjoin existing residential development or existing and proposed infrastructure easements. Development of medium constraint areas to support residential development would need to be accompanied by further biodiversity impact assessment to determine the ultimate development scheme.

Medium constraint areas would be the key areas for consideration of biodiversity management and mitigation measures as part of a development application for future residentail development on the Subject Site. Medium constraint areas are shown in Figure 7 and cover the majority of the Subject Site outside the high constraint areas.

Low constraint areas on the Subject Site are areas that have been subject to significant disturbance and have limited habitat value for threatened flora and fauna species highlighted in this assessment. These areas retain some level of flora and fauna habitat value primarily as support to the more intact native vegetation cover of the adjoining medium constraint area (Figure 7). Loss of flora and fauna habitat provided in the low constraints zone would be considered in the biodiversity management and mitigation measures as part of a development application and any future residential development of the Subject Site.

8.0 RECOMMENDATIONS

In proceeding with the planning and design of the current broader investigations of the Subject Site the biodiversity constraints mapping of Figure 7 should be taken into account. Table 5 outlines the flora and fauna management and mitigation measures that should be employed to minimise the potential for impacts on biodiversity and the environment of the Study Area. These recommended actions have been grouped by the high, medium and low constraint areas identified in section 6.0 and mapped in Figure 7. Other general recommendations are included as a guide to assist in minimising the potential ecological impacts of a future urban residential development on the Subject Site.

Table 5: Flora and fauna management and mitigation measures

Constraint area	Management measures and mitigation strategies
High	Apply an appropriate conservation land zoning and include these areas in Environmentally Significant Lands mapping of the SCC draft LEP 2009. Consider managing stormwater outside of the riparian zones through ESD engineering solutions. Design development layout to minimise APZs widths by use of hard surface infrastructure such roads or paths and open space to provide for the maximum retention of native vegetation. Limit disturbance and retain patches of vegetation in areas supporting potential feed trees of the Yellow-bellied Glider (sap-site trees, winter flowering eucalypts) and Glossy-black Cockatoo foraging habitat (*Allocasuarina littoralis*). Enhancement of the drainage lines with fauna habitat features (e.g. considering Giant Burrowing Frog habitat requirements) without limiting stormwater management and safety. Preparation of a Vegetation Management Plan (VMP) for retained riparian and other areas of vegetation. A VMP would need to be prepared prior to any development and address issues such as installation of temporary exclusion fencing to delineate clearing limits and protect retained vegetation.

Constraint area	Management measures and mitigation strategies
Medium	Development should take a staged approach whereby initial release areas commence in areas adjoining existing residential development Pre-clearing surveys of native vegetation would need to be undertaken to identify fauna individuals, species or populations requiring collection and relocation. Retention of and re-use habitat features and resources for native fauna (such as hollow-bearing trees, hollows logs and rocks) and place them in areas would be retained. Retain habitat trees (feed trees and hollow-bearing trees), where possible in open space and streetscapes. Adopt design principles that consider retention of as many mature native trees as possible. Consider the use of large allotments and reserve systems throughout this zone to maintain and permit connectivity and fauna movement corridors to other vegetative areas in the Locality. In consideration of the social structure (i.e. family groups may use several den trees) and home range (20-85 ha) of the Yellow-bellied Glider, areas containing feeding activity ("V" notched incisions) should be conserved. In consideration of the habitat requirements of the Eastern Pygmy-possum, retain patch sizes larger than 1 ha ensuring areas retained contain proteaceous foraging resources for this species. Ensure habitat to be retained permits fauna movement corridors between patches to prevent fauna displacement and to maintain gene flow. Investigate the possibility of soil translocation of resilient soil profiles to a nearby recipient site in secure conservation tenure identified for restoration.
Low/General	Restrict vegetation clearing to necessary areas only. Reduce clearance and disturbance of fauna habitat, especially hollow-bearing trees and other habitat features where fauna may be sheltering. Installation, maintenance and decommissioning of sediment and erosion controls as required particularly in the vicinity of riparian zones during construction of a residential development.

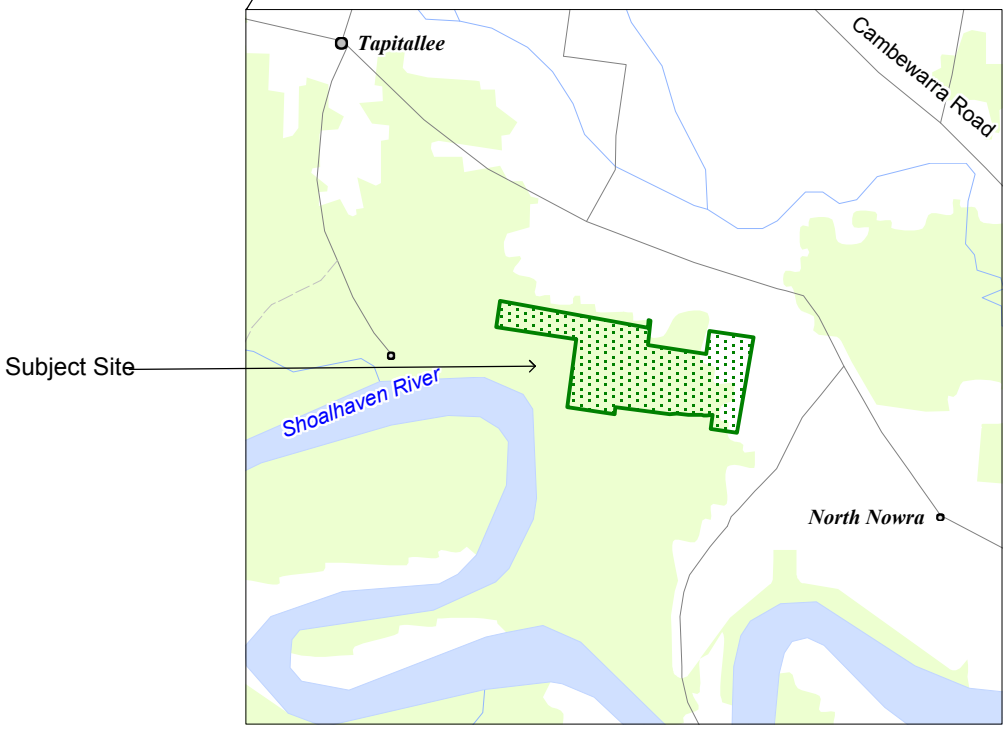
Assessments of significance for TSC and EPBC Act threatened biodiversity identified as occurring on, potentially utilising or potentially dependant on the habitats of the Subject Site or Study Area will need to be prepared for future development applications for the Subject Site.

TSC Act threatened flora and fauna species that would need to be addressed according to s.5A of EP&A Act and *Threatened species assessment guidelines. The assessment of significance* (DECC, 2007) are listed in Table 6. Similarly EPBC Act threatened species requiring assessment according to *Matters of National Environmental Significance. Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2009a) are also highlighted in Table 6.

Table 6: TSC and EPBC Act threatened flora and fauna species requiring impact assessments

Scientific Name	Common Name	EPBC Act	TSC Act
Flora			
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V
Genoplesium baueri			V
Melaleuca deanei	Deane's Melaleuca	V	V
Pterostylis gibbosa	Illawarra Greenhood	E	E
Triplarina nowraensis		E	E
Zieria baeuerlenii		E	E
Fauna			
Heleioporus australiacus	Giant Burrowing Frog	V	V
Callocephalon fimbriatum	Gang-gang Cockatoo	-	V
Lophoictinia isura	Square-tailed Kite	-	V
Calyptorhynchus lathami	Glossy Black-cockatoo	-	V
Daphoenositta chrysoptera	Varied Sittella	V	V
Glossopsitta pusilla	Little Lorikeet	-	V
Lathamus discolor	Swift Parrot	E	E1
Ninox strenua	Powerful Owl	-	V
Tyto novaehollandiae	Masked Owl	-	V
Tyto tenebricosa	Sooty Owl	-	V
Cercartetus nanus	Eastern Pygmy-possum	-	V
Dasyurus maculatus maculatus	Spotted-tailed Quoll (southeastern mainland)	E	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	-	V
Mormopterus norfolkensis	Eastern Freetail Bat	-	V
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E1
Petaurus australis	Yellow-bellied Glider	-	V
Potorous tridactylus	Long-nosed Potoroo	V	V
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	V
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat	-	V
Scoteanax rueppellii	Greater Broad-nosed Bat	-	V
Myotis macropus	Large-footed Myotis	-	V

FIGURES



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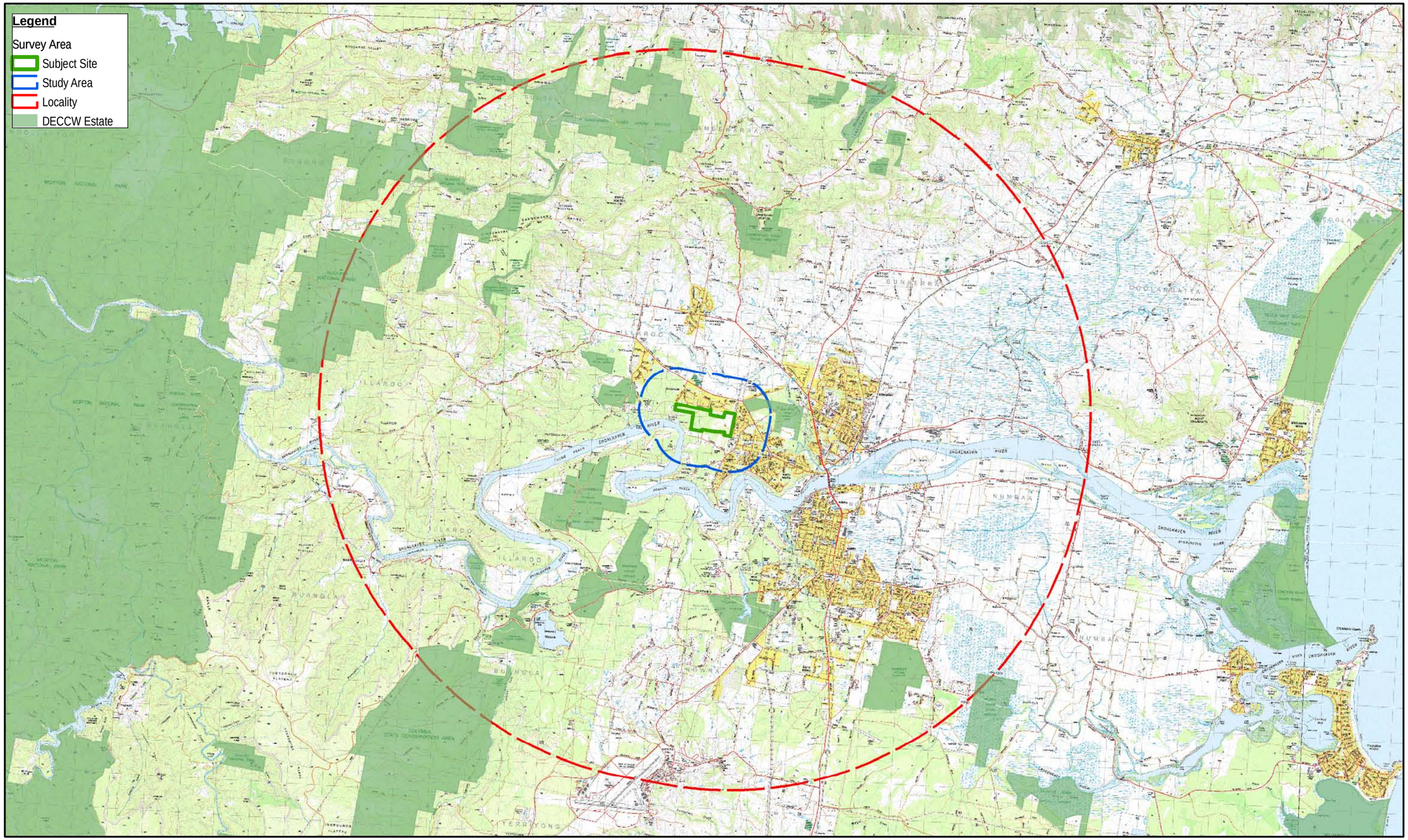
BIOSIS RESEARCH Pty. Ltd.
8 Tate Street
Wollongong
NEW SOUTH WALES 2500

Figure 1: Location of the Subject Site in a regional context

Date: 30 June 2010	Drawn by: ANP
File number: N5793	Checked by: BWM
Location: N5000s\N5700s\N5793\Mapping\N5793 F1_Locality.WOR	

Scale: 0 0.5 1.0 1.5 2.0 kilometres

N W E S



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2015

Figure 2: Overview of Subject Site, Study area and Locality showing DECCW Estate.

Date: 5 August 2010 | Drawn by: ANP

Job number: N5793 | Checked by: BWM

Location: ..\\Venus\nsw_projects\N5000s\N5700s\N5793\Mapping\N5793 F2_Overview.mxd

Acknowledgements:
Data from DECCW/NPWS
Topographic Image from Land and Property Management Authority 1:25000 topographic map series (2006)
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Kilometers

Scale: 1:100,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

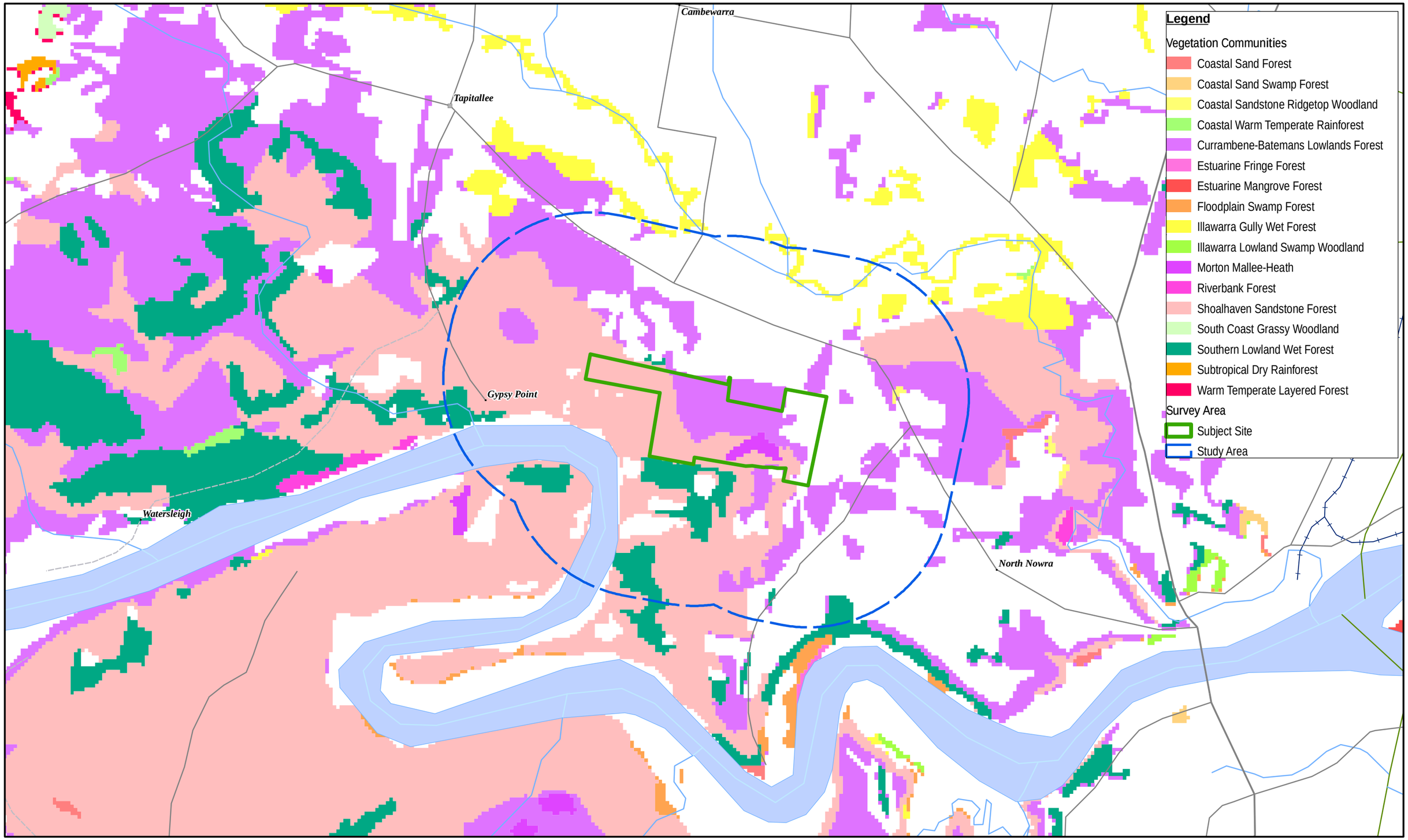

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Figure 3: Vegetation mapping of the locality (NSW NVMP)

Date: 30 June 2010 | Drawn by: ANP

Job number: N5793 | Checked by: BWM

Location: ..\\\Venus\nsw_projects\N5000s\N5700s\N5793\MappingN5793 F3_Vegetation.mxd

Acknowledgements:
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Kilometers

Scale: 1:13,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

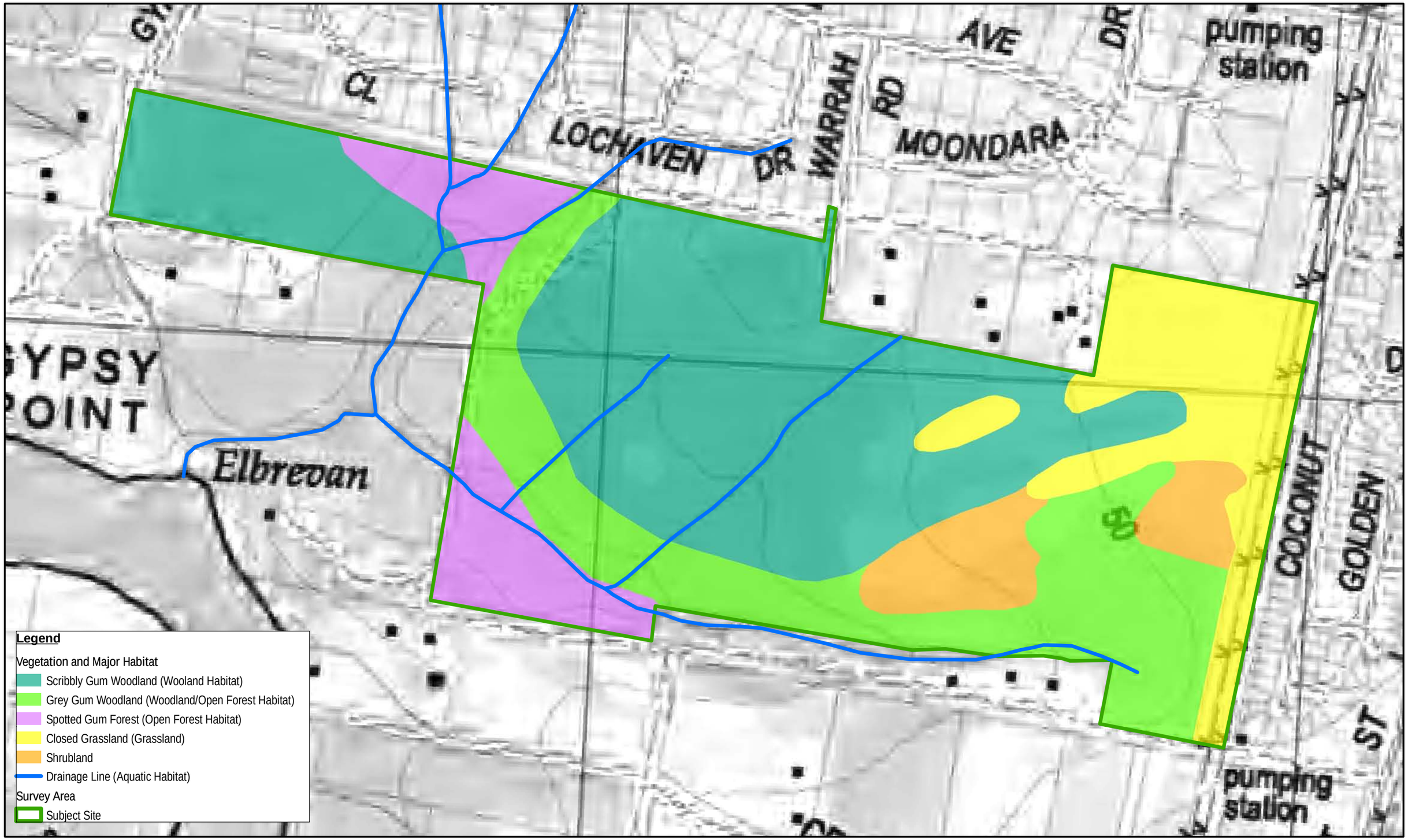

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Figure 4: Vegetation Communities and Major Habitats.

Date: 6 August 2010 | Drawn by: ANP

Job number: N5793 | Checked by: BWM

Location: ..\\Venus\nsw_projects\N5000s\N5700s\N5793\Mapping\N5793 F4_Vegetation and Major Habitat.mxd

Acknowledgements:
Topographic Image from Land and Property Management Authority 1:25000 topographic map series (2006)
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0 45 90 180 270 360
Meters

Scale: 1:5,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

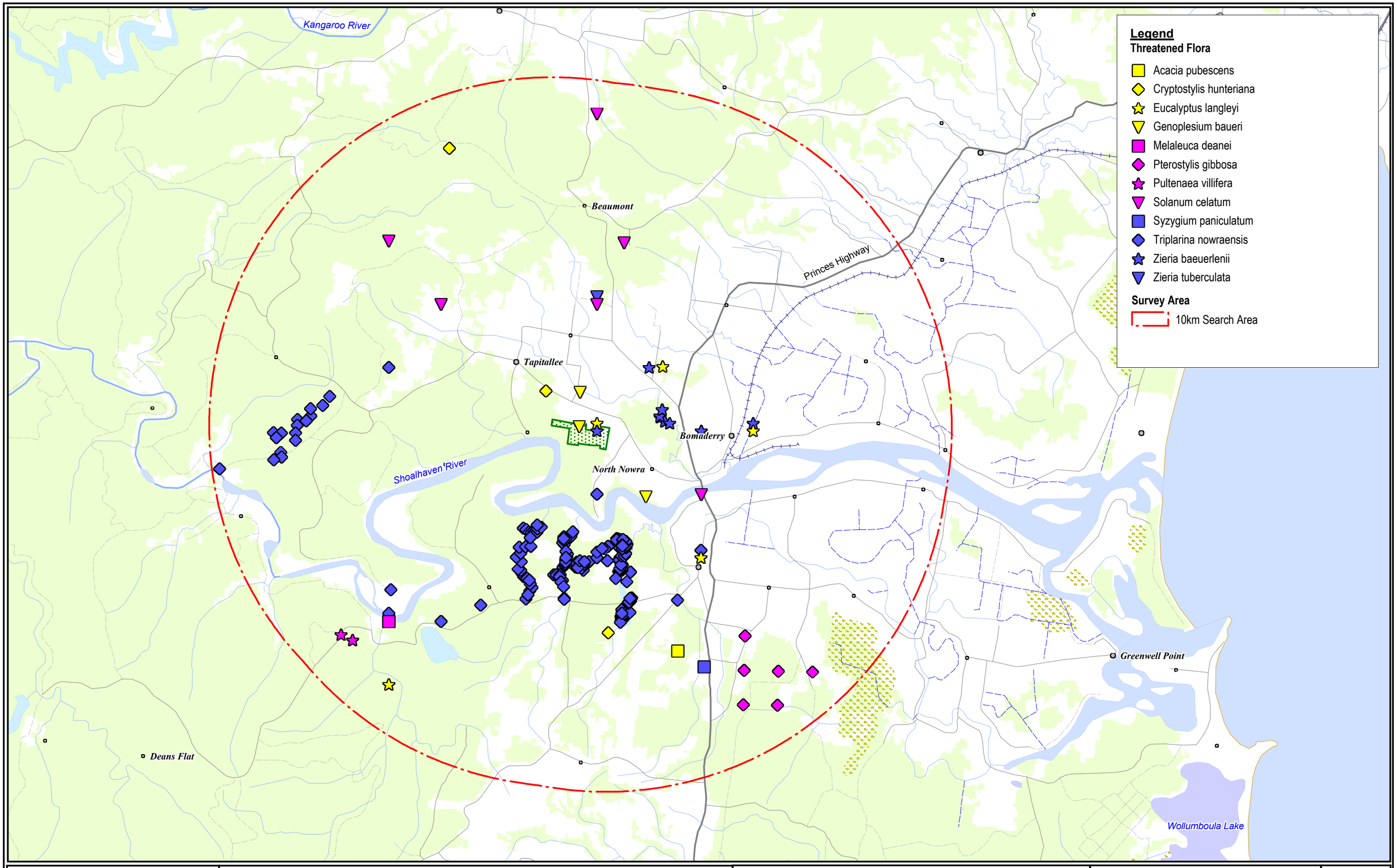

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Figure 5a: TSC and EPBC Act flora previously recorded in a 10km radius of the Study Area.

Date: 30 June 2010	Drawn by: ANP
File number: N5793	Checked by: BWM
Location:-..\\Venus\nsw_projects\N5000s\N5700s\N5793\Mapping\N5793 F5a Threatened Flora.WOR	

Acknowledgements:
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0 1 2 3 4 5
kilometres

Scale: 1:100,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N
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Figure 5a

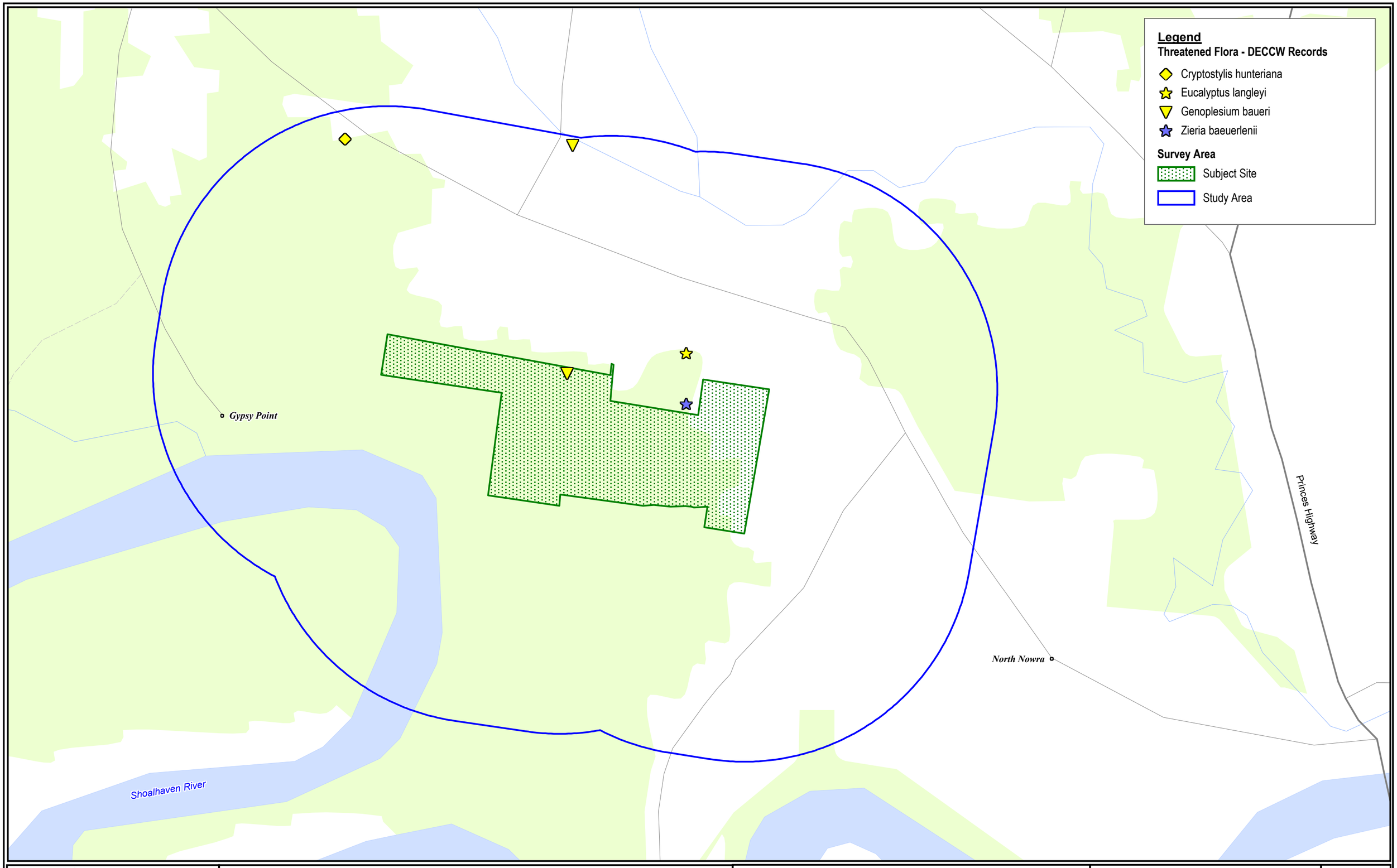

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Figure 5b: TSC and EPBC Act flora previously recorded in a 1km buffer of the Study Area.

Date: 30 June 2010	Drawn by: ANP
File number: N5793	Checked by: BWM
Location:-..\\Venus\nsw_projects\N5000s\N5700s\N5793\Mapping\N5793 F5b Threatened Flora.WOR	

Acknowledgements:
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0 0.15 0.3 0.45 0.6 0.75
kilometres

Scale: 1:15,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N
W E
S

Figure 5b

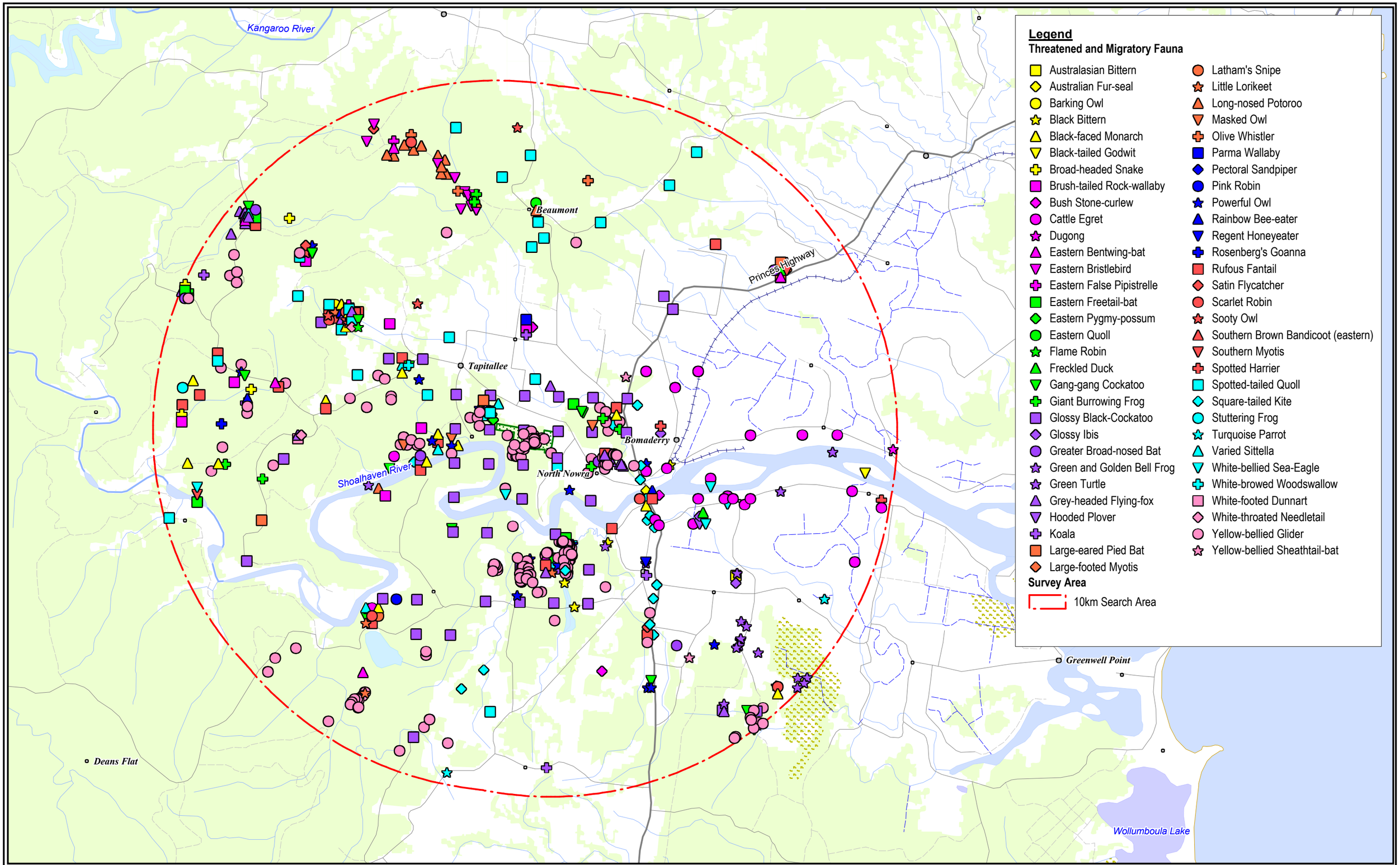

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Figure 6a: TSC and EPBC Act fauna previously recorded in a 10km radius of the Study Area.

Date: 30 June 2010	Drawn by: ANP
File number: N5793	Checked by: BWM
Location:-..\\Venus\nsw_projects\N5000s\N5700s\N5793\Mapping\N5793 F6a Threatened Fauna.WOR	

Acknowledgements:
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0 1 2 3 4 5
kilometres

Scale: 1:100,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N
W E
S

Figure 6a

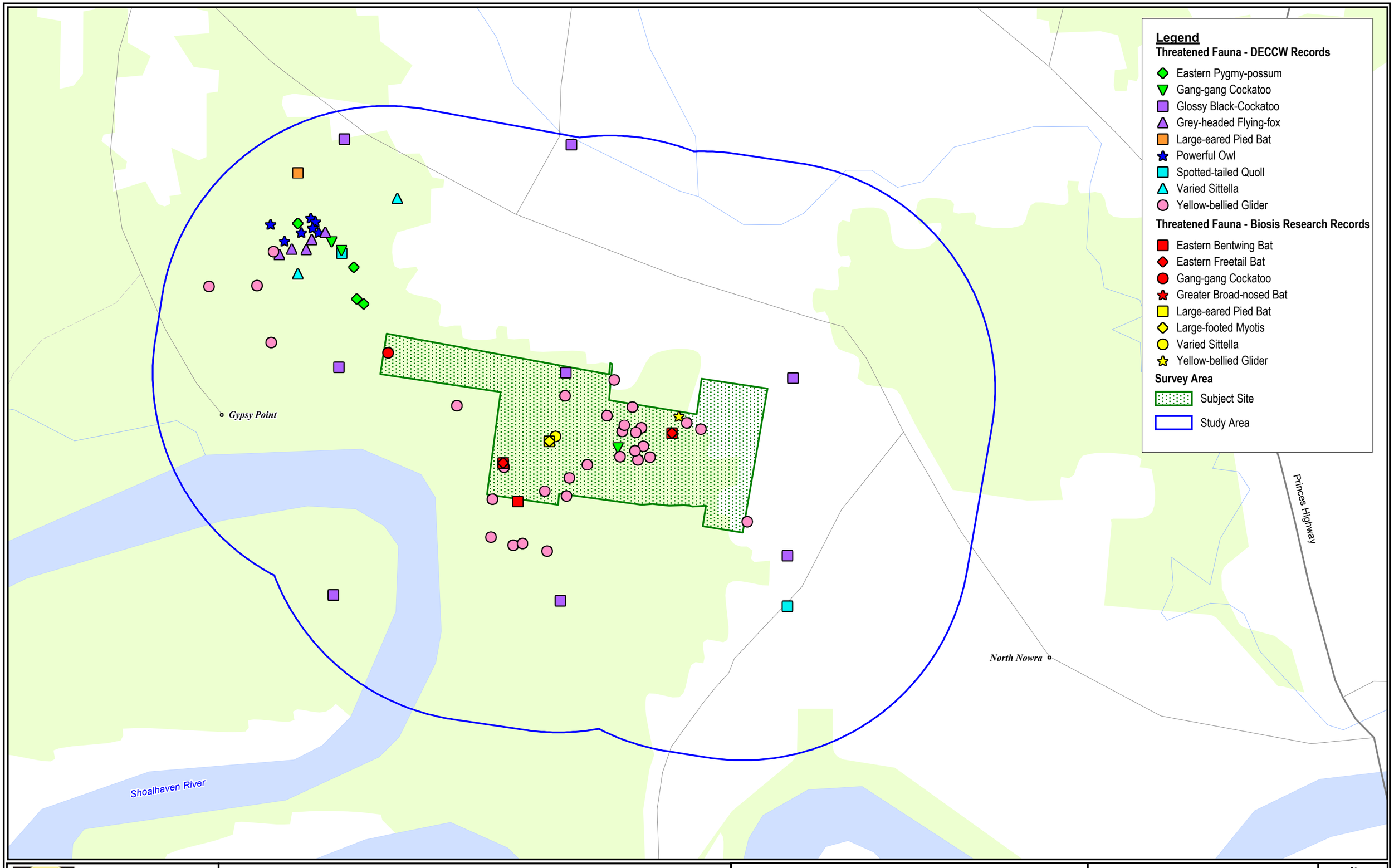

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Figure 6b: TSC and EPBC Act fauna previously recorded in a 1km buffer of the Study Area.

Date: 30 June 2010	Drawn by: ANP
File number: N5793	Checked by: BWM
Location:-..\\Venus\nsw_projects\N5000s\N5700s\N5793\Mapping\N5793 F6b Threatened Fauna.WOR	

Acknowledgements:
DECCW/NPWS and Biosis Reasearch Pty Ltd
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0 0.15 0.3 0.45 0.6 0.75
kilometres

Scale: 1:15,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N
W E
S

Figure 6b

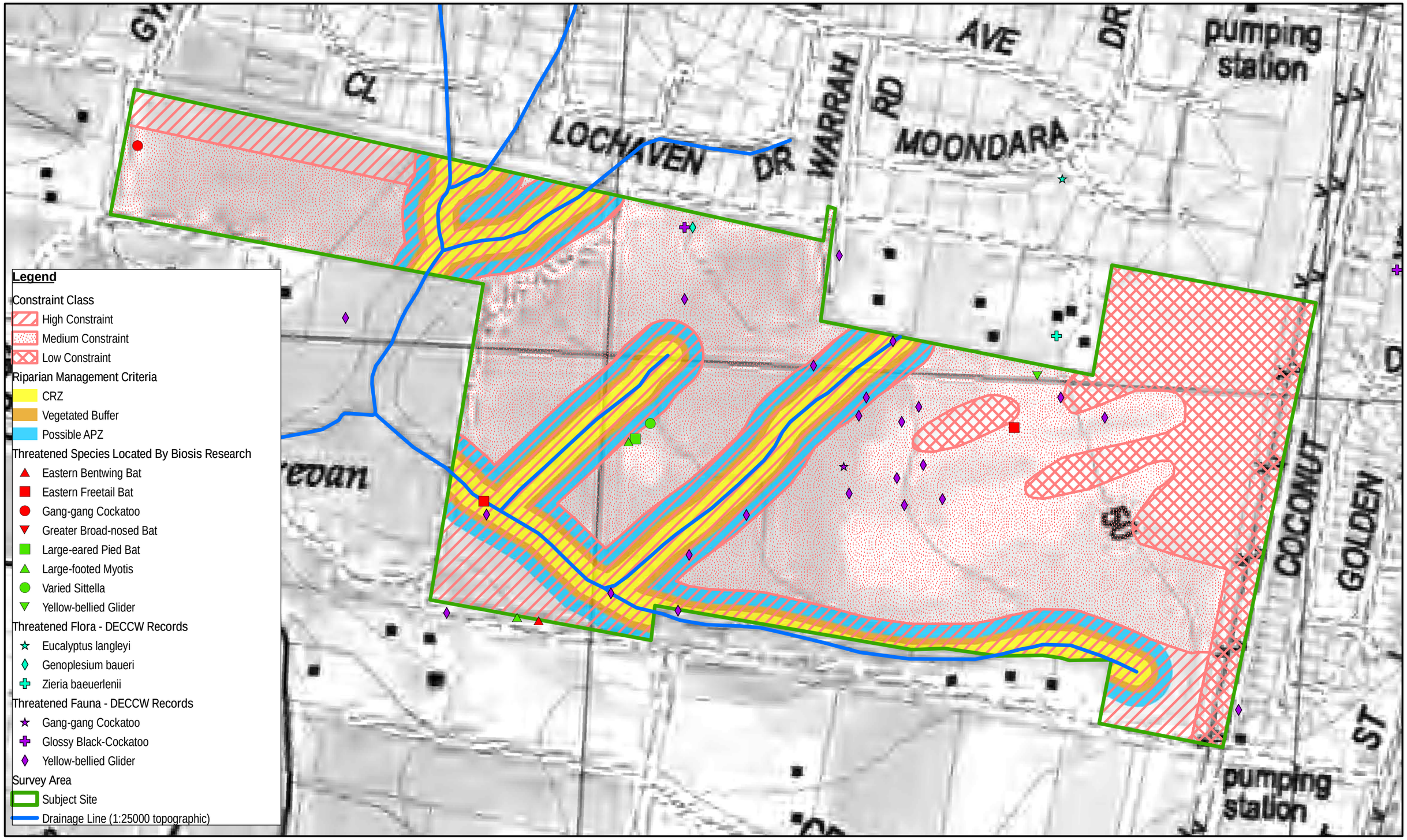

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Figure 7: Constraints Mapping

Date: 6 August 2010	Drawn by: ANP
Job number: N5793	Checked by: BWM
Location: ..\\Venus\nsw_projects\N5000s\N5700s\N5793\Mapping\N5793 F7_Constraints.mxd	

Acknowledgements:
Species data from DECCW/NPWS and Biosis Research Pty Ltd
Topographic Image from Land and Property Management Authority
1:25000 topographic map series (2006)
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0 45 90 180 270 360
Meters

Scale: 1:5,000 at A3
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

APPENDICES

APPENDIX 1

Flora and fauna species inventories

Flora inventory

Table 7: **Native and exotic flora recorded during surveys**

General Status	
*	Exotic (not native to Australia)
N( )	Noxious weeds and 'Control Class' as listed on the NSW Noxious Weeds Act 1993 for both the Shoalhaven LGA
nl	Non - locally occurring native species (does not naturally occur at this locality)
Conservation Status	
CE	Critically Endangered - listed under Schedule 1A of the TSC Act
E	Endangered - listed under Schedule 1 of the TSC Act
V	Vulnerable - listed under Schedule 2 of the TSC Act
CE +	Critically Endangered - listed under the EPBC Act
E +	Endangered - listed under the EBPC Act
V +	Vulnerable - listed under the EPBC Act
ROTAP	Rare or Threatened Australian Plant
Plant Communities	
SGF	Spotted Gum Forest
ScrGW	Scribbly Gum Woodland
GGW	Grey Gum Woodland
Sland	Shrubland
CGLand	Closed Grassland
Modified Braun Blanquet Cover Abundance (BB)	
1	<5% - 3 or less individuals
2	<5% - more than 3 sparsely scattered
3	<5% - common throughout plot
4	5% - 25%
5	25% - 50%
6	50% - 75%
7	75% - 100%

Status	Family	Genus species	Common Name	SGF	ScrGW	GGW	SLand	CGLand
	Fabaceae - Mimosoideae	*Acacia binervata*	Two-veined Hickory	2				
	Fabaceae - Mimosoideae	*Acacia floribunda*	White Sally Wattle					2

Status	Family	Genus species	Common Name	SGF	ScrGW	GGW	SLand	CGLand
	Fabaceae - Mimosoideae	*Acacia longifolia* ssp *longifolia*	Sydney Golden Wattle	3		2		
	Fabaceae - Mimosoideae	*Acacia mearnsii*	Black Wattle					2
	Fabaceae - Mimosoideae	*Acacia suaveolens*	Sweet Wattle		2			
	Fabaceae - Mimosoideae	*Acacia terminalis* ssp *angustifolia*	Sunshine Wattle	2	2	2		
	Fabaceae - Mimosoideae	*Acacia ulicifolia*	Prickly Moses	2	2	2		
	Orchidaceae	*Acianthus* sp				2		
	Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair	2		2		
N4	Asteraceae	*Ageratina adenophora*	Crofton Weed			2		
	Casuarinaceae	*Allocasuarina littoralis*	Black She-oak	3	3	3	3	
*	Primulaceae	*Anagallis arvensis*	Scarlet Pimpernel					2
*	Poaceae	*Andropogon virginicus*	Whisky Grass			2	3	6
	Myrtaceae	*Angophora floribunda*	Apple			2		
	Poaceae	*Anisopogon avenaceus*	Oat Speargrass	3	4	3		
	Fabaceae - Faboideae	*Aotus ericoides*			3			
	Poaceae	*Aristida ramosa*	Purple Wiregrass				2	
	Poaceae	*Aristida vagans*	Threeawn Speargrass	1				
*	Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass			2		4
	Myrtaceae	*Baeckea brevifolia*			2			
	Proteaceae	*Banksia serrata*	Old-man Banksia		3			
	Proteaceae	*Banksia spinulosa* var *spinulosa*	Hairpin Banksia		4	3		
	Cunoniaceae	*Bauera rubioides*	River Rose			3		
	Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	2	2			
	Fabaceae - Faboideae	*Bossiaea heterophylla*	Variable Bossiaea		2			
	Fabaceae - Faboideae	*Bossiaea obcordata*	Spiny Bossiaea			2		
	Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush	3				
	Acanthaceae	*Brunoniella australis*	Blue Trumpet	3				
	Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush		2	2		
	Dicksoniaceae	*Calochlaena dubia*	Soft Bracken			2		

Status	Family	Genus species	Common Name	SGF	ScrGW	GGW	SLand	CGLand
	Cyperaceae	*Caustis flexuosa*	Curly Wig		3			
	Apiaceae	*Centella asiatica*	Indian Pennywort			3		4
	Cunoniaceae	*Ceratopetalum gummiferum*	Christmas Bush	1				
	Adiantaceae	*Cheilanthes sieberi ssp sieberi*	Mulga Fern	1		2		
*	Asteraceae	*Cirsium vulgare*	Spear Thistle					2
*	Asteraceae	*Conyza* sp	Fleabane					2
	Asteraceae	*Coronidium oxylepis*				1		
	Orchidaceae	*Corybas* sp				2		
	Myrtaceae	*Corymbia gummifera*	Red Bloodwood	3	3	3		
	Myrtaceae	*Corymbia maculata*	Spotted Gum	4		2		
	Orchidaceae	*Cryptostylis subulata*	Large Tongue Orchid		2			
	Cyatheaceae	*Cyathea australis*	Black Tree-fern			1		
	Cyperaceae	*Cyathochaeta diandra*			3			
	Orchidaceae	*Cymbidium suave*	Snake Orchid		1			
	Poaceae	*Cynodon dactylon*	Couch					3
*	Cyperaceae	*Cyperus eragrostis*						3
	Cyperaceae	*Cyperus laevis*				3		
	Fabaceae - Faboideae	*Daviesia ulicifolia*	Gorse Bitter Pea	3				
	Phormiaceae	*Dianella caerulea* var *caerulea*	Blue Flax-lily			3		
	Phormiaceae	*Dianella caerulea* var *producta*		3		2		
	Convolvulaceae	*Dichondra repens*	Kidney Weed			3		
	Poaceae	*Digitaria ramularis*				1		
	Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush	5		4		
	Blechnaceae	*Doodia aspera*	Prickly Rasp Fern			2		
	Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	1				
	Poaceae	*Entolasia marginata*	Bordered Panic	4	3	3		
	Poaceae	*Entolasia stricta*	Wiry Panic		4	3	2	
	Ericaceae	*Epacris microphylla* var *microphylla*	Coral Heath		2			

Status	Family	Genus species	Common Name	SGF	ScrGW	GGW	SLand	CGLand
	Ericaceae	*Epacris pulchella*	Wallum Heath		3		1	
	Poaceae	*Eragrostis brownii*	Brown's Lovegrass	3	3	3		
	Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass					3
	Myrtaceae	*Eucalyptus agglomerata*	Blue-leaved Stringybark		2			
	Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark	2				
	Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint	4		2		
	Myrtaceae	*Eucalyptus punctata*	Grey Gum		2	4		
	Myrtaceae	*Eucalyptus saligna*	Sydney Blue Gum	2				
	Myrtaceae	*Eucalyptus sclerophylla*	Hard-leaved Scribbly Gum		4	2	2	
	Myrtaceae	*Eucalyptus* sp.						2
	Cyperaceae	*Gahnia* sp	Saw-sedge			2		
	Euphorbiaceae	*Glochidion ferdinandi* var *ferdinandi*	Cheese Tree					1
	Fabaceae - Faboideae	*Glycine microphylla*	Small-leaf glycine	2				
	Fabaceae - Faboideae	*Glycine tabacina*		2		3		
	Fabaceae - Faboideae	*Gompholobium grandiflorum*	Large Wedge Pea		2			
	Fabaceae - Faboideae	*Gompholobium pinnatum*	Pinnate Wedge Pea			2		
	Fabaceae - Faboideae	*Gompholobium uncinatum*	Red Wedge Pea		2			
	Haloragaceae	*Gonocarpus tetragynus*				3		
	Goodeniaceae	*Goodenia hederacea* ssp *hederacea*	Forest Goodenia	3	3	2		
	Proteaceae	*Hakea dactyloides*	Finger Hakea		2			2
	Proteaceae	*Hakea salicifolia*	Willow-leaved Hakea				2	2
	Proteaceae	*Hakea sericea*	Needlebush	2	3		2	2
	Fabaceae - Faboideae	*Hardenbergia violacea*	Purple Coral Pea			2		
	Poaceae	*Hemarthria uncinata* var *uncinata*	Matgrass			1		
	Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		2	1		
	Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower			1		
	Dilleniaceae	*Hibbertia empetrifolia* ssp *empetrifolia*			2			
	Dilleniaceae	*Hibbertia linearis*				2		

Status	Family	Genus species	Common Name	SGF	ScrGW	GGW	SLand	CGLand
	Dilleniaceae	*Hibbertia* sp				2		
	Apiaceae	*Hydrocotyle peduncularis*		2				3
	Poaceae	*Imperata cylindrica*	Blady Grass	3		2		
	Juncaceae	*Juncus usitatus*	Common Rush					2
	Myrtaceae	*Kunzea ambigua*	Tick Bush	2	3	3	2	
	Proteaceae	*Lambertia formosa*	Mountain Devil		4	3		
	Cyperaceae	*Lepidosperma laterale*		3	3	3		
	Myrtaceae	*Leptospermum juniperinum*	Prickly Tea-tree		2			
	Myrtaceae	*Leptospermum polygalifolium*	Yellow Tea-tree		2		4	2
	Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree		3	3	4	
	Restionaceae	*Lepyrodia scariosa*			2	2		
	Ericaceae - Styphelioideae	*Leucopogon juniperinus*	Prickly Beard-heath	2			2	
	Ericaceae - Styphelioideae	*Leucopogon lanceolatus* var *lanceolatus*				2		
	Lindsaeaceae	*Lindsaea linearis*	Screw Fern		3			
	Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern			2		
	Lomandraceae	*Lomandra confertifolia* ssp *rubiginosa*	Mat-rush			1		
	Lomandraceae	*Lomandra filiformis* ssp *filiformis*	Wattle Mat-rush	2				
	Lomandraceae	*Lomandra glauca*	Pale Mat-rush			2		
	Lomandraceae	*Lomandra gracilis*		1				
	Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	2		3		
	Lomandraceae	*Lomandra obliqua*		2	2	3		
	Zamiaceae	*Macrozamia communis*	Burrawang	2				
	Apocynaceae	*Marsdenia rostrata*	Milk Vine			1		
	Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark			2		
	Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	2				
	Myrtaceae	*Melaleuca thymifolia*	Thyme Honey-myrtle		2			
	Poaceae	*Microlaena stipoides* var *stipoides*	Weeping Grass	3	2	3		3
	Fabaceae - Faboideae	*Mirbelia rubiifolia*	Heathy Mirbelia		2			

Status	Family	Genus species	Common Name	SGF	ScrGW	GGW	SLand	CGLand
	Ericaceae - Stypheliodeae	*Monotoca scoparia*				2		
	Rubiaceae	*Opercularia diphylla*		3				
	Poaceae	*Oplismenus aemulus*	Oplismenus			3		
N5	Oxalidaceae	*Oxalis corniculata*						3
	Apocynaceae	*Parsonsia straminea*	Common Silkpod	2				
*	Poaceae	*Paspalum dilatatum*	Paspalum					4
*	Poaceae	*Paspalum urvillei*	Vasey Grass					3
	Iridaceae	*Patersonia glabrata*	Leafy Purple-flag		3	2		
	Iridaceae	*Patersonia sericea*	Silky Purple-Flag		2	3		
*	Poaceae	*Pennisetum clandestinum*	Kikuyu Grass					4
	Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	2	3	3		
	Proteaceae	*Petrophile sessilis*	Conesticks		1	2		
	Euphorbiaceae	*Phyllanthus hirtellus*		3		3		
	Fabaceae - Faboideae	*Phyllota phylicoides*	Heath Phyllota		3			
	Thymelaeaceae	*Pimelea linifolia* ssp *linifolia*	Slender Rice Flower	3		3		
*	Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues					3
	Fabaceae - Faboideae	*Platylobium formosum* ssp *formosum*				2		
	Apiaceae	*Platysace linearifolia*			3	3		
	Rhamnaceae	*Pomaderris discolor*		2				
	Rubiaceae	*Pomax umbellata*	Pomax			3		
	Euphorbiaceae	*Poranthera microphylla*				2		
	Lobeliaceae	*Pratia purpurascens*	Whiteroot	2		3	1	
	Dennstaedtiaceae	*Pteridium esculentum*	Common Bracken					2
	Pteridaceae	*Pteris tremula*	Tender Brake					
	Cyperaceae	*Ptilothrix deusta*			2			
	Fabaceae - Faboideae	*Pultenaea linophylla*		1	2	3		
*	Rubiaceae	*Richardia stellaris*						2
N4	Rosaceae	*Rubus fruticosus* agg sp	Blackberry					1

Status	Family	Genus species	Common Name	SGF	ScrGW	GGW	SLand	CGLand
	Polygonaceae	*Rumex brownii*	Swamp Dock					2
	Myrtaceae	*Sannantha pluriflora*				3		
	Goodeniaceae	*Scaevola ramosissima*	Purple Fan-flower		1			
	Uvulariaceae	*Schelhammera undulata*		1				
	Cyperaceae	*Schoenus melanostachys*			2	2		
N4	Asteraceae	*Senecio madagascariensis*	Fireweed			2		
*	Poaceae	*Setaria gracilis*	Slender Pigeon Grass					3
*	Malvaceae	*Sida rhombifolia*	Paddy's Lucerne					3
*	Poaceae	*Sporobolus africanus*	Parramatta Grass			2		1
	Stylidiaceae	*Stylidium graminifolium*	Grass Trigger-plant			1		
	Myrtaceae	*Syncarpia glomulifera* ssp *glomulifera*	Turpentine	1		2		
*	Asteraceae	*Taraxacum officinale*	Dandelion			2		3
	Poaceae	*Themeda australis*	Kangaroo Grass	3	3	3		
*	Fabaceae - Faboideae	*Trifolium repens*	White Clover					3
*	Verbenaceae	*Verbena bonariensis*	Purpletop					3
*	Verbenaceae	*Verbena rigida* ssp *rigida*						2
	Xanthorrhoeaceae	*Xanthorrhoea resinosa*	Grass Tree		3	2		
	Apiaceae	*Xanthosia tridentata*	Xanthosia	2		2		

Fauna inventory

Table 8: **Terrestrial fauna recorded during field surveys**

Group	Genus Species	Common Name	Observation Type	Status
Amphibian	*Crinia signifera*	Common Eastern Froglet	W	P
Amphibian	*Limnodynastes peronii*	Brown-striped Frog	W	P
Amphibian	*Litoria peronii*	Peron's Tree Frog	W	P
Amphibian	*Litoria verreauxii*	Whistling Tree Frog	W	P
Bird	*Acanthiza pusilla*	Brown Thornbill	W	P
Bird	*Acridotheres tristis**	Common Myna	O,W	U
Bird	*Anthochaera carunculata*	Red Wattlebird	O,W	P
Bird	*Anthochaera chrysoptera*	Little Wattlebird	O,W	P
Bird	*Cacatua galerita*	Sulphur-crested Cockatoo	O,W	P
Bird	***Callocephalon fimbriatum***	**Gang-gang Cockatoo**	**O,W**	**V - TSC Act**
Bird	*Colluricincla harmonica*	Grey Shrike-thrush	W	P
Bird	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	O,W	P
Bird	*Coracina tenuirostris*	Cicadabird	W	P
Bird	*Cormobates leucophaeus*	White-throated Treecreeper	W	P
Bird	*Corvus tasmanicus*	Forest Raven	O,W	P
Bird	*Cracticus torquatus*	Grey Butcherbird	W	P
Bird	*Cygnus atratus*	Black Swan	O,W	P
Bird	*Dacelo novaeguineae*	Laughing Kookaburra	O,W	P
Bird	***Daphoenositta chrysoptera***	**Varied Sittella**	**W**	**V - TSC Act**
Bird	*Eolophus roseicapillus*	Galah	O,W	P
Bird	*Eopsaltria australis*	Eastern Yellow Robin	W	P
Bird	*Falco berigora*	Brown Falcon	O	P
Bird	*Gerygone mouki*	Brown Gerygone	W	P
Bird	*Grallina cyanoleuca*	Magpie-lark	O,W	P
Bird	*Gymnorhina tibicen*	Australian Magpie	O,W	P
Bird	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	O	M
Bird	*Leucosarcia melanoleuca*	Wonga Pigeon	O,W	P
Bird	*Lichenostomus chrysops*	Yellow-faced Honeyeater	O,W	P
Bird	*Lichenostomus leucotis*	White-eared Honeyeater	W	P
Bird	*Lopholaimus antarcticus*	Topknot Pigeon	O	P
Bird	*Malurus cyaneus*	Superb Fairy-wren	O,W	P
Bird	*Malurus lamberti*	Variegated Fairy-wren	O,W	P
Bird	*Manorina melanocephala*	Noisy Miner	O,W	P
Bird	*Meliphaga lewinii*	Lewin's Honeyeater	W	P
Bird	*Acanthorhynchus tenuirostris*	Eastern Spinebill	O,W	P
Bird	*Melithreptus brevirostris*	Brown-headed Honeyeater	W	P
Bird	*Microeca fascinans*	Jacky Winter	O,W	P

Group	Genus Species	Common Name	Observation Type	Status
Bird	*Myzomela sanguinolenta*	Scarlet Honeyeater	W	P
Bird	*Neochmia temporalis*	Red-browed Finch	W	P
Bird	*Ninox boobook*	Southern Boobook	W	P
Bird	*Ocyphaps lophotes*	Crested Pigeon	O	P
Bird	*Pachycephala pectoralis*	Golden Whistler	W	P
Bird	*Pachycephala rufiventris*	Rufous Whistler	W	P
Bird	*Pardalotus punctatus*	Spotted Pardalote	W	P
Bird	*Pardalotus striatus*	Striated Pardalote	W	P
Bird	*Phaps chalcoptera*	Common Bronzewing	O	P
Bird	*Phylidonyris novaehollandiae*	New Holland Honeyeater	O,W	P
Bird	*Platycercus adscitus eximius*	Eastern Rosella	O	P
Bird	*Platycercus elegans*	Crimson Rosella	O	P
Bird	*Psophodes olivaceus*	Eastern Whipbird	W	P
Bird	*Pycnoptilus floccosus*	Pilotbird	W	P
Bird	*Rhipidura albiscapa*	Grey Fantail	O,W	P
Bird	*Rhipidura leucophrys*	Willie Wagtail	O,W	P
Bird	*Sericornis frontalis*	White-browed Scrubwren	O,W	P
Bird	*Sericornis magnirostris*	Large-billed Scrubwren	W	P
Bird	*Strepera graculina*	Pied Currawong	O,W	P
Bird	*Streptopelia chinensis**	Spotted Turtle-Dove	O	U
Bird	*Trichoglossus haematodus*	Rainbow Lorikeet	O	P
Mammal	*Antechinus sp.*	Unidentified Antechinus	P	P
Mammal	*Antechinus stuartii*	Brown Antechinus	T	P
Mammal	***Chalinolobus dwyeri***	**Large-Eared Pied Bat**	**A**	**V - TSC Act** **V - EPBC Act**
Mammal	*Chalinolobus gouldii*	Gould's Wattled Bat	A	P
Mammal	*Chalinolobus morio*	Chocolate Wattled Bat	A	P
Mammal	*Macropus giganteus*	Eastern Grey Kangaroo	O, P	P
Mammal	*Macropus rufogriseus*	Red-necked Wallaby	O,P	P
Mammal	***Miniopterus schreibersii oceanensis***	**Eastern Bentwing Bat**	**A**	**V - TSC Act**
Mammal	*Mormopterus "Species 2"*	Undescribed Freetail Bat	A	P
Mammal	***Mormopterus norfolkensis***	**Eastern Freetail Bat**	**A**	**V - TSC Act**
Mammal	*Mormopterus* spp.	Unidentified Freetail Bat	A	P
Mammal	***Myotis macropus***	**Large-Footed Myotis**	**A**	**V - TSC Act**
Mammal	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	A[#]	P
Mammal	*Oryctolagus cuniculus**	European Rabbit	P	U
Mammal	*Perameles nasuta*	Long-nosed Bandicoot	I	P
Mammal	*Petaurus breviceps*	Sugar glider	T	P
Mammal	***Petaurus australis***	**Yellow-bellied Glider**	**I**	**V – TSC Act**
Mammal	*Rattus fuscipes*	Bush Rat	T	P
Mammal	*Rhinolophus megaphyllus*	Eastern Horseshoe Bat	A	P

Group	Genus Species	Common Name	Observation Type	Status
Mammal	***Scoteanax rueppellii***	**Greater Broad-Nosed Bat**	**A**	**V - TSC Act**
Mammal	*Scotorepens orion*	Eastern Broad-nosed Bat	A	P
Mammal	*Tadarida australis*	White-striped Freetail-bat	W,A	P
Mammal	*Trichosurus vulpecula*	Brushtail Possum	T, O	P
Mammal	*Vespadelus darlingtoni*	Large Forest Bat	A	P
Mammal	*Vespadelus regulus*	Southern Forest Bat	A	P
Mammal	*Vespadelus vulturnus*	Little Forest Bat	A	P
Mammal	*Vombatus ursinus*	Common wombat	P	P
Mammal	*Vulpes vulpes**	Red Fox	P	U
Mammal	*Wallabia bicolor*	Swamp Wallaby	O,P	P
Reptile	*Lampropholis delicata*	Dark-flecked Garden Sunskink	O	P

Key: Observation Type: O – observed, W – Heard, P – scats; T- trapped, I =- Indirect evidence (sap-feeding incisions, diggings etc);' #Probable echolocation identification; * Introduced,; U – Unprotected, P – Protected; E – Endangered and V – Vulnerable under TSC Act/EPBC Act; M – migratory under EPBC Act

APPENDIX 2

Terrestrial flora and fauna listed on the TSC and/or EPBC Acts previously recorded in the Locality and likelihood to occur on the Subject Site

Table 9: **Terrestrial flora listed on the TSC and/or EPBC Acts previously recorded in the locality**

Key: 1) Listed on the EPBC Act as Critically Endangered (Z) Endangered (E), Vulnerable (V) or Extinct (X)

2) Listed on the TSC Act as Endangered (E1), Vulnerable (V) or Presumed Extinct (E4)

Genus species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Acacia pubescens	V	V	*Acacia pubescens* is found in Sydney Metropolitan, and Hawkesbury/Nepean Catchment Management Region, with concentrated populations around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon (NPWS 2003). It occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravelly soils, often with ironstone. The species occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland (NPWS 2003). Flowers from August to October. The pods mature in October to December (NPWS 2003).	Low. The Subject Site does not support the preferred soils of the species and the record is beyond the species known natural distribution.
Apatophyllum constablei		E	Known from four sites, three of which are within Wollemi National Park near Gospers Mountain and Coorongooba Creek, the fourth of which is about 2 km from Glen Davis. Occurs in dry sclerophyll forest on slopes with a north to north-westerly aspect. It typically grows near cliffs (i.e. near the base or just above). The soils at sites are sandy and skeletal, mostly on Narrabeen sandstone. Found in association with *Eucalyptus piperita, E. punctata, E. sparsifolia, Banksia serrata, Acacia linifolia, Cleistochloa rigida, Lomandra obliqua*. Flowering has been observed from August to December and fruiting from August to January (DEC 2005a)	Low. Although dry sclerophyll forest is present on the Subject Site and there are species of known association physiographic habitat features including aspect and topography are absent from the Subject Site.
Cryptostylis hunteriana	V	V	This species typically grows in swamp-heath on sandy soils chiefly in coastal districts (Harden 1993) but has also been recorded on steep bare hillsides (Bishop 1996). Within the Central Coast bioregion, this species has been recorded within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland (Bell 2001). This species does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by *Eucalyptus sclerophylla, E. sieberi, Corymbia gummifera* and *Allocasuarina littoralis*; appears to prefer open areas in the understorey of this community and is often found in association with the *Cryptostylus subulata* (DEC 2005d). It occurs in the following Catchment Management Regions Hawkesbury/Nepean, Hunter/Central Rivers, Northern Rivers and Southern Rivers.	Moderate. The Subject Site supports habitat for the species including the preferred vegetation and a range of associated flora species.

Genus species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Cynanchum elegans	E1	E	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley. Catchment Management Regions include Hawkesbury/Nepean , Hunter/Central Rivers, Northern Rivers, Southern Rivers and Sydney Metropolitan (DEC 2005{). *Cynanchum elegans* usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; *Leptospermum laevigatum*, *Banksia integrifolia* subsp. *integrifolia; Eucalyptus tereticornis* open forest and woodland; *Eucalyptus maculata* open forest and woodland; and Melaleuca armillaris scrub to open scrub (DEC 2005{). Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific (DEC 2005{).	Low. Although Spotted Gum forest and Woodland vegetation are present on the Subject Site the species is not recorded in the locality and is unlikely to occur on the Subject Site or in the Study Area.
Eucalyptus langleyi	V	V	The main occurrence of the Albatross Mallee is to the south-west of Nowra as far as Yarramunmun Creek. It is also found to a limited extent north of the Shoalhaven River in the vicinity of Bomaderry Creek Regional Park. Found in mallee shrubland on poorly-drained, shallow, sandy soils on sandstone. The species regenerates from rootstock after fire.(DEC 2005f).	Low. The Shrubland plant community provides potential habitat for this species. However this derived plant community has established following disturbance and is present due to continuing stormwater impacts. Although the species is known from the Study Area and locality it is unlikely to occur in, persist or colonise the Subject Site

Genus species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Genoplesium baueri	V		This terrestrial orchid species grows in open sclerophyll forest or moss gardens on sandstone. Typically the habitat is a drier heathy forest (Harden 1993) (Bishop 1996). The species has been recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Flowers Dec. - Mar (DEC 2005g).	High. The species was recorded in the central area of the Subject Site in 2005 and 2006 and habitat is present throughout in the Scribbly Gum and Grey Gum Woodlands.
Melaleuca biconvexa	V	V	Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Catchment regions include: Hunter/Central Rivers, Hawkesbury/Nepean, Southern Rivers, and Northern River Catchments (DEC 2005n). Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October (DEC 2005n).	Low. Although the riparian zones of the Subject Site provide some potential habitat, the alluvial soils preferred by the species are generally absent. The species is not recorded in the locality and is unlikely to occur on the Subject Site or in the Study Area.
Melaleuca deanei	V	V	*Melaleuca deanei* occurs in Catchment Management Regions Hawkesbury/Nepean, Southern Rivers, and Sydney Metropolitan. Distinctly it occurs in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas (DEC 2005o). The species grows in wet heath on sandstone (Harden 1991) and Dry Sclerophyll Forests. Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate(DEC 2005o).	Moderate. The Subject Site supports habitat for the species.

Genus species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Pterostylis gibbosa	E1	E	Known from a small number of populations in the Hunter region, the Illawarra region and the Shoalhaven region. It is apparently extinct in western Sydney which is the area where it was first collected (1803) (DEC 2005q). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by *Eucalyptus tereticornis, E. longifolia* and *Melaleuca decora*. Near Nowra, the species grows in an open forest of *Corymbia maculata, E.tereticornis* and *E. paniculata.* In the Hunter region, the species grows in open woodland dominated by *E. crebra*, Forest Red Gum and *Callitris endlicherii*(DEC 2005q). The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter (DEC 2005q). The Illawarra Greenhood can survive occasional burning and grazing because of its capacity to reshoot from an underground tuber (DEC 2005q).	Moderate. Although the records of the species are clustered in the southeast of the locality in Worrigee NR the Subject Site supports habitat for the species.
Pterostylis pulchella	V	V	The Waterfall Greenhood is found only at Fitzroy Falls, Belmore Falls, upper Bundanoon Creek (Meryla) and Minnamurra Falls(DEC 2005|). Is found on cliff faces close to waterfalls and creek banks and mossy rocks alongside running water. Flowers appear from February to May(DEC 2005|).	Low. Although marginal habitat for the species is present in the drainage lines other key habitat elements are absent.
Solanum celatum	E1		Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Majority of records are prior to 1960 and the majority of populations are likely to have been lost to clearing. Grows in rainforest clearings, or in wet sclerophyll forests. Flowers August to October and produces fruit December to January(DEC 2005t).	Low. The Subject Site does not support the preferred vegetation types with majority of records for the locality at higher elevations on the Cambewarra Range.

Genus species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Pterostylis sp. Flat Rock Creek *(Speculantha vernalis)*		Z	The Spring Tiny Greenhood is a tuberous terrestrial orchid endemic to New South Wales and is known from five populations in the Nowra district. One population is in a national park, one is on land zoned for urban development and the other three are on uncommitted crown land. Three of these populations occur near or adjacent to roads. The species grows in heath and heathy forests. It is most commonly found in open sites in shallow sandy soil and moss gardens around the margins of sandstone sheets with associated dwarf heaths and sedges. It is also found in moss beneath taller shrubs, particularly *Kunzea ambigua* (White Kunzea) and *Leptospermum sejunctum*. The species is associated with soil of a specific moisture regime, where the flow of water through the profile is inhibited by the underlying rock strata. The species appear from a dormant underground tuber in late autumn or early winter following good rains. The flower stem appears in late winter and plants flower from August to October. The flowers are pollinated by the males of tiny microdipteran (gnat) species. Seeds require interactions with a mycorrhizal fungal host for germination. Mature plants probably also rely on regular infection by a mycorrhizal fungal host to receive an adequate carbon and nutrient supply. This species does not rely on fire to induce flowering; however, flowering may be enhanced by summer fires. The population is estimated at 500 plants (DEWHA 2010)	Low. Although the Scribbly Gum Woodland and soils of the Subject Site provide some habitat no observations were made of locations that would support the moisture regime preferred by the species. The species is not recorded in the locality and is unlikely to occur on the Subject Site or in the Study Area.
Syzygium paniculatum	V	V	Subtropical and littoral rainforest on sandy soils or stabilised dunes near the sea(Harden 1991). Found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities(DEC 2005y). The species occurs in the following Catchment Authority Regions - Hunter/Central Rivers, Hawkesbury/Nepean, Sydney Metropolitan, and Southern Rivers.	Low. Although marginal habitat is present in the Spotted Gum Forest the single record in the locality is some distance to the south.
Thelymitra sp. Kangaloon		Z	*Thelymitra* sp. Kangaloon is a terrestrial orchid endemic to New South Wales, and is known from three locations near Robertson in the Southern Highlands. The swamp habitat in which the species occurs has an extent of occurrence of 300 km2 and an area of occupancy of 10 km2. The three swamps are Butlers Swamp, Stockyard Swamp and Wildes Meadow Swamp, and are all located above what is known as the Kangaloon aquifer. It flowers in late October and early November. The species grows amongst tall sedges and rushes in seasonally swampy sedgeland on grey silty clay loam at 600-700 m above sea level (Threatened Species Scientific Committee 2008).	Nil. The Subject Site does not support habitat for the species including vegetation and plant type associations.

Genus species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Thesium australe	V	V	Found in very small to large populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. *Thesium australe* is a root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass (DEC 2005z). It is often found in damp sites in association with *Themeda australis*, but also found on other grass species at inland sites (G. Leonard pers. obs.). Occurs on clay soils in grassy woodlands or coastal headlands (James *et al.* 1999).	Low. Areas of the Scribbly Gum Woodland provide some marginal habitat. However the species is not recorded in the locality and is unlikely to occur on the Subject Site or in the Study Area.
Triplarina nowraensis	E1	E	There are five known populations of Nowra Heath Myrtle. Three of these form a cluster to the immediate west of Nowra. A fourth, much smaller population is found 18km south-west of Nowra in the Boolijong Creek Valley. The fifth population is located north of the Shoalhaven River on the plateau above Bundanon. Nowra Heath Myrtle occurs on poorly drained, gently sloping sandstone shelves or along creek lines underlain by Nowra Sandstone. The sites are often either treeless or have a very open tree canopy due to the impeded drainage (DEC 2005}).	Moderate. Records of the species are clustered to the south in Bamarang and Triplarina NR's and further to the west. The Subject Site supports habitat for the species.
Zieria baeuerlenii	E1	E	The species occurs in only one location north-west of Nowra. The population occurs in a total of 43 colonies in six discrete clusters. These clusters are confined within a 0.5 km x 1.0 km area of the bushland, and are found on both sides of Bomaderry Creek. Bomaderry Zieria occurs on skeletal sandy loam overlaying sandstone, on a rocky plateau amongst sandstone boulders in either shrubby open forest, shrubby woodland or closed scrub(DEC 2005).	Moderate. The majority of records occur in the nearby Bomaderry Creek NR. The Subject Site supports optimal vegetation habitat for the species, however some physiographic habitat features are absent.

Genus species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Zieria tuberculata	V	V	Warty Zieria grows in the Mt Dromedary and Tilba Tilba area. The population in the Cambewarra Mountain area near Nowra is now referable to a separate taxon. The Warty Zieria grows in heath amongst rocky outcrops on rain forest edges and in tall forest and shrubland. The flowers appear from late winter to spring (DEWHA 2008b). Now known only from Little Dromedary Mt and the lower eastern slopes of Mt Dromedary in the Central Tilba area on the South Coast of NSW, the species has a geographic range of 6 km. In 1931, it was collected from Good Dog Mountain in the Cambewarra Range, north of Nowra but more recent searches have failed to find the species there. Although this site is now heavily revegetated, the species may have been eliminated from the area as a result of earlier clearing and grazing (DEWHA 2008b). The total known population of about 900 plants grows at eight sites. Four populations are on private property. Three of the smaller populations totalling about 60 plants occur within Gulaga NP and the Little Dromedary Mt population is on crown land (DEWHA 2008b).	Low. The Subject Site supports marginal preferred habitat and the record of the species in the locality is referable to a separate taxon.

Table 10: **Terrestrial fauna listed on the TSC and/or EPBC Acts previously recorded in the locality**

Key: 1) Listed on the EPBC Act as Critically Endangered (Z) Endangered (E), Vulnerable (V), Extinct (X), Migratory (M)

2) Listed on the TSC Act as Endangered (E1), Vulnerable (V) or Presumed Extinct (E4)

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Amphibians					
Litoria aurea	Green and Golden Bell Frog	V	E1	Most existing locations for the species occur as small, coastal, or near coastal populations, with records occurring between south of Grafton and northern VIC (NSW Government 2009). The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes. Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks (NPWS 1999e; White and Pyke 1996), although the species has also been recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land. Breeding usually occurs in summer. Tadpoles, which take approximately 6 weeks to develop, feed on algae and other vegetative matter. Adults eat insects as well as other frogs, including juveniles of their own species (DEC 2005i).	Low.
Litoria littlejohni	Littlejohn's Tree Frog	V	V	The species is distributed along the eastern slopes of the Great Dividing Range from Watagan State Forest near Wyong, south to Buchan in north-eastern VIC. It is not known from coastal habitats (DEH 2005). Occurs in wet and dry sclerophyll forests and heath communities associated with sandstone outcrops between 280 and 1000 m (Barker *et al.* 1995). Littlejohn's Tree Frog prefers permanent and semi-permanent rock flowing streams, but individuals have also been collected from semi-permanent dams with some emergent vegetation (Barker *et al.* 1995). Forages both in the tree canopy and on the ground, and has been observed sheltering under rocks on high exposed ridges during summer. The species breeds in autumn but will also breed after heavy rainfall in spring and summer (NSW Scientific Committee 2000). The species has been recorded calling in all seasons with variously reported peak calling periods (DEH 2005). Eggs are laid in loose gelatinous masses attached to submerged twigs; eggs and tadpoles are most often recorded in slow-flowing pools that receive extended exposure to sunlight (DEW 2007).	Low.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Heleioporus australiacus	Giant Burrowing Frog	V	V	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks (Daly 1996; Recsei 1996). Can also occur within shale outcrops within sandstone formations. Known from wet and dry forests and montane woodland in the southern part range (Daly 1996). Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water (Barker *et al.* 1995). Spends the majority of its time in non-breeding habitat 20-250m from breeding sites (Penman *et al.* 2008).	Moderate. Marginal breeding, foraging and sheltering habitat occurs within the Study Area. A large proportion of the unnamed creek lines are currently disturbed.
Mixophyes balbus	Stuttering Frog	V	E1	This species is usually associated with mountain streams, wet mountain forests and rainforests (Barker *et al.* 1995). It rarely moves very far from the banks of permanent forest streams, although it will forage on nearby forest floors. Eggs are deposited in leaf litter on the banks of streams and are washed into the water during heavy rains (Barker *et al.* 1995).	Low.
Birds					
Haliaeetus leucogaster	White-bellied Sea-eagle	M		A migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive (Marchant and Higgins 1993). Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees (Marchant and Higgins 1993).	High. Species recorded during field surveys.
Lophoictinia isura	Square-tailed Kite		V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia (Marchant and Higgins 1993). In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia*, *Corymbia maculata*, *E. elata*, or *E. smithii* (NPWS 1999i). Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs (Marchant and Higgins 1993).	Moderate.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Stictonetta naevosa	Freckled Duck		V	The freckled duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits (Simpson and Day 1996).	Low.
Apus pacificus	Fork-tailed Swift	M		Almost exclusively aerial (foraging). The fork-tailed swift breeds in Asia but migrates to Australia from September to April (Higgins 1999). Individuals or flocks can be observed hawking for insects at varying heights from only a few metres from the ground and up to 300 metres high (Boehm 1944).	Low. Species may occasionally fly over the Study Area.
Hirundapus caudacutus	White-throated Needletail	M		An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breed in Asia (Pizzey and Knight 1997).	Low. Species may occasionally fly over the Study Area.
Ardea alba	Great Egret	M		Terrestrial wetlands, estuarine and littoral habitats and moist grasslands. Inland, prefer permanent waterbodies on floodplains; shallows of deep permanent lakes (either open or vegetated), semi-permanent swamps with tall emergent vegetation and herb dominated seasonal swamps with abundant aquatic flora. Also regularly use saline habitats including mangrove forests, estuarine mudflats, saltmarshes, bare saltpans, shallows of salt lakes, salt fields and offshore reefs. Breeding requires wetlands with fringing trees in which to build nests including mangrove forest, freshwater lakes or swamps and rivers (Marchant and Higgins 1990).	Low.
Ardea ibis	Cattle Egret	M		Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands (Marchant and Higgins 1990).	Low.
Botaurus poiciloptilus	Australasian Bittern		V	The Australasian Bittern is distributed across south-eastern Australia. Often found in terrestrial and estuarine wetlands, generally where there is permanent water with tall, dense vegetation including Typha spp. and Eleoacharis spp. (DECC 2005a; NPWS 1999a). Typically this bird forages at night on frogs, fish and invertebrates, and remains inconspicuous during the day. The breeding season extends from October to January with nests being built amongst dense vegetation on a flattened platform of reeds (DECC 2005a).	Low.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Ixobrychus flavicollis	Black Bittern		V	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation (DEC 2005c; NPWS 1999b). The Black Bittern typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates (DEC 2005c). The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water.	Low.
Burhinus grallarius	Bush Stone-curlew		E1	Lightly timbered open forest and woodland, or partly cleared farmland with remnants of woodland, with a ground cover of short sparse grass and few or no shrubs where fallen branches and leaf litter are present (Marchant and Higgins 1993).	Low.
Callocephalon fimbriatum	Gang-gang Cockatoo		V	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (Higgins 1999). Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest (Forshaw and Cooper 1981). In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (Shields and Crome 1992). It requires tree hollows in which to breed (Gibbons and Lindenmayer 1997).	High. Species recorded during field surveys.
Calyptorhynchus lathami	Glossy Black-cockatoo		V	Inhabits forest with low nutrients, characteristically with key Allocasuarina species. Tends to prefer drier forest types (NPWS 1999c). Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead (Higgins 1999).	High. High number of records within the Study Area and foraging and breeding habitat is present.
Charadrius bicinctus	Double-banded Plover	M		Tidal mudflats, beaches, exposed reefs, salt marshes, freshwater wetlands, inland salt lakes, short grass on golf courses, airfields (Morcombe 2003).	Low.
Charadrius leschenaultii	Greater Sand Plover	M	V	Entirely coastal in NSW, foraging on intertidal sand and mudflats in estuaries and roosting during high tide on sandy beaches or rocky shores. Individuals have been recorded on inshore reefs, rock platforms, small rocky islands and sand cays on coral reefs, within Australia. Occasional sightings have also occurred on near-coast saltlakes, brackish swamps, shallow freshwater wetlands and grassed paddocks (NPWS 1999d).	Low.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Charadrius mongolus	Lesser Sand Plover	M	V	In Australia, the species is known to favour coastal environs including beaches, mudflats and mangroves. Within NSW, individuals have been observed on intertidal sand and mudflats in estuaries or roosting on sandy beaches or rocky shores at high tide (NPWS 1999f).	Low.
Charadrius veredus	Oriental Plover	M		Generally inland; open grasslands in arid and semi-arid zones; less often in estuarine or littoral environments. Prefer flat inland plains, sparsely vegetated with short grass, and with much hard bare ground, including claypans, playing fields, lawns and cattle camps. At onset of wet season, may move to lightlywooded grasslands. (Marchant and Higgins 1993)	Low.
Pluvialis fulva	Pacific Golden Plover	M		Migratory species that visits estuaries mudflats, saltmarshes and ocean shores as well as paddocks, grasslands and swamps near the coast (Pizzey and Knight 1997).	Low.
Thinornis rubricollis	Hooded Plover		C1	Prefers sandy ocean beaches, especially those that are broad and flat (Marchant and Higgins 1993).	Low.
Monarcha melanopsis	Black-faced Monarch	M		A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland (Pizzey and Knight 1997).	Moderate.
Myiagra cyanoleuca	Satin Flycatcher	M		Migratory species that occurs in coastal forests, woodlands and scrubs during migration. Breeds in heavily vegetated gullies (Pizzey and Knight 1997).	Moderate.
Rhipidura rufifrons	Rufous Fantail	M		Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. During migration it can stray into gardens and more open areas (Pizzey and Knight 1997).	Moderate.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Anthochaera phrygia	Regent Honeyeater	E	E1	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests (NPWS 1999g; Pizzey and Knight 1997). Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises: E. microcarpa, E. punctata, E. polyanthemos, E. mollucana, Corymbia robusta, E. crebra, E. caleyi, C.maculata, E.mckieana, E. macrorhyncha, E. laevopinea, and Angophora floribunda. Nectar and fruit from the mistletoes A. miquelii, A. pendula, A. cambagei are also eaten during the breeding season (DEC 2005r). Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and sheoaks. Also nest in mistletoe haustoria. An open cup-shaped nest is constructed of bark, grass, twigs and wool by the female (DEC 2005r).	Low.
Merops ornatus	Rainbow Bee-eater	M		Usually occurs in open or lightly timbered areas, often near water. Nest in embankments, including banks of creeks and rivers, in sand dunes, in quarries and in roadside cuttings. Breeding occurs from November to January. It has complex migratory movements in Australia. NSW populations migrate north for winter (Higgins 1999).	Low.
Petroica rodinogaster	Pink Robin		V	The Pink Robin is found in dense, dank forests and treefern gullies (Pizzey and Knight 1997). During the winter months the Pink Robin disperses north (as far up as the central coast of NSW) and west (as far as the ACT area) into more open forests, woodlands and scrublands (DECCW 2005).	Low.
Daphoenositta chrysoptera	Varied Sittella	V	V	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature Eucalypts (Higgins and Peter 2002; NSW Scientific Committee 2010). The Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years (NSW Scientific Committee 2010).	High. Species recorded during field surveys.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Glossopsitta pusilla	Little Lorikeet		V1	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes (NSW Scientific Committee 2008).	Moderate.
Lathamus discolor	Swift Parrot	E	E1	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects (Forshaw and Cooper 1981). The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW (Shields and Crome 1992). Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummifera, Mugga Ironbark E. sideroxylon, and White Box E. albens. Commonly used lerp infested trees include Grey Box E. microcarpa, Grey Box E. moluccana and Blackbutt E. pilularis (DEC 2005x). This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability (Pizzey and Knight 1997).	Moderate.
Neophema chrysogaster	Orange-bellied Parrot	ZM	C1	A single breeding population of fewer than 200 individuals occurs in a narrow coastal strip of south-west Tasmania. Adult birds depart Tasmania for the mainland in February. The first adults begin leaving the mainland for Tasmania in September with the last birds having departed by November. It is a coastal species inhabiting saltmarshes, sedgeplains, coastal dunes, pastures, shrublands and moorlands, generally within 10 km of the coast (OBPRT 1998). Critical winter habitat for the species includes natural saltmarshes dominated by Sarcocornia quinqueflora (Beaded Glasswort) and Sclerostegia arbuscula (Shrubby Glasswort), as well as the associated grassy or weedy pastures (DECC 2007). Historical records indicate that the Orange-bellied Parrot was formerly more abundant and widespread in NSW than it is now, however the species' distribution continues to extend into south-eastern NSW where suitable habitat is still available (DECC 2007).	Low.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Pezoporus wallicus wallicus	Eastern Ground Parrot	E		Occurs in high rainfall coastal or near coastal low heathlands and sedgelands, generally below one metre in height and very dense. They breed between September to December, which is believed to be triggered by seed availability. This species can re-colonise burnt habitats after 1-2 years and reach maximum densities after 15-20 years post-fire (Higgins 1999)..	Low.
Rostratula australis	Australian Painted Snipe	VM	E1	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, ephemeral or permanent, although they have been recorded in brackish waters (Marchant and Higgins 1993).	Low.
Calidris acuminata	Sharp-tailed Sandpiper	M		Inland waters, coastal (Simpson and Day 1996).	Low.
Ninox strenua	Powerful Owl		V	The Powerful Owl occupies wet and dry eucalypt forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas (Debus and Chafer 1994b; Debus and Chafer 1994a). Large mature trees with hollows at least 0.5 m deep are required for nesting (Garnett 1992). Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials (Gibbons and Lindenmayer 1997). Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm (Gibbons and Lindenmayer 1997). It has a large home range of between 450 and 1450 ha (DEC 2005p).	High. Numerous records of this species are present within the Study Area and potential foraging and breeding habitat is available.
Tyto novaehollandiae	Masked Owl		V	The Masked Owl may be found across a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting (Higgins 1999). It has mostly been recorded in open forests and woodlands adjacent to cleared lands. They nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead (Higgins 1999). The nest hollows are usually located within dense forests or woodlands (Gibbons and Lindenmayer 1997). Masked Owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet (Gibbons and Lindenmayer 1997; Higgins 1999). It has a large home range of between 500 to 1000 ha (DEC 2005m).	Moderate.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Tyto tenebricosa	Sooty Owl		V	The Sooty Owl is often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW it is mostly found on escarpments with a mean altitude <500 m. The Sooty Owl nests and roosts in hollows of tall emergent trees, mainly eucalypts (Higgins 1999) often located in gullies (Gibbons and Lindenmayer 1997). Nests have been located in trees 125 to 161 cm in diameter (Gibbons and Lindenmayer 1997).	Moderate.
Mammals					
Cercartetus nanus	Eastern Pygmy-possum		V	Patchily distributed from the coast to the Great Dividing, and as far as Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Soft fruits are eaten when flowers are unavailable and it also feeds on insects (DEC 2005e; Ward and Turner 2008). Will often nest in tree hollows, but can also construct its own nest (Turner and Ward 1995). Because of its small size it is able to utilise a range of hollow sizes including very small hollows (Gibbons and Lindenmayer 1997). Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5 ha area over a 5 month period (Ward 1990). It is mainly solitary, and each individual uses several nests. Home ranges of males are generally less than 0.75 ha, and those of females are smaller (Ward and Turner 2008).	High. Species has been previously recorded in the Study Area and good quality foraging and breeding resources are available.
Dasyurus maculatus maculatus	Spotted-tailed Quoll (southeastern mainland)	E	V	Occurs along the east coast of Australia and the Great Dividing Range (Belcher *et al.* 2008). Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests (Dickman and Read 1992). Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas (NPWS 1999k). Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage (Edgar and Belcher 1995). 70% of the diet is medium-sized mammals, and also feeds on invertebrates, reptiles and birds. Individuals require large areas of relatively intact vegetation through which to forage (NPWS 1999h). The home range of a female is between 180 – 1000 ha, while males have larger home ranges of between 2000 – 5000 ha. Breeding occurs from May to August (Belcher *et al.* 2008).	Moderate.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat		V	Found throughout NSW (Richards 2008). They have been reported from southern Australia between January and June (Churchill 1998). Reported from a wide range of habitats throughout eastern and northern Australia, including wet and dry sclerophyll forest, open woodland, acacia shrubland, mallee, grasslands and desert (Churchill 1998). They roost in tree hollows in colonies of up to 30 (but more usually two to six) and have also been observed roosting in animal burrows, abandoned Sugar Glider nests, cracks in dry clay, hanging from buildings and under slabs of rock. It is high-flying, making it difficult to detect. It forages above the canopy of eucalypt forests, but comes lower to the ground in mallee or open country (Churchill 2008; Richards 2008).	Moderate.
Macropus parma	Parma Wallaby		V	Occurs in wet and dry sclerophyll forest with a thick, shrubby understorey associated with grassy patches. They may also occur in rainforest but prefer the wet sclerophyll forest (Strahan 1995). This species feed on grasses and herbs (Strahan 1995).	Low.
Petrogale penicillata	Brush-tailed Rock-wallaby	V	E1	Occurs along the Great Dividing Range south to the Shoalhaven, and also occurs in the Warrumbungles and Mt Kaputar. Habitats range from rainforest to open woodland. It is found in areas with numerous ledges, caves and crevices, particularly where these have a northerly aspect. Individuals defend a specific rock shelter, emerging in the evening to forage on grasses and forbs, as well as browse in drier months. Home sizes range from 2-30 ha (Eldridge and Close 1995).	Low.
Mormopterus norfolkensis	Eastern Freetail Bat		V	Distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney (Churchill 1998). Most records are from dry eucalypt forests and woodland. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught foraging low over a rocky river within rainforest and wet sclerophyll forest habitats. The species generally roosts in hollow spouts of large mature eucalypts (including paddock trees), although individuals have been recorded roosting in the roof of a hut, in wall cavities, and under metal caps of telegraph poles. Foraging generally occurs within a few kilometres of roosting sites (Churchill 2008; Hoye *et al.* 2008).	High. Species detected during field surveys.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Pseudomys fumeus	Smoky Mouse	E	E1	Appears to prefer heathy ridgetops and slopes within sclerophyll forests, heathland and open forest from the coast to sub-alpine regions of up to 1800 m (Lee 1995). The Smoky Mouse is restricted to a small number of sites in Victoria, south-east NSW and the ACT. In NSW there are records from Kosciuszko National Park, Bondo and Ingbyra State Forests, Mt Poole, Nullica State Forest and the adjoining S. E. Forests National Park (DEC 2005s).	Low.
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E1	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time (Braithwaite 1995). A mosaic of post fire vegetation is important for this species (Maxwell *et al.* 1996a).	Moderate.
Petaurus australis	Yellow-bellied Glider		V	Restricted to tall native forests in regions of high rainfall along the coast of NSW. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows. Critical elements of habitat include sap-site trees, winter flowering eucalypts, mature trees suitable for den sites and a mosaic of different forest types (NPWS 1999j). Live in family groups of 2-6 individuals which commonly share a number of tree hollows. Family groups are territorial with exclusive home ranges of 30-60 ha. Very large expanses of forest (>15,000 ha) are required to conserve viable populations (Goldingay 2008)	High. Sap feeding incisions detected during field surveys.
Phascolarctos cinereus	Koala		V	In NSW the Koala mainly occurs on the central and north coasts with some populations in the western region (DEC 2005j). Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally (Martin *et al.* 2008). Primary feed trees include *Eucalyptus robusta*, E. tereticornis, *E. punctata*, *E. haemostoma* and E. signata (DoP 1995). They are solitary with varying home ranges. In high quality habitat home ranges may be 1-2 ha and overlap, while in semi-arid country they are usually discrete and around 100 ha (Martin *et al.* 2008).	Low. Potential feed trees of these species are present, but they are unlikely to occur in the Study Area on the basis of previous records and the fragmented nature of the landscape

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Potorous tridactylus	Long-nosed Potoroo	V	V	Occurs from Queensland to Victoria, normally within 50 km of the coast (Claridge *et al.* 2007). Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy. Known to eat fungi, arthropods, fleshy fruit, seeds and plant tissue. It is solitary and sedentary, buts tends to aggregate in small groups. It has two breeding seasons, one in late winter-early spring and the other in late summer (Johnston 2008). This species appears to benefit from a lack of recent disturbance (Claridge *et al.* 2007).	Moderate.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies (camps), commonly in dense riparian vegetation. Bats commute daily to foraging areas, usually within 15 km of the day roost (Tidemann 1995) although some individuals may travel up to 70 km (Augee and Ford 1999).	Moderate.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney Basin and Hunter Valley (van dyck and Strahan 2008). Primarily found in dry sclerophyll forests and woodlands, but also found in rainforest fringes and subalpine woodlands (Churchill 2008; Hoye and Schulz 2008). Forages on small, flying insects below the forest canopy. Roosts in colonies of between three and 80 in caves, Fairy Martin nests and mines, and beneath rock overhangs, but usually less than 10 individuals. Likely that it hibernates during the cooler months (Churchill 2008). The only known existing maternity roost is in a sandstone cave near Coonabarabran (Pennay 2008).	High. Species detected during field surveys.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V	Distribution extending east of the Great Dividing Range throughout the coastal regions of NSW, from the Queensland border to the Victorian border. Prefers wet high-altitude sclerophyll and coastal mallee habitat, preferring wet forests with a dense understorey but being found in open forests at lower altitudes (Churchill 2008). Apparently hibernates in winter. Roosts in tree hollows and sometimes in buildings in colonies of between 3 and 80 individuals. Often change roosts every night. Forages for beetles, bugs and moths below or near the canopy in forests with an open structure, or along trails (Law *et al.* 2008). Has a large foraging range, up to 136 ha (Churchill 2008; Law *et al.* 2008). Records show movements of up to 12 km between roosting and foraging sites (Menkhorst and Lumsden 1995).	Moderate.
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat		V	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways (Churchill 2008; Hoye and Hall 2008).	High. Species recorded during field surveys.
Myotis macropus	Large-footed Myotis		V	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects ((Richards *et al.* 2008)).	High. Species recorded during field surveys.
Scoteanax rueppellii	Greater Broad-nosed Bat		V	Occurs along the Great Dividing Range, generally at 500 m but up to 1200 m, and in coastal areas. Occurs in woodland and rainforest, but prefers open habitats or natural or human-made openings in wetter forests. Often hunts along creeks or river corridors. Flies slowly and directly at a height of 30 m or so to catch beetles and other large, flying insects. Also known to eat other bats and spiders. Roosts in hollow tree trunks and branches (Churchill 2008; Richards *et al.* 2008).	High. Species recorded during field surveys.
Reptiles					
Hoplocephalus bungaroides	Broad-headed Snake	V	E1	Mainly occurs in association with communities occurring on Triassic	Low.

Latin Name	Common Name	EPBC Act	TSC Act (NSW)	Habitat	Likelihood of Occurrence
				sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer (Webb 1996; Webb and Shine 1998).	

9.0 REFERENCES

Anderson J, Law B, and Tidemann C (2006) Stream use by the Large-footed Myotis (*Myotis macropus*) in relation to environmental variables in northern New South Wales. *Australian Mammalogy* 28**,** 15-26.

ANOS (2008). Genoplsium baueri, http://www.anos.org.au/conservation/genoplsium-baueri/, Australasian Native Orchid Society

Augee M and Ford D (1999) Radio-tracking studies of Grey-headed Flying-foxes, *Pteropus poliocephalus*, from the Gordon colony, Sydney. *Proceedings of the Linnaean Society of New South Wales* 121**,** 61-70.

Barker J *et al.* (1995) 'A Field Guide to Australian Frogs.' Surrey Beatty and Sons, Sydney.

Belcher C *et al.* (2008) Spotted-tailed Quoll *Dasyurus maculatus*. Pp. 60-62 In 'The Mammals of Australia' (Eds S Van Dyck and R Strahan). Reed New Holland, Sydney.

Bell SAJ (2001) Notes on population size and habitat of the vulnerable *Cryptostylis hunteriana* (Orchidaceae) from the Central Coast of New South Wales. *Cunninghamia* 7**,** 195-204.

Benson D and McDougal L (1998) Ecology of Sydney Plant Species Part 6: Myrtaceae. *Cunninghamia* 5**,** 808-984.

Bishop T (1996) 'Field Guide to the Orchids of New South Wales and Victoria.' UNSW Press, Sydney.

Boehm EF (1944) The Fork-tailed Swift in South Australia. *South Australian Ornithology* 15**,** 54-58.

Braithwaite RW (1995) Southern Brown Bandicoot. Pp. 176-177 In 'The Mammals of Australia' (Ed. R Strahan). Reed New Holland, Sydney.

Churchill S (1998) 'Australian Bats.' Reed New Holland, Sydney.

Churchill S (2008) 'Australian Bats. Second Edition.' Allen & Unwin, Sydney.

Claridge A *et al.* (2007) 'Bettongs, Potoroos and the Musky Rat-kangaroo.' CSIRO Publishing, Melbourne.

Daly G (1996) Observations of the Eastern Owl Frog *Helioporous australiacus* (Anura: Myobatrachidae) in Southern NSW. *Herpetofauna* 26**,** 33-42.

Debus S and Chafer C (1994a) The Powerful Owl *Ninox strenua* in New South Wales. *Australian Birds* 28**,** 21-39.

Debus S and Chafer C (1994b) The Sooty Owl, *Tyto tenebricosa* & Powerful Owl, *Ninox strenua* in NSW. *Australian Birds* 28 Supplement**,** 2.

DEC (2004). Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10544, Department of Environment and Conservation

DEC (2005a). Apatophyllum constablei - Threatened Species Profile, http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10058,

DEC (2005b). Barking Owl: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10561, Department of Environment and Conservation

DEC (2005c). Black Bittern: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10441,

DEC (2005d). *Cryptostylis hunteriana* - Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10187, Department of Environment and Conservation

DEC (2005e). Eastern Pygmy-possum: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10155, Department of Environment and Conservation

DEC (2005f). Eucalyptus langleyi - Threatened Species Profile, http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10298,

DEC (2005g). *Genoplesium baueri* - Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10875, Department of Environment and Conservation

DEC (2005h). Greater Broad-nosed Bat: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10748, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10748

DEC (2005i). Green and Golden Bell Frog: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10483, Department of Environment and Conservation

DEC (2005j). Koala: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10616, Department of Environment and Conservation

DEC (2005k). Large-footed Myotis: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10549, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10549

DEC (2005l). Long-nosed Potoroo: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10662, Department of Environment and Conservation

DEC (2005m). Masked Owl: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10820, Department of Environment and Conservation

DEC (2005n). Melaleuca biconvexa - Threatened Species Profile, http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10514,

DEC (2005o). *Melaleuca deanei* - Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10515, Department of Environment and Conservation

DEC (2005p). Powerful Owl: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10562, Department of Environment and Conservation

DEC (2005q). Pterostylis gibbosa - Threatened Species Profile, http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10701,

DEC (2005r). Regent Honeyeater: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10841, Department of Environment and Conservation (NSW)

DEC (2005s). Smoky Mouse *Psedomys fumeus* - Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10686, Department of Environment and Conservation

DEC (2005t). Solanum celatum - Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10761,

DEC (2005u). Sooty Owl: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10821, Department of Environment and Conservation

DEC (2005v). Southern Brown Bandicoot (eastern) Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10439, Department of Environment and Conservation

DEC (2005w). Square-tailed Kite: Threatened Species Profiles, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10495, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10495

DEC (2005x). Swift Parrot: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10455, Department of Environment and Conservation

DEC (2005y). *Syzygium paniculatum* - Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10794, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10794

DEC (2005z). *Thesium australe* - Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10802, Department of Environment and Conservation

DEC (2005{). Threatened Species Profile, *Cynanchum elegans*, http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10196, Department of Environment and Climate Change and Water

DEC (2005|). Threatened Species Profile, Pterostylis saxicola, http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10705, http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10705

DEC (2005}). *Triplarina nowraensis* - Threatened Species Profile, http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10813, Department of Environment and Climate Change and Water

DEC (2005~). Yellow-bellied Sheathtail-bat: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10741, Department of Environment and Conservation

DEC (2005). *Zieria baeuerlenii* - Threatened Species Profile, http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10850, Department of Environment and Climate Change and Water

DECC (2005a). Australasian Bittern: Threatened Species Profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10105, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10105

DECC (2005b) 'Environmental Impact Assessment Guidelines, *Melaleuca deanei*.' NSW Department of of Environment and Climate Change.

DECC (2007). Orange-bellied parrot - critically endangered species, http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Psittacidae_critically_endangered_species, Department of Environment and Climate Change

DECCW (2005). Pink Robin *Petroica rodingaster* - Threatened species profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10607, Department of Environment, Climate Change and Water

DECCW (2009). Draft National Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*), http://www.environment.gov.au/biodiversity/threatened/publications/recovery/pubs/pteropus-poliocephalus.pdf, Prepared for Department of Environment, Water, Heritage and the Arts

DEH (2005). Litoria littlejohni in Species Profile,

DEW (2007). Litoria littlejohni - Littlejohn's Tree Frog, Heath Frog: Species Profile and Threats Database, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64733,

DEWHA (2007). *Melaleuca deanei* - Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on Amendments to the List of Threatened Species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), http://www.environment.gov.au/biodiversity/threatened/species/m-deanei.html#conservation, Department of Environment, Water, Heritage and the Arts

DEWHA (2008a). Approved Conservation Advice for Cryptostylis hunteriana (Leafless Tongue-orchid), http://www.environment.gov.au/biodiversity/threatened/species/pubs/19533-conservation-advice.pdf, Department of Environment, Water, Heritage and the Arts

DEWHA (2008b). *Zieria tuberculata* (Warty Zieria) in Species Profile and Threats Database, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=56736, Department of Environment, Water, Heritage and the Arts

DEWHA (2009a) 'Matters of National Environmental Significance Significant impact guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999*.' Department of the Environment, Water, Heritage and the Arts, Canberra.

DEWHA (2009b) 'Matters of National Environmental Significance: Significant Impact Guidelines 1.1.' Commonwealth of Australia, Canberra.

DEWHA (2010). *Pterostylis sp. Flat Rock Creek (D.L.Jones 15873 & K.J.Fitzgerald)* in Species Profile and Threats Database, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=81967, Department of the Environment, Water, Heritage and the Arts

Dickman CR and Read DG (1992) 'The biology & management of dasyurids of the arid zone in NSW.' NPWS, NSW, No. 11.

DoP (1995). State Environmental Planning policy no 44 - Koala Habitat Protection, http://www.legislation.nsw.gov.au/viewtop/inforce/epi+5+1995+FIRST+0+N/?fullquery=(((%22state%22%20AND%20%22environmental%22%20AND%20%22planning%22%20AND%20%22policy%22))), Department of Planning

DWE (2008) 'Guidelines for controlled activities - Riparian Corridors.' NSW Government, Department of Water and Energy.

Eby P (1991) Seasonal movements of Grey-headed Flying-foxes *Pteropus poliocephalus* from two maternity camps in northern New South Wales. *Wildlife Research* 18**,** 547-559.

Eby P (1995) 'The biology and management of flying-foxes in NSW; species management report.' NPWS, No. 18, Hurstville.

Edgar R and Belcher C (1995) Spotted-tailed Quoll. Pp. 67-68 In 'The Mammals of Australia' (Ed. R Strahan). Reed New Holland, Sydney.

Eldridge MDB and Close RL (1995) Brush-tailed Rock-wallaby. Pp. 383-385 In 'The Mammals of Australia' (Ed. R Strahan). Reed New Holland, Sydney.

Forshaw JM and Cooper WT (1981) 'Australian Parrots (2nd Ed).' Lansdowne Press, Melbourne.

Garnett S (1992) 'Threatened and Extinct Birds of Australia.' York Press, Richmond.

Gibbons P and Lindenmayer DB (1997) Conserving Hollow-dependent Fauna in Timber Production Forest. *Environmental Heritage Monograph* 3**,** 110.

Goldingay R (2008) Yellow-bellied Glider *Petaurus australis*. Pp. 228-230 In 'The Mammals of Australia' (Eds S Van Dyck and R Strahan). Reed New Holland, Sydney.

Harden G (1991) 'Flora of New South Wales Volume 2.' NSW University Press, Kensington.

Harden G (1993) 'Flora of New South Wales Volume 4.' NSW University Press, Kensington.

Harris JM, Goldingay RL, Broome L, Craven P, and Maloney KS (2007) Aspects of the ecology of the Eastern Pygmy-possum *Cercartetus nanus* at Jervis Bay, New South Wales. *Australian Mammalogy* 29**,** 39-46.

Higgins PJ (1999) 'Handbook of Australian, New Zealand and Antarctic Birds. Volume 4: Parrots to Dollarbird.' Oxford University Press, Melbourne.

Higgins PJ and Peter JM (2002) 'Handbook of Australian, New Zealand & Antarctic Birds. Volume 6: Pardalotes to shrike -thrushes.' Oxford University Press, Victoria.

Hoye GA and Hall LS (2008) Eastern Bent-winged Bat: *Miniopterus schreibersii oceanensis*. Pp. 507-508 In 'The Mammals of Australia' (Eds S Van Dyck and R Strahan). Reed New Holland, Sydney.

Hoye GA *et al.* (2008) East-coast Free-tailed Bat *Mormopterus norfolkensis*. Pp. 491-492 In 'The Mammals of Australia' (Eds S van dyck and R Strahan). Reed New Holland, Sydney.

Hoye GA and Schulz M (2008) Large-eared Pied Bat: *Chalinolobus dwyeri*. Pp. 531-532 In 'The Mammals of Australia' (Eds S Van Dyck and R Strahan). Reed New Holland, Sydney.

James T *et al.* (1999) 'Rare Bushland Plants of Western Sydney.' Royal Botantical Gardens,

Johnston PG (2008) Long-nosed Potoroo *Potorous tridactylus*. Pp. 302-304 In 'The Mammals of Australia' (Eds S Van Dyck and R Strahan). Reed New Holland, Sydney.

Law BS *et al.* (2008) Eastern False Pipistrelle *Falsistrellus tasmaniensis*. Pp. 542-543 In 'Mammals of Australia' (Eds S Van Dyck and R Strahan). Reed New Holland, Sydney.

Lee AK (1995) 'The Action Plan for Australian Rodents.' Australian Nature Conservation Agency, No. Project Number 130.

Marchant S and Higgins PJ (1990) 'Handbook of Australian, New Zealand and Antarctic Birds. Volume 1 Ratites to Ducks: Part B Australian Pelican to Ducks.' Oxford University Press, Melbourne.

Marchant S and Higgins PJ (1993) 'Handbook of Australian, New Zealand and Antactic Birds. Volume 2 Raptors to Lapwings.' Oxford University Press, Melbourne.

Martin RW *et al.* (2008) Koala *Phascolarctos cinereus*. Pp. 198-201 In 'The Mammals of Australia' (Eds S Van Dyck and R Strahan). Reed New Holland, Sydney.

Maxwell S, Burbidge AA, and Morris K (1996a) 'The Action Plan for Australian Masupials and Monotremes.' Australian Marsupial and Monotremes Specialist Group, IUCN Survival Commission, Environment Australia Endangered Species Program No. 500, Canberra.

Maxwell S, Burbidge A, and Morris K (1996b) 'The 1996 Action Plan for Australian Marsupials and Monotremes.' National Parks and Wildlife, Canberra.

Menkhorst PW and Lumsden LF (1995) Eastern False Pipistrelle.In 'Mammals of Victoria' (Ed. PW Menkhorst). Oxford University Press, Melbourne.

Morcombe M (2003) 'Field Guide to Australian Birds.' Steve Parish Publishing, Brisbane.

Morcombe M (2006) 'Field Guide to Australian Birds.' Steve Parish Publishing, Brisbane.

NPWS (1999a). Australasian Bittern: Threatened Species Information, http://www.nationalparks.nsw.gov.au/PDFs/tsprofile_australasian_bittern.pdf , NSW National Parks and Wildlife Service

NPWS (1999b). Black Bittern: Threatened Species Information, http://www.nationalparks.nsw.gov.au/PDFs/tsprofile_black_bittern.pdf, NSW National Parks and Wildlife Service

NPWS (1999c). Glossy Black Cockatoo: Threatened Species Information, http://www2.nationalparks.nsw.gov.au/PDFs/tsprofile_glossy_black_cockatoo.pdf, NSW National Parks and Wildlife Service

NPWS (1999d). Greater Sand Plover: Threatened Species Information, http://www.environment.nsw.gov.au/resources/nature/tsprofileGreaterSandPlover.pdf, NSW National Parks and Wildlife Service

NPWS (1999e). Green and Golden Bell Frog: Threatened Species Information, http://www.nationalparks.nsw.gov.au/PDFs/tsprofile_green_golden_bell_frog.pdf, National Parks and Wildlife Service

NPWS (1999f) 'Lesser Sand Plover: Threatened Species Information.' NPWS, Hurstville.

NPWS (1999g). Regent Honeyeater: Threatened Species Information, http://www.nationalparks.nsw.gov.au/PDFs/tsprofile_regent_honeyeater.pdf, NSW National Parks and Wildlife Service

NPWS (1999h). Spotted-tailed Quoll: Threatened Species Information, http://www.nationalparks.nsw.gov.au/PDFs/tsprofile_spotted_tailed_quoll.pdf, New South Wales National Parks and Wildlife Service

NPWS (1999i). Threatened Species Information; Square-tailed Kite, http://www2.nationalparks.nsw.gov.au/PDFs/tsprofile_squaretailed_kite.pdf, NSW National Parks and Wildlife Service

NPWS (1999j). Yellow-bellied Glider: Threatened Species Information, http://www2.nationalparks.nsw.gov.au/PDFs/tsprofile_yellowbellied_glider.pdf, NSW National Parks and Wildlife Service

NPWS (2002) '*Pterostylis gibbosa (R.Br.) Illawarra Greenhood Orchid Recovery Plan.*' NSW National Parks and Wildlife Service, Hurstville.

NPWS (2003). *Acacia pubescens*: Threatened Species Information, http://www.environment.nsw.gov.au/resources/nature/tsprofileAcaciaPubescens.pdf, NSW National Parks and Wildlife Service

NSW Government (2009). BioNet, http://www.bionet.nsw.gov.au/Area.cfm , NSW Government

NSW NPWS (2000) '*Draft NSW and National Recovery Plan for the Nowra Heath-myrtle (Triplarina nowraensis).*' NSW National Park Wildlife Service, Hurstville NSW.

NSW NPWS (2002). Recommendation for the Identification of Critical Habitat for the Bomaderry Zieria (*Zieria baeuerlenii*), http://www.environment.nsw.gov.au/resources/nature/bomaderryZieriaDraftRecommendation.pdf, NSW National Parks and Wildlife Service

NSW Scientific Committee (2000) 'Final determination to list Litoria littlejohnii (Littlejohn's Tree Frog) as a Vulnerable species under the TSC Act.' NSW Scientific Committee, Hurstville.

NSW Scientific Committee (2008). Little Lorikeet *Glossopsitta pusilla* - proposed vulnerable species listing, http://www.environment.nsw.gov.au/determinations/littlelorikeetpd.htm, http://www.environment.nsw.gov.au/determinations/littlelorikeetpd.htm

NSW Scientific Committee (2010). Varied Sittella *Daphoenositta chrysoptera* - Final Determination of proposed vulnerable species listing, http://www.environment.nsw.gov.au/determinations/variedsittellaFD.htm, Department of Environment, Climate Change and Water

OBPRT (1998) 'Orange-bellied Parrot Recovery Plan 1998-2002.' Orange-bellied Parrot Recovery Team. Parks and Wildlife Service, Hobart.

Penman T, Lemckert F, Slade C, and Mahony M (2005) Non-breeding habitat requirements of the giant burrowing frog, Heleioporus australiacus (Anura: Myobatrachidae) in south-eastern Australia. *Australian Zoologist* 33**,** 251-257.

Penman TD, Lemckert FL, and Mahony MJ (2008) Spatial ecology of the giant burrowing frog (*Heleioporus australiacus*): implications for conservation prescriptions. *Australian Journal of Zoology* 56**,** 179-186.

Pennay M (2008) A maternity roost of the Large-eared Pied Bat *Chalinolobus dwyeri* (Ryan) (Microchiroptera: Vespertilionidae) in central New South Wales Australia. *Australian Zoologist* 34**,** 564-569.

Pizzey G and Knight F (1997) 'The Field Guide to the Birds of Australia.' Angus and Robertson, Sydney.

Recsei J (1996) Eastern Owl Frog, *Heleioporus australiacus*. Pp. 55-64 In 'Threatened Frogs of New South Wales: Habitats, Status and Conservation.' (Ed. H Ehmann). Frog and Tadpole Study Group of NSW, Sydney South.

Richards GC (2008) Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris*. Pp. 472-473 In 'Mammals of Australia' (Eds S Van Dyck and R Strahan). Reed New Holland, Sydney.

Richards GC *et al.* (2008) Large-footed Myotis: *Myotis macropus*. Pp. 544-545 In 'The Mammals of Australia' (Eds S Van Dyck and R Strahan). Reed New Holland, Sydney.

SCC (2004) 'Shoalhaven City Council SOE maps.' Shoalhaven City Council, http://gis.shoalhaven.nsw.gov.au/soemaps.

SCC (2006) 'Shoalhaven City Council State of Environment Report. Vegetatation Diversity 2006.' Shoalhaven City Council, http://www.shoalhaven.nsw.gov.au.

Shields J and Crome F (1992) 'Parrots and Pigeons of Australia.' Angus and Robertson, Sydney.

Simpson K and Day N (1996) 'Field guide to the birds of Australia.' Viking. Penguin Books Australia Ltd., Ringwood.

Strahan R (1995) 'The Mammals of Australia.' Reed Books, Chatswood.

Threatened Species Scientific Committee (2008). *Commonwealth Listing Advice on* Thelymitra sp. Kangaloon (D.L.Jones 18108), http://www.environment.gov.au/biodiversity/threatened/species/pubs/81971-listing-advice.pdf, Department of the Environment, Water, Heritage and the Arts

Tidemann CR (1995) Grey-headed Flying-fox. Pp. 439-440 In 'The Mammals of Australia' (Ed. R Strahan). Reed New Holland, Sydney.

Tozer MGTKSCKDABPMBTD&PC (2006) 'Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. Version 1.0.'.

Turner LM and Erskine WD (1997) Thermal, oxygen and salt stratification in three weir pools on the Nepean River, NSW.In 'Proceedings of Science and Technology in the Environmental Management of the Hawkesbury-Nepean Catchment' (Eds S Riley, W Erskine, and S Shrestha). Institution of Engineers Australia National Conference NCP 91/01; Geographical Society of NSW Conference Papers No. 14.,

Turner V and Ward SJ (1995) Eastern Pygmy-possum. Pp. 217-218 In 'The Mammals of Australia' (Ed. R Strahan). Reed New Holland, Sydney.

van dyck S and Strahan R (2008) 'The Mammals of Australia Third Edition.' Reed New Holland, Sydney.

Ward SJ (1990) Life history of the eastern pygmy possum, *Cercartetus nanus* (Burramyidae, Marsupialia) in south-eastern Australia. *Australian Journal of Zoology* 38**,** 287-304.

Ward SJ and Turner V (2008) Eastern Pygmy-possum *Cercartetus nanus*. Pp. 219-221 In 'The Mammals of Australia' (Eds S van dyck and R Strahan). Reed New Holland, Sydney.

Webb JK (1996) Ecology and Conservation of the Threatened Broad-headed Snake *Hoplocephalus bungaroides*.PhD Dissertation,' University of Sydney.

Webb JK and Shine R (1998) Ecological characteristic of an endangered snake species *Hoplocephalus bungeroides* (Sepentes: Elapidae). *Animal Conservation* 1**,** 185-193.

White AW and Pyke GH (1996) Distribution and conservation status of the Green and Golden Bell Frog *Litoria aurea* in New South Wales. *Australian Zoologist* 30**,** 177-189.