Ecological Constraints and Opportunities Assessment

Speers Point Quarry, Speers Point

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Disclaimers

Executive Summary

RPS Australia East Pty Ltd (RPS) was commissioned by Lake Macquarie City Council to prepare a Local Environmental Study (LEP) for the old Speers Point Quarry site. This report provides an ecological constraints assessment of the quarry site to cover potential rezoning of the site for mixed uses, potentially including industrial, residential, conservation and commercial zones.

Five vegetation communities were identified across the site, including one Endangered Ecological Community (EEC). The communities were Coastal Foothills Spotted Gum – Ironbark Forest (the dominant forest type on the site), Coastal Narrabeen Moist Forest, Coastal Wet Gully Forest (an EEC covering 3.97 ha of the site), Wetlands and Disturbed Lands. No threatened flora species were identified during field surveys. Potentially suitable habitat was identified for four other threatened flora species, namely *Cynanchum elegans* (White-flowered Wax Plant)*, Diuris praecox* (Newcastle Doubletail), *Tetratheca juncea* (Black-eyed Susan) and *Syzygium paniculatum* (Magenta Lilly Pilly)*.*

Three threatened fauna species (listed on the *Threatened Species Conservation Act* 1995 [*TSC Act*] or *Environment Protection and Biodiversity Conservation Act 1999* [*EPBC Act*]) were identified during field surveys, namely the Grey-headed Flying-fox, Little Bentwing-bat and Common Bentwing-bat. A single migratory species (listed on the *EPBC Act*), the White-bellied Sea Eagle, was identified during field surveys. Potentially suitable habitat was identified for a further 20 threatened species listed on the *TSC Act* and a further 13 threatened and/or migratory species listed on the *EPBC Act*. While not recorded during field surveys, potential habitat exists for the threatened Squirrel Glider and combined with the presence of known populations on neighbouring properties, the Squirrel Glider is considered highly likely to occur on the site.

Potential opportunities for future development across the site are predominately restricted to the western and north-western areas of the site where the existing quarry and a large area of disturbed lands occur.

Potential opportunities for conservation across the site include the retention of all forest vegetation communities in the east and south of the site. The conservation of such areas would maintain habitat areas for local species (including the threatened Squirrel Glider), stop-over habitat for highly mobile species with the landscape and habitat areas for less mobile species within the landscape.

If the conservation of forest vegetation communities is not part of the rezoning proposal the potential constraints to the proposal include a possible significant impact on the Squirrel Glider, the need to undertaken seasonal field survey for cryptic threatened flora species, and a likely requirement of offset areas to compensate for the potential loss of areas of EEC. Further constraints and opportunities are identified in **Section 5**.

TERMS AND ABBREVIATIONS

Abbreviation	Meaning
API	Aerial Photograph Interpretation
CRZ	Core Riparian Zone
DECCW	Department of Environment, Climate Change and Water (now SEWPAC)
DEWHA	Department of Environment, Water, Heritage and Arts
DoP	Department of Planning
DWE	Department of Water and Energy
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
LGA	Local Government Area
LHCCREMS	Lower Hunter and Central Coast Regional Environment Management Strategy Vegetation Survey, Classification and Mapping; Lower Hunter and Central Coast Region
LMCC	Lake Macquarie City Council
NPWS	National Parks and Wildlife Service
ROTAP	Rare or Threatened Australian Plants
RPS	RPS Australia East Pty Ltd
SAT	Spot Assessment Technique
SEPP 14	State Environmental Planning Policy No. 14
SEPP 44	State Environmental Planning Policy No. 44
SEPP 71	State Environmental Planning Policy No. 71
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities (previously DEWHA)
TSC Act	*Threatened Species Conservation Act 1995*
VB	Vegetation Buffer
VMP	Vegetation Management Plan
WM Act 2000	*Water Management Act 2000*

Contents

Figures

Tables

Appendices

1 Introduction

1.1 Background

RPS Australia East Pty Ltd (RPS) has been commissioned by Lake Macquarie City Council to prepare a Local Environmental Study (LEP) for the old Speers Point Quarry, hereafter to be known as the site. The proposal is to cover rezoning of the site for mixed uses, potentially including industrial, residential, conservation and commercial zones. The site includes Lot 21 DP 790637, Lot 1 DP 557315, Lot 1 DP 321254, Lot 1 210440, and Lots 1 and 2 DP 105845. The Ecological Constraints and Opportunities Assessment has been prepared in accordance with Lake Macquarie Flora and Fauna Survey Guidelines (2001). The old Speers Point Quarry is located between the suburbs of Boolaroo and Lakelands, at the northern end of Lake Macquarie (**Figure 1-1**).

1.2 Site Particulars

Locality – The old Speers Point Quarry occurs along the eastern boundary of the suburb of Boolaroo and extends approximately 1.2km east towards the suburbs of Macquarie Hills and Lakelands.

LGA – Lake Macquarie City Council.

Titles – Lot 21 DP 790637, Lot 1 DP 557315, Lot 1 DP 321254, Lot 1 210440, and Lots 1 and 2 DP 105845.

Area – The site comprises an area of approximately 79.4 hectares.

Zoning – A mixture of 4(1) Industrial (Core), 7(2) Conservation (Secondary), and 1(1) Rural (Production).

Boundaries – The site is bounded by private residences and properties in the east from Macquarie Hills to Speers Point coming off Fairfax Rd. To the west is bounded by private residences from First St. through to Farm St., to the south is bounded by private residences off Thompson Rd. The northern boundary is a rail corridor and industrial estate coming off Munibung and Mitchell Rd's.

Current Land Use – The site is currently disused, and was used for a gravel quarry. The associated lands are vacant land containing disturbed areas of forest and grassy woodland.

TITLE: FIGURE 1-1 SITE LOCATION MAP | LOCATION: SPEERS POINT | DATUM: DATUM | PROJECTION: MGA ZONE 56 (GDA 94) | DATE: 5/7/2010 | PURPOSE: REPORT FIGURE | LAYOUT REF: J:\JOBS\26K\26292 -Speers Point \10- Drafting\MapInfo\Report Figures\26292 Figure 1-1 Site Location Map A-A4 270110.wor | VERSION (PLAN BY): A-A4 (SC/SC)

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JOB REF: 26292

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Topography – The site is located on the south-western slopes of Munibung Hill ranging in altitude from 30m ADSL to 140m ADSL. Slopes are predominately moderate however some steep slopes occur, particularly around Munibung Hill. Numerous drainage lines and gullies traverse the site.

Soils and Geology – Three soil types comprise the site (Matthei 1995). The central pit areas are mapped as disturbed highly variable soils. The surrounding soils down to an approximate elevation of 80m to 100m ADSL are Stockrington Soil Landscapes, characterised by moderately deep to deep rapidly drained Earthy Loams and Friable Loams on upper slopes, with deep well drained Red Podzolic Soils, red Soloths, brown Soloths, and yellow Soloths on midslopes and benches. Soils below approximately 100m ADSL are Cedar Hill Soil Landscapes, characterised by moderately deep to deep, well to imperfectly drained Brown Podzolic Soils and Yellow Podzolic Soils, some deep well-drained Non-calic Groan Soils and moderately deep, well-drained Structured Loams.

The geology of the site is part of the Newcastle Coal Field and is characterised by areas of conglomerate, sandstone, tuff, shale and coal (Department of Mines 1966).

1.3 Description of the Proposal

The existing quarry, comprising two main pit areas, ceased operation in 2007. Lake Macquarie City Council (LMCC) is considering alternative land uses of the site. Such alternative uses include a wide range of sustainable uses capable of meeting the needs of the community for housing, access to services and facilities, as well as maintaining ecological valuable land, and links between conservation areas.

1.4 Scope of the Study

The scope of this ecological constraints assessment report is to:

- Provide a literature review of local threatened flora and fauna species records that have been recorded on the site and in the local area.
- Identify vascular plant species found on the site;
- Identify the potential habitat value for targeted threatened cryptic flora species and if found on-site, map the distribution of species such as;
  - *Tetratheca juncea*
  - *Cryptostylis hunteriana*
  - *Diuris praecox*

- Identify and map existing vegetation communities;
- Assess the status of identified plant species and vegetation communities under relevant legislation;
- Identify existing habitat types on the site and assess the habitat potential for threatened species, populations, or ecological communities known from the proximate area;
- Identify threatened and/or migratory fauna potentially using the site;
- Identify the landscape and regional scale biodiversity value of the site;
- Provide advice on the potential constraints of any proposals on any threatened species, populations or ecological communities listed within the TSC Act, should the proposal advance beyond an ecological constraints and opportunities assessment.
- Provide advice on the potential opportunities for the conservation of threatened species, populations or ecological communities as part of any future development proposal on the site.

The purpose of this report is to:

- Ensure planning, management and development decisions are based on sound scientific information and advice by documenting the presence of any biodiversity components or potential significant impacts that may exist on the site;
- Provide information to facilitate future compliance with applicable assessment requirements contained within the *TSC Act*, *EP&A Act*, the *Commonwealth EPBC Act*, and any other relevant state, regional and local environmental planning instruments; and
- Enable the provision and analysis of ecological data that is comparable with data for other sites within the region to ensure continuity and consistency for survey and results.

1.5 Qualifications and Licensing

1.5.1 Qualifications

This report was written by Toby Lambert (BEnvSc), Steven Cox (BAppSc (Hons)), Robert Sansom (BSc (Hons)) and Shaun Corry of RPS. The academic qualifications and professional experience of all involved RPS staff is documented in **Appendix 4**.

1.5.2 Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2011);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2011);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2011).

1.6 Certification

As the principal author, I, Toby Lambert, make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the site;
- Commonwealth, state and local government policies and guidelines formed the basis of project surveying methodology, or where the survey work has been undertaken with specified departures from industry standard guidelines, details of which are discussed and justified in **Section 2**; and

Principal Author and Certifier:

Toby Lambert,
RPS Australia East Pty Ltd
February 2011

2 Methodology

A variety of techniques were employed over the course of desktop and fieldwork to describe, record and assess the potential constraints and opportunities associated with the proposal upon fauna and flora communities and their habitats present and potentially present on the site.

Survey and reporting for this assessment has been undertaken to address the requirements of the Lake Macquarie Flora and Fauna Survey Guidelines (2001).

2.1 Desktop Assessment

Assessments drew on a number of information sources including previous reporting by RPS in this locality and information held on government databases and archives.

Data gathered during preliminary assessments was used to assist in identifying distributions, suitable habitats and known records of threatened species so that field investigations could more efficiently focus survey effort. Assessment information sources included:

1. Aerial Photograph Interpretation (API) and literature reviews to determine the broad categorisation of vegetation within the site;
2. Review of fauna and flora records contained in the DECCW Atlas of NSW Wildlife (DECCW 2009);
3. DEWHA *EPBC Act* Protected Matters Search (DEWHA 2009);
4. Review of the Draft Natural Vegetation of the Lake Macquarie Government Area, NSW (Bell, 2009);
5. Review of previous and local ecological assessments of relevance to the site;
6. A review of GIS data including (but not limited to) aerial photography, topographic maps, SEPP 14 Wetland Mapping, Soil Landscapes, Acid Sulphate Soil Potential;
7. Review of the Department of Conservation and Land Management - Soil Landscapes of the Newcastle 1:100,000 Sheet (Matthei, 1995);
8. Department of Environment and Climate Change (DECCW) database of Threatened Species, Populations and Ecological Communities (website); and
9. Collective knowledge gained from extensive work in the local area.

2.2 Consultation

Lake Macquarie City Council staff members were contacted to provide background material for the preparation of this report. Thanks to Lucy Larkins (Strategic Planner) and Robbie Economos (Environmental Planner) for providing background material, strategic/environmental advice and comment on the proposed rezoning flora and fauna assessment.

2.3 Flora / Vegetation Survey

A flora field survey was undertaken from 16 to 18 December 2009 and 4 to 8 January 2010. Assessment of the flora/vegetation at the site is as follows:

- Aerial Photograph Interpretation (API) to map the community(s) extent into definable map units;
- Review of the Natural vegetation of the Lake Macquarie Government Area, NSW (Bell, 2009);
- Confirmation of the community type(s) present (dominant species) via undertaking flora surveys and plant identification, with emphasis on particularly significant or threatened species;
- Twelve 20 x 20 metre quadrats were undertaken within the site (**Figure 2-1**). Quadrat locations were selected to delineate vegetation communities and create a thorough species list;
- Random meanders were utilised across the entire site to identify plant species present. Random meanders further delineated vegetation boundaries and targeted potential threatened species habitat areas;
- Consideration was given to the potential for the derived vegetation communities to constitute EECs as listed within the *TSC Act*;
- Flora surveys were carried out across the site, with an emphasis on potentially significant species, as outlined below. The general flora survey also included the casual consideration of the site in line with methodology such as the “Random Meander Technique” described by Cropper (1993); and
- Map the type and general extent of the vegetation communities present and to classify them into definable map units where appropriate.

TITLE: FIGURE 2-1
FLORA SURVEY EFFORT

LOCATION: SPEERS POINT

DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 1/7/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: 26292 Figure 2-1 Flora Survey Effort A-A4.wor
VERSION (PLAN BY): A-A3 (S.C)

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Floristic Structure

Vegetation structure was determined based on methodology described by Specht *et al,* (1995) by estimation of the height and Projected Canopy Cover (PFC) within each stratum present. Individual taxon data for each quadrat was recorded using proformas based on NPWS species data forms. Species abundances were recorded utilising a modified Braun-Blanquet (1982) cover abundance six ranking scale (**Table 2-1**) as follows:

Table 2-1: Braun-Blanquet Projected Canopy Cover Scale

Cover Code	Projected Canopy Cover
1	<5% and uncommon
2	<5% and common
3	5-25% cover
4	26-50% cover
5	51-75% cover
6	76-100% cover

Significant Flora Survey

A list of potentially occurring significant flora species from the locality (10km radius) was compiled, which included threatened species (Endangered or Vulnerable) and EECs listed under the *TSC Act*, those species listed under the *EPBC Act*, Rare or Threatened Australian Plants (ROTAP) listed flora species (Briggs and Leigh 1996). Any such species identified were considered for potential occurrence, and where appropriate targeted surveys were undertaken throughout the site.

Targeted survey was undertaken for *Angophora inopina* and focused on the northern portions of the site (especially near the old water tank in the north-western corner of the site). *Angophora inopina* is known to occur within 600m of the northern boundary of the site. All potential habitat areas in the northern parts of the site were searched for the species. In addition, all other surveys within other parts of the site were utilised to opportunistically search for *A. inopina*.

The timing of the flora surveys in mid-December and early January allowed for specific targeted seasonal surveys to occur for other threatened species recorded in the locality such as *Cryptostylis hunteriana* and *Tetratheca juncea.* Other known species from the locality can be surveyed at any time, except for *Diuris praecox*.

2.4 Fauna Survey

A list of potentially occurring significant fauna species from the locality (10km radius) was compiled, which included threatened species (Endangered or Vulnerable) under the *TSC Act* and/or listed under the *EPBC Act,* as well as any other species considered to be of local importance. The fauna survey methodology was then designed to sample those threatened and/or locally important species using the Lake Macquarie Flora and Fauna Survey Guidelines (2001). The requirements of the guidelines were tailored to the quantity and quality of habitat types for fauna species on the site.

Fauna survey was undertaken from 16 to 18 December 2009 and 4 to 8 January 2010. An additional site inspection was undertaken on 28 April 2010 to further investigate the suitability of the wetlands and quarries to provide habitat for threatened species.

Habitat Survey

An assessment of the relative habitat value present on site was undertaken. This assessment focused primarily on the identification of specific habitat types and resources on the site favoured by known threatened species from the region. The assessment also considered the potential value of the site (and surrounds) for all major guilds of native flora and fauna.

Habitat assessment was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

The general density of hollow bearing trees throughout the site was also identified.

Following the completion of the main field surveys, a site inspection was undertaken on 28 March 2010 to further investigate the suitability of the wetlands and quarries to provide habitat for threatened species.

Trapping

Four trap lines were established across the site, sampling the representative habitat areas (**Figure 2-2**). Two trap lines comprised of 25 terrestrial Elliott A traps, 5 terrestrial Elliott B traps, 5 arboreal Elliott B traps and a single cage trap. The two remaining trap lines did not contain cage traps but otherwise the same survey effort. All Elliott and cage traps were set for four nights. A single harp trap was set at a single site for four consecutive nights.

Avifauna Survey

Bird surveys were undertaken on each of the three mornings for 30min at each of the four trapping sites. A total of 6 person hours of targeted bird surveys were completed. Opportunistic recording of bird species was undertaken during all other activities and added to the total bird survey level of effort.

Spotlighting Survey

Spotlighting was undertaken over two nights with each spotlighting transect traversed on foot each night by two people with 100-Watt hand-held spotlights and head torches, resulting in a total of seven person hours of spotlighting undertaken within the site. Priority was given to those areas that were deemed most likely to contain nocturnal species, particularly arboreal and terrestrial mammals. Locations of spotlight transects are shown in **Figure 2-2**.

Herpetofauna Survey

Targeted and opportunistic amphibian and reptile searches were conducted during fauna surveys. Nocturnal amphibian and reptile searches were undertaken during two separate nights. Nocturnal amphibian and reptile searches were undertaken around the existing wetlands within the site over two consecutive nights for one hour each night (**Figure 2-2**). A total of four person hours of nocturnal reptile and amphibian searches were undertaken.

Diurnal reptile and amphibian searches were undertaken at each of the four trapping sites on each of three days. At total of six person hours of diurnal reptile and amphibian searches were completed. An additional one person hour of diurnal amphibian searches was undertaken during March 2010 across five wetlands within the site.

Call Playback

Pre-recorded calls of owl species with the potential to occur on the site were broadcast in an effort to elicit vocal responses from the owls or to attract an owl to the playback site. The calls were broadcast through an amplification system design to project the sound for at least 1km under still night conditions. As described by Kavanagh and Peake (1993) the call of each species was broadcast for at least five minutes, followed by five minutes of listening, and stationary spotlighting. Following the final broadcast and listening, the area was spotlighted on foot. The call playback location was selected in an area where calls could be broadcast across the entire site (**Figure 2-2**).

A total of four call playback sessions were undertaken, across two sites on two consecutive nights. During each session the calls of the Powerful Owl, Masked Owl, Barking Owl and Sooty Owl were broadcast.

Ball Call Survey

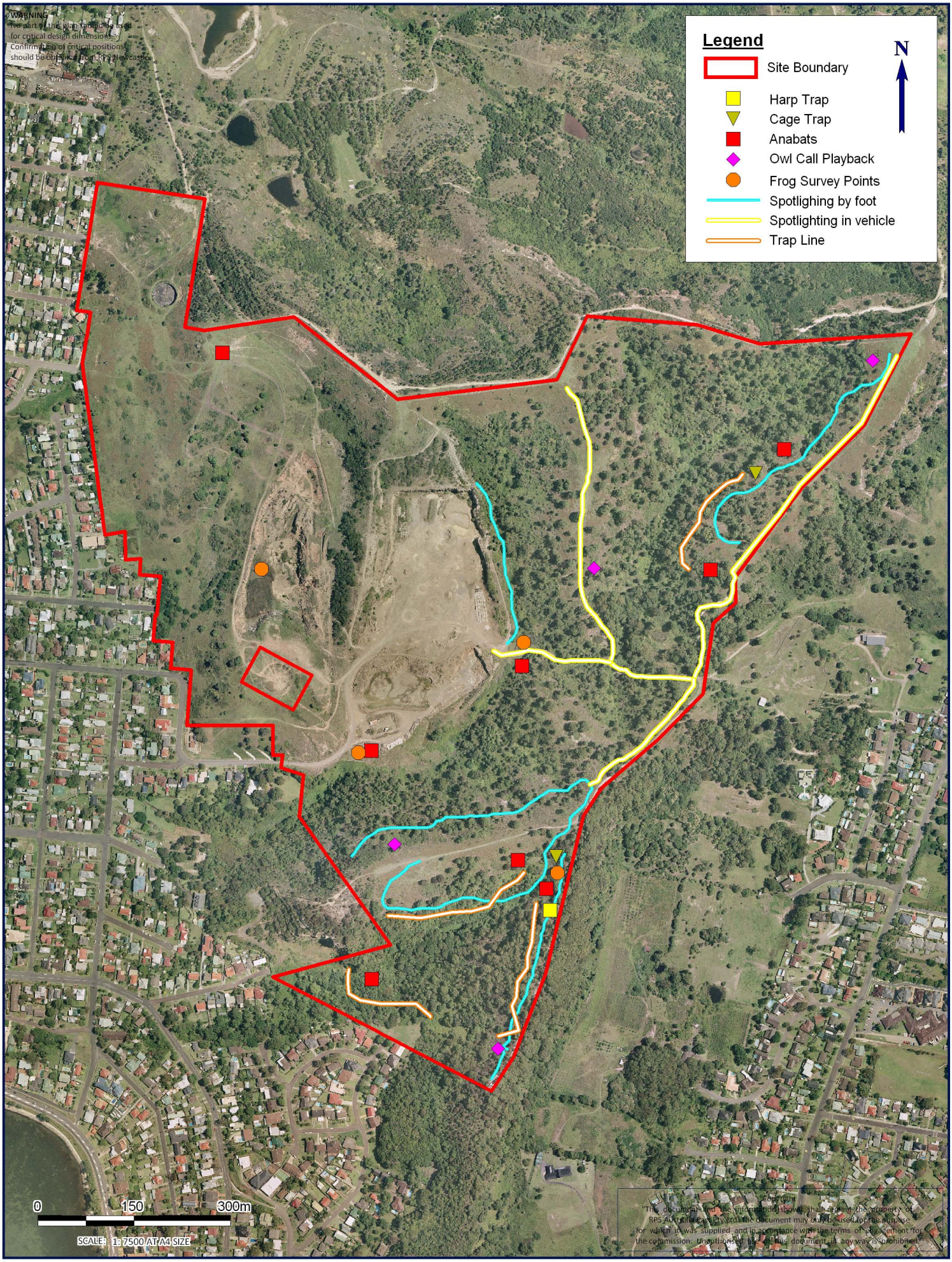
Anabat II Bat Detector and CF ZCAIM were used to record bat echolocation calls. Two Anabats were placed within the site over night for four nights each to record any micro-chiropteran activity (**Figure 2-2**). The Anabats were positioned at different locations for each of the four nights, targeting preferred habitats including water bodies, rocky outcrops and possible flyways. The recorded calls were analysed by Anna Lloyd using “Analook” with reference to Pennay *et al.* (2004).

Secondary Indications and Incidental Observations

Opportunistic sightings of secondary indications (scratches, scats, diggings, tracks etc.) of resident fauna were noted. Such indicators included:

- Distinctive scats left by mammals.
- Scratch marks made by various types of arboreal animals;
- Nests made by various guilds of birds;
- Feeding scars on Eucalyptus trees made by Gliders;
- Whitewash, regurgitation pellets and prey remains from Owls;
- The calls of fauna;
- Skeletal material of vertebrate fauna; and
- Footprints left by mammals.

Any other incidental observations of fauna were recorded during all phases of fieldwork.



TITLE: FIGURE 2-2
FAUNA SURVEY EFFORT

LOCATION: SPEERS POINT

DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 6/7/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: 26292 Figure 2-2 Survey Location Map A-A4.wor
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2.5 Compliance with LMCC Flora and Fauna Survey Guidelines

2.5.1 Flora

During field surveys, four vegetation communities were identified on the site. Three communities comprised remnant vegetation totalling an area of 40.79 hectares. The fourth community, disturbed land, lacked remnant vegetation and comprised an area of 38.60 hectares. The flora survey effort undertaken was tailored to the amount and type of vegetation communities recorded on the site (**Table 2-2**).

Table 2-2: Lake Macquarie Flora Survey Guideline Minimum Requirements and the Level of Survey Undertaken.

Area of Land With Remnant vegetation	Activity	Minimum Survey Effort	Effort Undertaken and Comments
11 – 50 ha	Flora Survey Complex Floristic Structure	3 walking transects + 2 quadrats per community, plus 1 quadrat per community > 5 ha	Coastal Foothills Spotted Gum – Ironbark Forest (32.67 ha), 8 quadrats and 6 walking transects. Coastal Narrabeen Moist Forest (4.14 ha), 1 quadrat and 1 walking transect (most areas were inaccessible). Coastal Wet Gully Forest (3.98 ha) – 1 quadrat and 2 walking transects. Disturbed Land (38.6 ha) – 2 quadrats and 4 walking transects.

The small areas and inaccessibility of parts of Coastal Narrabeen Moist Forest and Coastal Wet Gully Forest areas negated the need for additional quadrats and walking transects.

2.5.2 Fauna

Following analysis of aerial photography and local vegetation mapping two main habitat types were identified on the site, namely forest habitats and disturbed land. Forest habitats included three forest vegetation communities (later identified by on ground vegetation mapping), Coastal Foothills Spotted Gum – Ironbark Forest (32.67 hectares), Coastal Narrabeen Moist Forest (4.14 hectares) and Coastal Wet Gully Forest (3.98 hectares). Trapping sites were positioned within or along the ecotones between vegetation communities. In many areas dense stands of lantana restricted the location of trapping sites to ecotones between vegetation communities or the boundary of forest habitat areas.

Four trapping sites were established in forest habitats across the site (**see Figure 2-2**), in areas where the density of Lantana was low enough to facilitate the setting and checking of traps. No trapping was undertaken in disturbed lands due to the lack of suitable habitat for target species.

Area search methods such as bird surveys and reptile and amphibian surveys were undertaken throughout forest habitat areas. Disturbed lands were sampled

opportunistically during movements around the site and wherever specific habitat areas occurred (e.g. dams).

The fauna survey effort undertaken was tailored to the amount and type of fauna habitats recorded on the site (**Table 2-3**).

Table 2-3: Lake Macquarie Fauna Survey Guideline Minimum Requirements and the Level of Survey Undertaken.

Fauna Group	Survey Technique	Survey Period	Survey Effort per Vegetation Type	Effort Undertaken and Comments
Birds				
Diurnal birds	Formal census	Summer and winter	1 ha. plot for 20 minutes	Forest habitats - A total of 12, 30 minute surveys were undertaken across three days totalling six person hours of survey. Disturbed Land – Sampled opportunistically
Nocturnal birds	Formal census	Summer and winter	One point census per square kilometre	Forest habitats - Spotlighting transects were undertaken on two nights, totalling seven person hours of survey. Four call playback sessions were also undertaken over two nights (once at each of four sites). Disturbed Land – Sampled opportunistically
Mammals				
Small terrestrial	Small mammal traps	All year	100 trap nights over 3-4 consecutive nights per vegetation community	Forest habitats - 400 Elliott A trap nights Disturbed Land – no suitable habitat for trapping.
Medium terrestrial	Cage/B Elliott traps	All year	100 trap nights over 3-4 consecutive nights per vegetation community	Forest habitats - 80 Elliott B trap nights Disturbed Land – no suitable habitat for trapping.
Arboreal mammals	B Elliott traps	All year	6 – 10 traps for 3 consecutive nights	Forest habitats - 80 Elliott B trap nights Disturbed Land – no suitable habitat for trapping.
	Faecal pellet counts	All year	Minimum of one plot per 1000 square metres	No suitable habitat occurred for the koala and no signs of presence were opportunistically recorded. No Faecal pellet counts were undertaken.
	Spotlighting	All year	Walking rate of 1 kilometre per hour	Forest habitats - Seven person hours of spotlighting were undertaken across treed habitat areas. Spotlighting was undertaken across two nights. Disturbed Land – Sampled opportunistically
Microchiropteran bats	Harp traps	All year	2 harp traps per night per veg community	Forest habitats - A single harp trap was set at a single location for four nights. Anabat detectors also sampled bat species. Disturbed Land – no suitable flyways for trapping.
	Echolocation call	All year	45 minute of continuous recording of call activated all night	Forest habitats - A total of five Anabat all night surveys were completed, each night at a different site. Disturbed Land – A total of three Anabat all

Fauna Group	Survey Technique	Survey Period	Survey Effort per Vegetation Type	Effort Undertaken and Comments
				night surveys were completed, each night at a different site. Two of these sites were on the interface between forest habitats and disturbed land.
Reptiles				
Diurnal searches	Habitat searches	Sept. to March	1 ha search for one person hour on 2 separate days per vegetation community	Forest habitats - A total of six person hours of diurnal searches were completed over three days, at the four trapping sites. Disturbed Land – Sampled opportunistically
Nocturnal searches	Spotlight searches	Sept. to March	Walking rate of 1 kilometre per hour on 2 separate nights	Forest habitats – A total of four person hours of nocturnal searches were completed over two nights, at the four trapping sites. Disturbed Land – Sampled Opportunistically
Specific habitats	Diurnal and nocturnal searches	Sept. to March	One person hour diurnal + one person hour per ha. nocturnal	Forest habitats - Sampled Opportunistically Disturbed Land – Sampled opportunistically
Amphibians				
Diurnal searches	Habitat searches	Sept. to March	1 hectare search for one person hour on 2 separate days per vegetation community	Forest habitats – Undertaken as part of reptile diurnal searches, of which six person hours were completed over three days at the four trapping sites. Disturbed Land – Sampled opportunistically
Nocturnal searches	Spotlight searches	Sept. to March	30 minutes on two separate nights	Forest habitats - Undertaken as part of reptile nocturnal searches, of which four person hours were completed over two days at the four trapping sites. Disturbed Land – Sampled opportunistically
	Playback of recorded calls	Sept. to March	Once on each of two separate nights	Forest habitats – Not undertaken. At the few small dams the entire waters margin was searched and call playback was unnecessary. Disturbed Land – Not undertaken.
	Specific habitat searches	Sept. to March	2 hrs per 200 metre of water body edge.	The entire margin of each water body was searched on two separate nights.

2.6 Limitations

Limitations associated with this Flora & Fauna Assessment Report are presented herewith. The limitations have been taken into account specifically in relation to threatened species assessments, results and conclusions.

In these instances, a precautionary approach has been adopted; as such 'assumed presence' of known and expected threatened species, populations and ecological communities has been made where relevant and scientifically justified to ensure a holistic assessment.

Seasonality

The flowering and fruiting plant species that attract some nomadic or migratory threatened species, often fruit or flower in cycles spanning a number of years. Furthermore, these resources might only be accessed in some areas during years when resources more accessible to threatened species fail. As a consequence threatened species may be absent from some areas where potential habitat exists for extended periods.

The seasonality of the surveys places limits on the number of flora species identified on the site as the flora surveys occurred in December and January which is outside the known flowering period for some species making them difficult to detect or make a positive identification. However it is considered that all locally known threatened seasonal flora could be adequately targeted during these periods, except for *Diuris praecox. Diuris praecox* flowers July - September. This species is considered to have moderate potential to occur on the site in the least disturbed areas of forested vegetation, which are the most likely to be conserved on the site as part of its future development. In any case habitat for this species has been substantially affected by previous land management practices such as tree removal, clearing, grazing, trampling, underscrubbing and subsequent weed invasion.

Data Availability and Accuracy

The collated threatened flora and fauna species records provided by the DECCW for the region are known to vary in accuracy and reliability. Traditionally this is due to the reliability of information provided to the NPWS for collation and/or the need to protect specific threatened species locations. For the purposes of this assessment this information has been considered to have an accuracy of ± 1km.

Threatened flora and fauna records within the region were predominantly sourced from the DECCW Atlas of Wildlife Database and a DEWHA Protected Matters Search. Limitations are known to exist with regards to these data sources and their accuracy.

Note: Data recorded by RPS during the survey period, has been located with a Trimble GeoXH GPS unit, which is capable of sub-metre accuracy following post processing.

Fauna

The presence of fauna within a particular area is not static over time, may be seasonal or in response to the availability of a particular resource. As such, where survey effort targeting particular threatened fauna species has not specifically met guidelines recommended by LMCC, habitat assessment and prediction of the occurrence of threatened fauna species has been applied. Nevertheless, it is considered that the combined survey effort and dataset from all of the investigations undertaken to date provide a substantial and reliable picture of the fauna species and habitat values occurring within the site.

3 Results

3.1 Desktop Assessment

3.1.1 Previous Ecological Assessments in the Local Area

Umwelt (2009) – Masterplan Ecological Assessment for the Former Pasminco Cockle Creek Smelter Site

The Masterplan ecological assessment studied 212 hectares of former industrial and buffer land of the former Pasminco Smelter on the northern boundary of the current site. The Masterplan complied a large number of previous studies on and adjacent to the former Pasminco Cockle Creek Smelter site.

Umwelt reported at study by Ecotone (2002, cited by Umwelt 2009) for a proposed subdivision of Lot 117 DP 846847 that identified the Squirrel Glider as present. A later SIS by Ecotone (2003a, cited by Umwelt 2009) suggested that after the implementation of proposed mitigation measures, the viability of the Squirrel Glider population may improve.

Umwelt report a study by Wildthing (2002, cited by Umwelt 2009) for a Statement of Effect for a proposed subdivision at the Pasminco Cockle Creek Smelter Site. The threatened tree Charmhaven Apple (*Angophora inopina*) was identified, as well as an intergrade with Rough-barked Apple (*Angophora floribunda*).

Umwelt report a study by Ecotone (2003, cited by Umwelt 2009) for Flora and Fauna Assessment of a wetland adjacent to the Pasminco Cockle Creek Smelter Site. No threatened flora was recorded. A single threatened species, the Common Bentwing-bat, was recorded by an Anabat detector.

Six previous reports by Umwelt on the former Pasminco Cockle Creek Smelter Site identified the following threatened species within the former Pasminco Cockle Creek Smelter Site:

- Charmhaven Apple (*Angophora inopina*) plus an intergrade with Rough-barked Apple (*Angophora floribunda*).
- Grey-headed Flying-fox
- Common Bentwing-bat

Ecotone (2006) – Management Plan Lots 448 & 449 on the Northern Slopes of Munibung Hill at Macquarie Hills

Ecotone prepared a five year management plan for Lots 448 and 449 on the northern slopes of Munibung Hill. Twenty nest boxes for the Squirrel Glider were established in Lots 448 & 449 in 2004 and subsequent monitoring has identified Squirrel Gliders using the nest boxes.

LMCC DCP No. 1 – Part 4.15 Lawson Road Area Plan

The Lawson Road Area study area occurs approximately 500 metres to the north-east of the study area of this report. No threatened flora species, populations or EECs were recorded. The Lawson Road study area was considered to provide potential koala habitat however no indications of the presence of the koala have been recorded.

Four threatened bat species, Eastern False Pipistrelle, Eastern Freetail Bat, Little Bentwing Bat and Eastern Bentwing Bat, and one threatened bird species, the Masked Owl, were recorded from the Lawson Road study area.

3.1.2 Vegetation Communities

The Natural Vegetation of the Lake Macquarie Local Government Area, Lake Macquarie, NSW (Bell, 2009 - DRAFT), maps two native vegetation communities over the site, being (MU 6) *Coastal Narrabeen Moist Forest* and (MU 15) *Coastal Foothills Spotted Gum – Ironbark Forest*. Other disturbed vegetation or cleared areas were not mapped within Bell (2009).

3.1.3 Threatened Flora

A search of the NSW Wildlife Atlas database (DECCW 2009) indicated that 14 threatened flora species have been previously recorded within 10km of the site (the locality), these are:

- *Angophora inopina** — Charmhaven Apple
- *Callistemon linearifolius* — Nettled Bottle Brush
- *Chamaesyce psammogeton* — Sand Spurge
- *Cryptostylis hunteriana** — Leafless Tongue-orchid
- *Cynanchum elegans* — White-flowered Wax Plant
- *Diuris praecox** — Rough-double Tail
- *Epacris purpurascens* var. *purpurascens*
- *Eucalyptus camfieldii** — Heart-leaved Stringybark
- *Grevillea parviflora* subsp. *parviflora** — Small-flower Grevillea
- *Melaleuca biconvexa** — Biconvex Paperbark
- *Senecio spathulata* — Coast Groundsel
- *Syzygium paniculatum** — Magenta Lilly Pilly
- *Tetratheca juncea** — Black-eyed Susan
- *Zannichellia palustris*

A search of Matters of National Environmental Significance within area of 10km of the site failed to identify any additional threatened flora species (identified species are denoted with an asterisk in the above list). A total of 14 state and federally listed threatened flora species were identified in desktop searches.

3.1.4 Threatened Populations

One Threatened Population is known in the Lake Macquarie Local Government Area. This threatened population is known as *Eucalyptus parramattensis* subsp. *parramattensis* in Wyong and Lake Macquarie Local Government Areas. Despite detailed targeted searches this species was not observed on site.

3.1.5 Threatened Ecological Communities

A search of Matters of National Environmental Significance within an area of 10km of the site revealed the following federally listed Threatened Ecological Communities:

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Both of these Threatened Ecological Communities are listed as Critically Endangered within the *EPBC Act*. Neither of these communities have suitable habitat nor were they observed within the site.

Twelve Threatened Ecological Communities listed within the *NSW TSC Act* are known to occur within the Lake Macquarie Local Government Area. These vegetation communities are:

- Sydney Freshwater Wetland;
- Freshwater Wetlands on Coastal Floodplains;
- Swamp Oak Floodplain Forest;
- River-flat Eucalypt Forest on Coastal Floodplain;
- Swamp Sclerophyll Forest on Coastal Floodplain;
- Coastal Saltmarsh;
- Lower Hunter Spotted Gum – Ironbark Forest;
- Littoral Rainforest;
- Hunter Lowlands Redgum Forest;
- Themeda Grassland;
- Lowland Rainforest; and
- Lower Hunter Valley Dry Rainforest.

It is considered that one EEC known as Lowland Rainforest is present within the site. The Lowland Rainforest EEC corresponds to the Coastal Wet Gully Forest vegetation community described later in this document.

3.1.6 Threatened Fauna

The results of a desktop search (DECCW 2009) indicated that 38 threatened fauna species (excluding marine species) have been previously recorded within 10km of the site (the locality) and / or have potential habitat within the site. These are:

- *Crinia tinnula* Wallum Froglet
- *Pseudophryne australis* Red-crowned Toadlet
- *Oxyura australis* Blue-billed Duck
- *Ephippiorhynchus asiaticus* Black-necked Stork
- *Ixobrychus flavicollis* Black Bittern
- *Pandion haliaetus* Osprey
- *Irediparra gallinacean* Comb-crested Jacana
- *Rostratula australis* Painted Snipe
- *Ptilinopus magnificus* Wompoo Fruit-Dove
- *Ptilinopus regina* Rose-crowned Fruit-Dove
- *Ptilinopus superbus* Superb Fruit-Dove
- *Callocephalon fimbriatum* Gang Gang Cockatoo
- *Calyptorhynchus lathami* Glossy Black Cockatoo
- *Glossopsitta pusilla* Little Lorikeet
- *Lathamus discolor* Swift Parrot
- *Neophema pulchella* Turquoise Parrot
- *Ninox connivens* Barking Owl
- *Ninox strenua* Powerful Owl
- *Tyto novaehollandiae* Masked Owl
- *Tyto tenebricosa* Sooty Owl
- *Climacteris picumnus* Brown Treecreeper
- *Anthochaera phrygia* Regent Honeyeater
- *Melanodryas cucullata* Hooded Robin
- *Pyrrholaemus saggitatus* Speckled Warbler
- *Phascolarctos cinereus* Koala
- *Dasyurus maculatus* Spotted-tailed Quoll
- *Petaurus norfolcensis* Squirrel Glider
- *Petaurus australis* Yellow-bellied Glider
- *Pteropus poliocephalus* Grey-headed Flying-fox
- *Mormopterus norfolkensis* Eastern Freetail-bat

- *Miniopterus australis* Little Bentwing-bat
- *Miniopterus schreibersii* Common Bentwing-bat
- *Scoteanax rueppellii* Greater Broad-nosed Bat
- *Vespadelus troughtoni* Eastern Cave Bat
- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat
- *Chalinolobus dwyeri* Large-eared Pied Bat
- *Falsistrellus tasmaniensis* Eastern False Pipistrelle
- *Myotis adversus* Large-footed Myotis

A search of Matters of National Environmental Significance within area of 10kms of the site revealed the following additional threatened species (excluding marine species) that are listed on the *EPBC Act*. Species also listed on the *TSC Act* but not identified during the above Atlas of NSW Wildlife database search are asterisked:

- *Hoplocephalus bungaroides** Broad-headed Snake
- *Litoria aurea** Green and Golden Bell Frog
- *Litoria littlejohni** Littlejohn's Tree Frog
- *Mixophyes balbus** Stuttering Frog
- *Mixophyes iterates** Southern Barred Frog
- *Rostratula australis* Painted Snipe
- *Lathamus discolor* Swift Parrot
- *Anthochaera phrygia* Regent Honeyeater
- *Petrogale penicillata** Brush-tailed Rock-wallaby
- *Potorous tridactylus* ssp. *tridactylus* * Long-nosed Potoroo
- *Dasyurus maculatus maculatus* Spotted-tailed Quoll
- *Pteropus poliocephalus* Grey-headed Flying Fox
- *Chalinolobus dwyeri* Large-eared Pied Bat

A total of 13 federally listed species were identified during desktop searches.

3.1.7 Migratory Species

A search of Matters of National Environmental Significance within an area of 10kms of the site revealed the following 10 migratory species (excluding marine species) that are listed on the *EPBC Act*.

- *Haliaeetus leucogaster* White-bellied Sea-Eagle
- *Hirundapus caudacutus* White-throated Needletail
- *Merops ornatus* Rainbow Bee-eater

- *Monarcha melanopsis* Black-faced Monarch
- *Myiagra cyanoleuca* Satin Flycatcher
- *Rhipidura rufifrons* Rufous Fantail
- *Anthochaera phrygia* Regent Honeyeater
- *Ardea modesta* Great Egret
- *Ardea ibis* Cattle Egret
- *Apus pacificus* Fork-tailed Swift

3.1.8 Critical Habitat

No areas of critical habitat are known within the local area.

3.1.9 Corridors and Habitat Linkages

Forest and scattered tree habitat areas across the site, combined with similar vegetation that occurs to the north and north-east of the site provide a habitat area for species in the local area (**Figure 3-1**). However due to the proximity of residential, commercial and industrial areas and nearby Lake Macquarie there are limited movement corridors for species to and from the site. To the north of the site similar vegetation extends for approximately 1.4km. Beyond this vegetation no significant movement paths exist through the industrial, commercial and residential areas of and surrounding Argenton.

To the east a 100m to 200m wide potential corridor occurs between Macquarie Hills and Lakelands and extends beyond Cardiff South to the Hillsborough area. To the south of the site a small area of vegetation extends beyond the boundary of the site, however further movement south is highly unlikely due to the presence of Lake Macquarie. To the west, the site is bounded by the suburb of Boolaroo and Cockle Creek.

The potential corridor to the east is the only likely corridor movement path for species with low or moderate movement ability. Highly mobile species, many but not all bird species, are likely to be able to move in any direction to and from the site, however they must move through significant areas of unsuitable habitat such as building, roads, creeks and train lines.

The Lake Macquarie Native Vegetation and Corridors Map (LMCC 2009) (**Figure 3-1**), identifies the vegetation on the site as a corridor of partially cleared remnant native vegetation. Three rehabilitation corridors are mapped to the north, east and south, and corridors less than 200 metres in width are mapped to the east and north-east. The only significant corridor linking the vegetation of the site to nearby similar vegetation occurs to the east of the site, mapped as a less than 200 metre wide corridor of remnant native vegetation. All other corridors mapped on the Lake Macquarie Native Vegetation and Corridors Map (LMCC 2009) are unlikely to provide significant paths or corridors of movement for species with moderate or low movement and dispersal abilities. Highly mobile species (mainly birds) may use such corridors to move to and from the site.

3.2 Regional Biodiversity Value

Within the region, the site represents an area of marginal habitat for most species. While the site provides some areas of forest cover, most forested areas were disturbed through previous clearing and the presence of weed species, particularly *Lantana camera* (Lantana) and *Ligustrum sinense* (Small-leaved Privet). The vegetated areas are also dissected by vehicle tracks along ridgelines resulting in a level of internal fragmentation.

The central pit areas and the disturbed habitat areas to the west of the pit areas are of low regional biodiversity value due to the high levels of exotic flora species and the low number of native species they are likely to support.

While the site has a low level of connectivity within the landscape, with only a single clear likely movement corridor to east, the site's location between large areas of forest habitat to the west of Teralba and areas of forest habitat to the east, in the Hillsborough and Garden Suburb areas (and further south and north from these areas), provides stop-over habitat areas for highly mobile species.

The Wet Gully Forest corresponds to the EEC known as Lowland Rainforest. It is expected that the majority of this vegetation type will be retained as part of the riparian corridors associated with the gully vegetation. Considering the above factors, overall the site is of moderate regional biodiversity value.

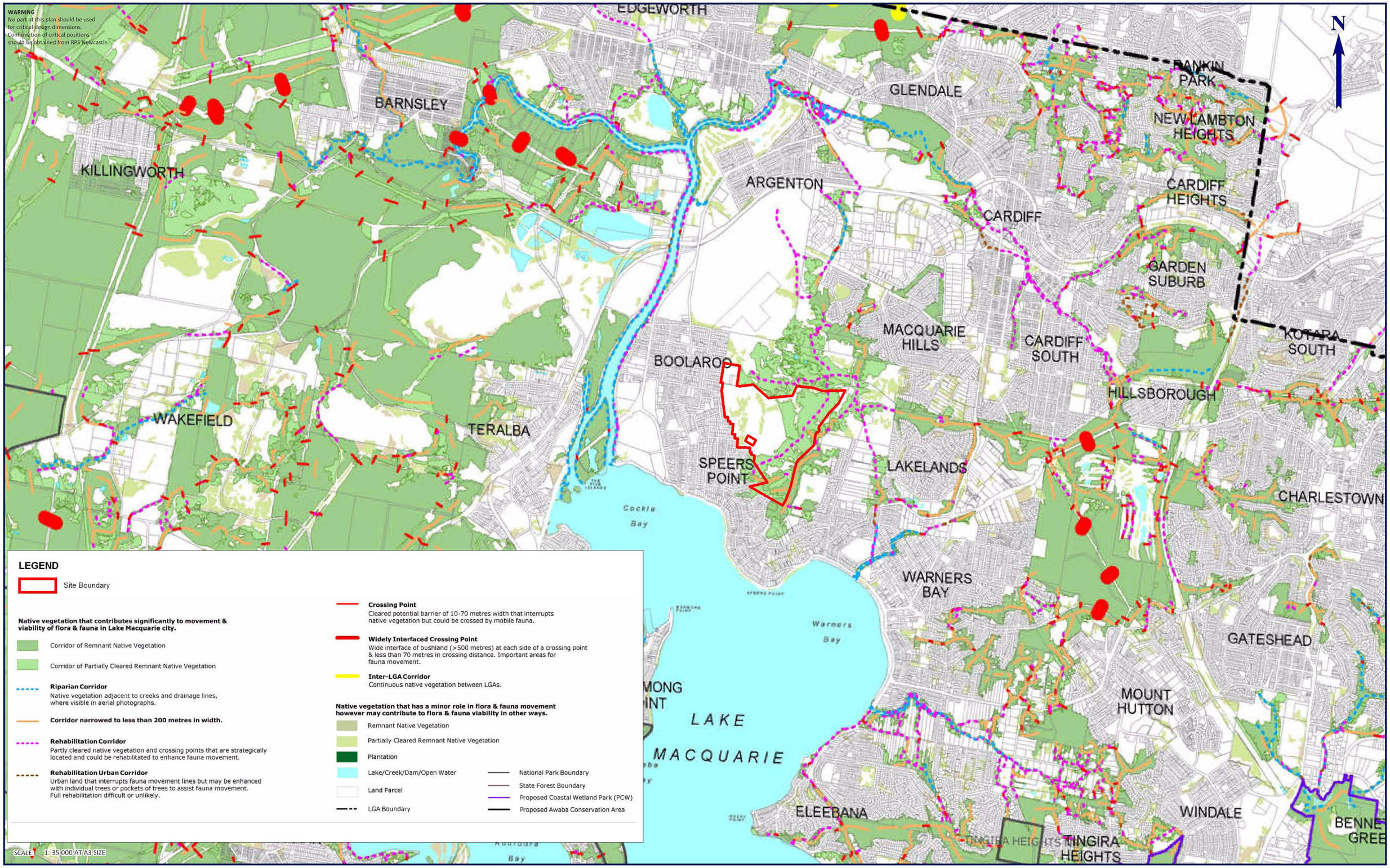
3.3 Weather Conditions During the Survey Periods

The prevailing weather conditions during the survey period are presented in **Table 2.4** below.

Table 3-1: Prevailing Weather Conditions[1]

	16 Dec 2009	17 Dec 2009	18 Dec 2009	4 Jan 2010	5 Jan 2010	6 Jan 2010	7 Jan 2010	8 Jan 2010	28 Apr 2010
Temperature (°C)	20 - 35	20 - 40	22 - 23	18 - 25	16 - 30	19 - 30	20 – na	na - 28	11 - 24
Cloud[2]	4 - 1	0 - 4	8 - 8	7 - 7	2 - 0	2 - 3	8 - 7	na	0 - 0
Rain (mm)[3]	0	0	0	9.6	0	0	0.6	na	0
Sun Rise[4]	05:40	05:40	05:40	05:51	05:51	05:52	05:53	05:54	06:24
Sun Set[4]	19:58	19:59	20:00	20:06	20:06	20:06	20:06	20:06	17:18
Moon Rise[4]	04:58	05:52	06:48	22:38	23:10	23:42	na	00:14	05:59
Moon Set[4]	19:54	20:43	21:25	09:28	10:37	11:43	12:47	13:51	17:43

1 = Temperature, cloud cover and rainfall measured at the Newcastle University Bureau of Meteorology Weather Station (http://www.bom.gov.au/climate/dwo/IDCJDW0208.shtml)
2 = Cloud cover at 9am and 3pm, measured as eights of the sky.
3 = 24 hours to 9am.
4 = Times calculated by the Geoscience Australia website tool (http://www.ga.gov.au/geodesy/astro/sunrise.jsp#enter)
na = data not available



TITLE: FIGURE 3-1 LAKE MACQUARIE NATIVE VEGETATION AND CORRIDORS MAP

LOCATION: SPEERS POINT

DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 1/7/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: 26292 FIGURE 3-1 LMCC CORRIDOR MAP A-A3
VERSION (PLAN BY): A-A3 (S.C)

CLIENT: LAKE MACQUARIE CITY COUNCIL
JOB REF: 26292

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3.4 Flora

3.4.1 Vegetation Community Assessment

Site inspection and vegetation community delineation identified five vegetation communities (**Figure 3-2**):

- Coastal Foothills Spotted Gum – Ironbark Forest;
- Coastal Narrabeen Moist Forest;
- Coastal Wet Gully Forest (EEC);
- Wetlands; and
- Disturbed Lands.

The following section provides a brief outline of the dominant floral characteristics of each vegetation community. A full list of species is provided in **Appendix 1**.

Coastal Foothills Spotted Gum – Ironbark Forest

Plate 3-1: Coastal Foothills Spotted Gum – Ironbark Forest

Classification: The areas of Coastal Foothills Spotted Gum – Ironbark Forest within the site do not correspond with any Threatened Ecological Communities (TECs) listed on the *TSC Act* or *EPBC Act.*

Description: This vegetation community is commensurate with MU 15 – Coastal Foothills Spotted Gum – Ironbark Forest as mapped by the Draft Natural Vegetation of the Lake Macquarie Local Government Area (Bell, 2009). This community occurs on the upper slopes and ridges of the eastern half of the site (**Figure 3-2**). This vegetation community covers approximately 32.67 ha of the site. Scattered hollow-bearing trees were rare in this community. This community varied in form, from grassland with scattered remnant trees in parts, to areas of forest in other parts.

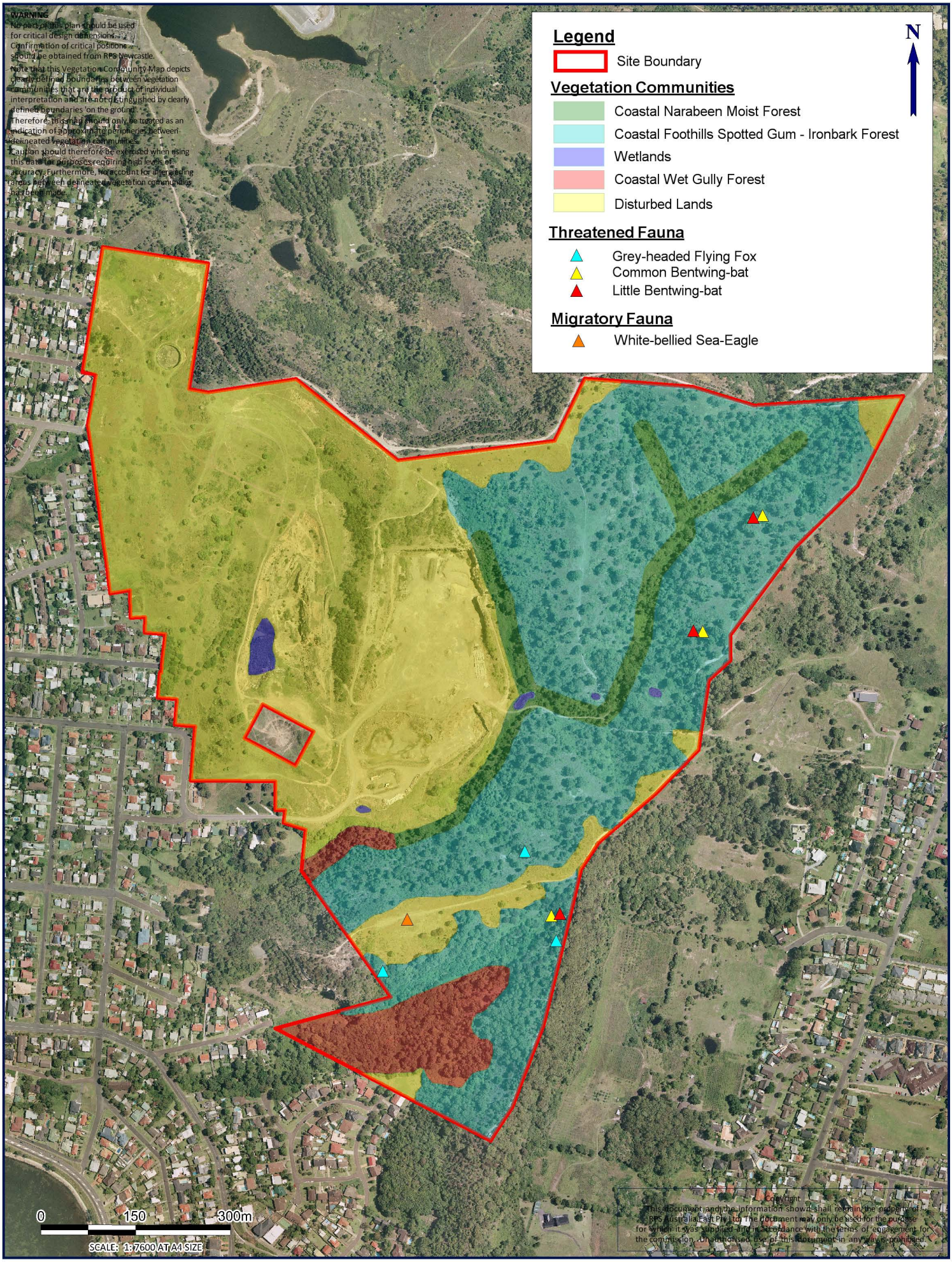
Upper-storey: 10 to 22m – 10%-30% Percent Foliage Cover (PFC). *Corymbia maculata* (Spotted Gum), *Eucalyptus acmenoides* (White Mahogany) and *Eucalyptus paniculata* subsp*. paniculata* (Grey Ironbark).

Upper Mid-storey: 5 to 12m – 10%-40% PFC. *Allocasuarina torulosa* (Forest Oak), *Pittosporum undulatum* (Sweet Pittosporum), *Casuarina glauca* (Swamp Oak) and juvenile *Corymbia maculata* (Spotted Gum).

Mid-storey: 2 to 7m – 5%-20% PFC. *Acacia irrorata*, *Acacia floribunda* (White Sallow Wattle), *Allocasuarina littoralis* (Black She-oak), *Lantana camara* (Lantana), *Pittosporum undulatum* (Sweet Pittosporum), *Jacksonia scoparia* (Dogwood) and *Persoonia linearis* (Narrow-leaved Geebung).

Under-storey: 1 to 4m – 5%-40% PFC. *Acacia brownii* (Heath Wattle), *Bursaria spinosa* (Blackthorn), *Myrsine variabilis* (Muttonwood), *Notelaea longifolia* (Mock Olive), *Allocasuarina littoralis* (Black She-oak), *Acacia ulicifolia* (Prickly Moses), *Sida rhombifolia* (Paddy's Lucerne), *Persoonia linearis* (Narrow-leaved Geebung) and *Lantana camara* (Lantana).

Ground Cover: 0.1 to 1m – 10%-100% PFC. *Themeda australis* (Kangaroo Grass), *Ageratina adenophora* (Crofton Weed), *Pennisetum clandestinum* (Kikuyu), *Plantago lanceolata* (Ribwort), *Paspalum dilatatum* (Paspalum), *Verbena rigida* (Veined Verbena), *Imperata cylindrical* (Blady Grass), *Pteridium esculentum* (Bracken), *Briza subaristata, Melinus repens* (Red Natal Grass), *Entolasia stricta* (Wiry Panic), *Aristida vagans* (Three-awn Speargrass), *Dianella caerulea* var. *producta* (Blue Flax Lily), *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush), *Xanthorrhoea minor* subsp. *minor, Desmodium varians* (Slender Tick-trefoil), *Pratia purpurascens* (Whiteroot), *Sorghum halpense* (Johnson Grass) and *Poa labillardieri* (Tussock Grass).



TITLE: FIGURE 3-2 VEGETATION COMMUNITIES AND THREATENED SPECIES LOCATION MAP

LOCATION: SPEERS POINT

DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 1/7/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: 26292 Figure 3-2 Vegetation Community Map A-A4.wor
VERSION (PLAN BY): A-A3 (S.C)

CLIENT: LAKE MCQUARIE CITY COUNCIL
JOB REF: 26292

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Coastal Narrabeen Moist Forest

Plate 3-2: Coastal Narrabeen Moist Forest

Classification: The areas of Coastal Narrabeen Moist Forest within the site do not correspond with any TECs listed on the *TSC Act* or *EPBC Act.*

Description: This vegetation community is commensurate with MU 6 – Coastal Narrabeen Moist Forest as mapped by the Draft Natural Vegetation of the Lake Macquarie Local Government Area (Bell, 2009). This community occurs along the drainage line in the central and north-eastern area of the site (**Figure 3-2**). This vegetation community covers approximately 4.14 ha of the site. This community was found to be dominated by dense stands of Lantana in the understorey.

Upper-storey: Up to 24m – 10% Percent Foliage Cover (PFC). *Corymbia maculata* (Spotted Gum), *Eucalyptus acmenoides* (White Mahogany) and *Syncarpia glomulifera* (Turpentine).

Upper Mid-storey: Up to 18m – 60% PFC. *Clerodendrum tomentosum* (Hairy Clerodendrum), *Guioa semiglauca* (Guioa), *Cryptocarya microneura* (Murrogun) and *Acacia irrorata.*

Mid-storey: Up to 6m – 20% PFC. *Ligustrum lucidum* (Large-leaved Privet), *Ligustrum sinense* (Small-leaved Privet), *Nicotiana glauca* (Tree Tobacco) and *Pittosporum undulatum* (Sweet Pittosporum).

Under-storey: Up to 4m – 60% PFC. *Lantana camara* (Lantana) and *Ficus coronata* (Sandpaper Fig).

Ground Cover: 0.1 to 1.5m – 30% PFC. *Verbena bonariensis* (Purpletop), *Ageratina adenophora* (Crofton Weed) and *Cortaderia selloana* (Pampas Grass).

Coastal Wet Gully Forest

Plate 3-3: Coastal Wet Gully Forest

Classification: The areas of Coastal Wet Gully Forest within the site correspond to the **Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC** on the *TSC Act.* The areas of Coastal Wet Gully Forest within the site do not correspond to any TECs listed on the *EPBC Act*.

Description: This vegetation community is commensurate with MU 1 – Coastal Wet Gully Forest as mapped by the Draft Natural Vegetation of the Lake Macquarie Local Government Area (Bell, 2009). This community occurs along drainage lines in southern end of the site (**Figure 3-2**). This vegetation community covers approximately 3.97 ha of the site. This community was dominated by dense stands of *Pittosporum undulatum* (Sweet Pittosporum) and *Ligustrum sinense* (Small-leaved Privet).

Upper-storey: Up to 20m – 80% PFC. *Pittosporum undulatum* (Sweet Pittosporum), *Acacia maidenii* (Maiden's Wattle) and *Diploglottis cunninghamii* (Native Tamarind).

Upper Mid-storey: Up to 14m – 60% PFC. *Pittosporum undulatum* (Sweet Pittosporum) and *Ligustrum sinense* (Small-leaved Privet).

Mid-storey: Up to 10m – 40% PFC. *Ligustrum sinense* (Small-leaved Privet) and *Lantana camara* (Lantana).

Under-storey: Up to 4m – 10% PFC. *Ficus coronata* (Sandpaper Fig), *Breynia oblongifolia* (Coffee Bush) and *Pittosporum spinescens* (Orange Thorn).

Ground Cover: 0.1 to 1.0m – 20% PFC. *Adiantum formosum* (Giant Maidenhair) and *Adiantum hispidulum* (Rough Maidenhair).

Wetlands

Plate 3-4: Wetland Area Within the Western Quarry (Largest Wetland)

Classification: The areas of Wetlands within the site do not correspond with any TECs listed on the *TSC Act* or *EPBC Act.* The areas of wetlands do not qualify as the Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

EEC (on the *TSC Act*) as they do not occur on silts, muds, or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains, generally below 20 metres elevation. The areas of wetlands also do not qualify as Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC (on the *TSC Act*) as they do not occur as freshwater swamps in swales and depressions on sand dunes and low nutrient sandplain sites in coastal areas.

Description: This community occurs as five wetland areas varying in size from approximately 10 to 50 metres in diameter (**Figure 3-2**). All five wetlands contained dense stands of tall reeds (*Typha spp.*) (**Plate 3-4**, **Plate 3-6**). The wetland on the eastern edge of the eastern quarry was the only wetland to contain water deeper than approximately 300 millimetres (estimated) and likely contained areas of deep water (greater than one metre deep). The other four wetlands likely dry out during dry periods due to their shallow nature.

Disturbed Lands

Plate 3-5: Disturbed Lands – Looking West, Note Motorbike Tracks and Dominance of Exotics

Classification: The areas of Disturbed Lands within the site do not correspond with any TECs listed on the *TSC Act* or *EPBC Act.*

Description: This community is found in the north-western half of the site, including the two old quarry pit areas. With the exception of the two pit areas, the disturbed lands are typically characterised by grasslands with scattered trees and shrubs. This vegetation community covers approximately 38.60 ha of the site (**Figure 3-2**). The pit areas contain a wide diversity of flora species that are typical of wasteland areas. Few native species are present.

3.4.2 Threatened Flora Survey

No threatened flora species listed within the *TSC Act* or the *EPBC Act* were recorded within the site.

Due to the known presence of an *Angophora inopina* (Charmhaven Apple) population to the north-west of the site individual Angophora plants were targeted for species identification during the flora survey. No *Angophora inopina* (Charmhaven Apple) trees were identified.

Seasonal survey of cryptic threatened flora species occurred for all species except *Diuris praecox*. However potential habitat areas for this species occur within the forest areas of the site that may be conserved as part of the proposed rezoning. If potential habitat areas are conserved as part of the proposed rezoning no further survey is likely to be required.

3.4.3 Endangered Ecological Communities

One EEC was recorded on the site. It is considered that the Coastal Wet Gully Forest described above corresponds to the Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC on the *TSC Act*. The EEC occurs as two patches in two drainage line areas within the southern end of the site (**Figure 3-2).** The larger of the two patches (3.5 hectares) occurs in the southernmost drainage line within the site. The smaller (0.5 hectares) patch occurs just south of the existing quarry area (**Figure 3-2**). Both patches of the EEC extend an unknown distance beyond the boundary of the site. Both areas of the EEC were dominated by dense stands of *Pittosporum undulatum* (Sweet Pittosporum) and *Ligustrum sinense* (Small-leaved Privet).

3.5 Fauna

A full list of all the fauna species recorded during field surveys is provided in **Appendix 2**.

3.5.1 Habitat Assessment

Habitat within the site was assessed for its potential to support native fauna species including threatened fauna for which records occur within the wider locality.

Open forest communities on the site provide moderately suitable habitat for a number of terrestrial mammals. They also provide abundant foraging resources such as foliage, pollen, nectar and invertebrates for possums and gliders. The dominant tree species have potential to supply nectar for the majority of the year, however most areas are

characterised by trees of limited maturity, which limits the incidence of hollow-bearing trees within the site.

Disturbed areas with a low diversity and density of eucalypt species hold limited habitat for arboreal species. This habitat type occupies the majority of the western area of the site and provides only limited habitat for common native browsers, such as various macropod species and pest species such as *Oryctolagus cuniculus* (Rabbit).

The small number of hollow bearing trees located within the site limits roosting and den habitat for micro-chiropteran bats and some other hollow-dependent mammals. The previous land use, as a gravel quarry, has left large rocky cliff areas exposed within the site. Although no specific caves were identified within the site, these areas provide potential roosting habitat for cave dwelling micro-chiropteran bat species. Hollow trees present were not suitable as breeding or roosting sites for owls, larger parrots or cockatoos.

The wooded areas provide suitable foraging resources and nesting and roosting opportunities for a variety of sedentary birds, with the three Forest vegetation communities providing potential habitat for a range of woodland species. Two potential food tree species of the Glossy Black-Cockatoo, *Allocasuarina torulosa* and *A. littoralis*, were recorded in five of twelve vegetation plots and ranged in percentage cover from less than five percent to between 50 to 75 percent cover. No chewed cones of either *Allocasuarina* species were recorded. Some terrestrial and arboreal mammal species are present within the site and may provide hunting opportunities for a variety of forest owl species including the Powerful Owl.

Several small dams occur on the site providing suitable habitat for frog species, some reptile species and some fresh water bird species. Forest areas across the site also provide habitat areas for frog and reptile species with small amounts of fallen timber and leaf litter sporadically distributed across the area.

Five wetlands (including dams) were identified across the site (see **Figure 3-2**). The five wetlands vary in size from approximately 10 to 50 metres in diameter and all contained dense stands of tall reeds (*Typha spp.*). The wetland on the eastern edge of the eastern quarry was the only wetland to contain water deeper than approximately 300 millimetres (estimated) and likely contained areas of deep water (greater than one metre deep). The other four wetlands likely dry out during dry periods due to their shallow nature.

Plate 3-6: Small Wetland Area

Within the eastern quarry, cracks and fissures occur sporadically throughout the rock face of the quarry walls. At a distance these cracks and fissures appear to provide suitable roosting habitat for bat species, however upon closer inspection all cracks and fissures were found to provide poor quality bat habitat. Most cracks and fissures were less than 300 millimetres deep and did not contain suitable sheltered positions for bats to roost. Several of the cracks were also drainage channels for water moving down the rock faces during moderate to heavy rainfall.

Three shallow drill holes (presumably old blasting drill holes) occur in the south western face. While the three drill holes are a suitable size for micro-bat species they are unlikely to be suitable roosting positions due to their easterly aspect and shallow nature. All three drill holes are likely to be too warm/hot in the morning and mid morning sun to provide suitable roosting sites for microbat species.

Plate 3-7: Drill Hole in South-western Rock Face of Eastern Quarry.

No suitable rock faces occur in the western quarry where the walls of the quarry are composed of soil rather than rock.

3.5.2 Avifauna Survey

Bird species diversity across the site was relatively low and species typically characteristic of disturbed and isolated sites were recorded. Such species included the *Gymnorhina tibicen* (Australian Magpie), *Dacelo novaeguineae* (Laughing Kookaburra) and *Rhipidura leucophrys* (Willie Wagtail). Bird species typically characteristic of small remnant forest patches were recorded within the three forest communities present. Such species included the *Rhipidura albiscarpa* (Grey Fantail), *Pachycephala pectoralis* (Golden Whistler), *Lichenostomus chrysops* (Yellow-faced Honeyeater) and *Acanthiza pusilla* (Brown Thornbill). A full list of birds observed within the site is provided in **Appendix 2**.

3.5.3 Spotlighting Survey

Three *Pseudocheirus peregrinus* (Ringtail Possums), a *Podargus strigoides* (Tawny Frogmouth) and six threatened Grey-headed Flying-foxes were observed during spotlighting surveys. All six Grey-headed Flying-foxes were observed feeding in tree canopies.

3.5.4 Herpetofauna Survey

Targeted and opportunistic surveys were conducted for amphibians and reptiles within the site. Three common amphibian species, *Crinia signifera* (Common Eastern Froglet), *Uperoleia fusca* (Dusky Toadlet) and *Litoria fallax* (Eastern Dwarf Tree Frog) were observed calling throughout the site. No additional species were recorded during the diurnal amphibian surveys undertaken on 28 April 2010.

One reptile species, *Tiliqua scincoides* (Eastern Blue-tongued Lizard), was recorded during field surveys. Council has also noted Eastern Water Dragons on the site.

3.5.5 Call Playback

No owls responded to owl call playback sessions.

3.5.6 Bat Survey

All seven species of bats recorded (**Appendix 2**) were identified by Anabat echolocation analysis, at the 'definite' level of identification. The seven species included two threatened species, the Little Bentwing-bat and the Common Bentwing-bat. No bats were captured during harp trapping. **Appendix 3** contains the Anabat echolocation results.

3.5.7 Secondary Indications and Incidental Observations

No secondary indications and incidental observations of note were recorded on site.

3.5.8 Threatened Species

Six threatened Grey-headed Flying-foxes were observed during spotlighting surveys. Two individuals were observed foraging on the first night of spotlighting. On the second night another four individuals were also observed foraging.

Two microbat species, the Little Bentwing-bat and Common Bentwing-bat, were identified using Anabat detectors.

The threatened Squirrel Glider was not identified during field surveys for this report, however it is known to occur on neighbouring properties (see **Section 3.1.1**). A suitable density of appropriately sized of tree hollows exist for the Squirrel Glider along the drainage lines and gully areas of the site however, the mid-storey and understorey lacked many of the flowering plant species typically present (but not always present) in Squirrel Glider habitat areas. The understorey of most treed parts of the site also contained dense stands of Lantana, further reducing the habitat quality for the Squirrel Glider.

Movement to and from the site via the potential corridor to the east (see **Section 3.1.9)** provides a potential movement path for Squirrel Gliders to and from the site. Internally there are suitable areas of forest cover for the Squirrel Glider to reach all areas of forest cover in the eastern and southern areas of the site, providing a total habitat area of around 34 hectares.

Due to the presence of suitable hollows, the presence of potentially suitable movement corridors within and off the site, and the known occurrence of the species on neighbouring properties, the Squirrel Glider is considered highly likely to occur on the site.

3.5.9 Migratory Species

A single migratory species was identified during field surveys, being a White-bellied Sea Eagle flying over the site.

3.6 Threatened Species and Endangered Populations Likelihood of Occurrence Assessment

Threatened flora and fauna species (listed under the *TSC Act* and / or the *EPBC Act*) that have been gazetted and previously recorded (database searches or local reports) within a 10 km radius of the site are considered in the following assessment of species' potential to occur within the site. Migratory fauna species have also been included. EECs known from the broader area have also been addressed.

This assessment deals with the following heads of consideration in tabulated form (**Table 4-1**):

Species/Community/Population – Lists each threatened and/or migratory species, EEC's or populations known in the locality. The status of each species, EEC or population under the *TSC Act* and the Commonwealth *EPBC Act* are also provided.

Habitat Description – Provides a brief account of the species/community/population and the preferred habitat attributes required for the existence/survival of each species/community/population.

'Chance of Occurrence on Site' – Assesses the likelihood of each species/community/population to occur along or within the immediate vicinity of the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of current field investigations, data gained from various sources (such as Atlas of NSW Wildlife, scientific committee determinations and NPWS or DECCW profiles) and previously gained knowledge via fieldwork undertaken within the locality.

Table 3-2 : Threatened Species and Communities Considered and Assessment of Potential Impacts

Species / Community	Habitat Description	Chance of Occurrence On Site
Angophora inopina Charmhaven Apple (V, V*)	Small to medium tree found in shallow sandy soils in open woodland, swamp woodland and wet heath. The main occurrences of this species are in the Wyong and Lake Macquarie LGA's (from Charmhaven to Wyee and Morisset, and north to near Toronto), with disjunct populations also in Port Stephens LGA (south of Karuah).	**Moderate** Known to occur on flats approximately 500m north of the northern boundary of the site. Detailed targeted searches did not locate this species within the site.
Callistemon linearifolius Netted Bottle Brush (V)	Shrub that grows in dry sclerophyll forest on the coast and adjacent ranges. Re-sprouting / juvenile specimens difficult to distinguish from other *Callistemon* species such as *C. rigidus* (Red Bottlebrush) or *C. linearis* (Narrow-leaved Bottlebrush)without the aid of flowering parts. Re-sprouting / juvenile specimens are difficult to distinguish from other *Callistemon* species such as *C. rigidus* or *C. linearis* without the aid of flowering parts. Little habitat information is available on this species generally but in the Hunter Valley this species has been recorded where dry forest habitats interface with salt tolerant vegetation communities, such as Swamp Oak Rushland Forest and Riparian Melaleuca forest. Significant populations recently found within Werakata National Park around the Cessnock area and surrounding properties.	**Low** This species was not observed on site. It is considered that previous land management practices such as tree removal, clearing, grazing, trampling, underscrubbing and subsequent weed invasion within the site has considerably reduced the habitat suitability. Low suitable habitat.
Chamaesyce psammogeton (E) Sand Spurge	Perennial prostrate herb, which grows on sand dunes near the sea and exposed headlands often with *Spinfex sericeus* (Spinifex). It is thought that seed dispersal may come from beach to beach as the seed of *C. psammogeton* float. Found on the east coast from Qld to Jervis Bay NSW.	**Low** Suitable habitat (Sand Dunes near the sea) is not present on site.
Cryptostylis hunteriana Leafless-tongue Orchid (V*)	The Leafless Tongue Orchid occurs from the Gibraltar Range (N.S.W) to eastern Victoria. RPS has recorded this species in Catherine Hill Bay. This species is a saprophytic orchid, which grows in small localised colonies on flat plains close to the coast. This species has also been recorded in mountainous areas growing in moist depressions as well as in swampy habitats.	**Low** This species was not recorded within the site. It is considered that previous land management practices such as tree removal, clearing, grazing, trampling, underscrubbing and subsequent weed invasion within the site has considerably reduced the habitat suitability. Low suitable habitat.
Cynanchum elegans White-flowered Wax Plant (E, E*)	Occurs scattered along the NSW Northern Coast to Wollongong usually in dry, littoral or subtropical rainforest and occasionally melaleuca scrub or woodland. A climbing or twining plant species that flowers from August to May with peak flowering in November. One record within the Atlas of NSW Wildlife data occurs within the Lower Hunter Region and Central Coast at Green Point to the north of Belmont.	**Moderate** This species was not recorded within the site. It is considered that previous land management practices such as tree removal, clearing, grazing, trampling, underscrubbing and subsequent weed invasion within the site has reduced the habitat suitability for this species within the Coastal Wet Gully Forest. Low suitable habitat.
Diuris praecox Newcastle Doubletail (V, V*)	Found predominantly in coastal Eucalypt forests on hilltops or slopes which usually have a grassy to fairly dense understorey. This species has been recorded at a number of dry woodland locations to the south east of Lake Macquarie.	**Moderate** It is considered that previous land management practices such as tree removal, clearing, grazing, trampling, underscrubbing and subsequent weed invasion within the site has considerably reduced the habitat

Species / Community	Habitat Description	Chance of Occurrence On Site
		suitability. Low suitable habitat but seasonal survey not undertaken. Habitat likely to be conserved in less disturbed forested areas.
Epacris purpurascens var. *purpurascens* (V)	An erect shrub, 50-150 cm high that grows in sclerophyll forest, scrubs and swamps. This species occurs in a range of habitat types, most of which have a strong shale soil influence. Records for this species exist from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the south.	**Low** This species was not recorded within the site, with preferred habitat (shale influenced soils), not present within the site and known northern distribution limit being Gosford.
Eucalyptus camfieldii Camfield's Stringybark (V,V*)	This species has a restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park. This species generally occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas, with associated species including; stunted *E. oblonga*, *E. capitellata* and *E. haemastoma*.	**Low** This species was not recorded within the site, with preferred habitat not present within the site.
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea (V*)	*Grevillea parviflora* ssp. *parviflora* is distributed from Prospect to Camden and Appin, with disjunct northern populations occurring near Putty, Cessnock and Cooranbong. A number of records of the species from the locality are known from secure habitats within Werakata National Park and from a number of other 'unprotected' locations around Kurri Kurri, Heddon Greta, Ellalong and on the western slopes of the Sugarloaf Range.	**Low** This species was not recorded within the site. This species has been found in Spotted Gum forest, however, it is considered that previous land management practices such as tree removal, clearing, grazing, trampling, underscrubbing and subsequent weed invasion within the site has considerably reduced the habitat suitability. Low suitable habitat.
Melaleuca biconvexa Biconvex Paperbark (V, V*)	A shrub to small tree, which grows on poorly drained flats, near streams or low lying areas on alluvial soils or sheltered aspects from Jervis Bay to Port Macquarie. It may occur in dense stands adjacent to watercourses, in association with other Melaleuca species or as an understorey species in wet forest.	**Low** There is no suitable habitat (poorly drained flats) within the site.
Senecio spathulatus Coast Groundsel (E)	*Senecio spathulatus* is a specialised coastal species occurring mostly on frontal sand dunes and forming low, broad clumps. This species is known from Port Stephens to Sydney and flowers most of the year.	**Low** There is no suitable habitat (frontal sand dunes) within the site.
Syzygium paniculatum Magenta Lilly Pilly (V,V*)	A shrub to small tree found in sub-tropical and littoral rainforest on sandy soils or sheltered gullies mostly near water courses. Distribution between Bulahdelah and Jervis Bay.	**Moderate** This species was not recorded within the site, however the preferred habitat of sub-tropical and littoral rainforest is present within the site.

Species / Community	Habitat Description	Chance of Occurrence On Site
Tetratheca juncea Black-eyed Susan (V, V*)	Occurs in a variety of forested and heathy habitats. Usually found in low open forest/woodland with a mixed understorey and native grassy groundcover. Most commonly found on well drained sites and on ridges, although they have been found on upper slopes, mid slopes and occasionally in gullies.	**Moderate** This species was not recorded within the site. It is considered that previous land management practices such as tree removal, clearing, grazing, trampling, underscrubbing and subsequent weed invasion within the site has reduced the habitat suitability over much of the site, however there are small pockets of suitable habitat remaining. None were recorded during seasonal targeted surveys.
Zannichellia palustris (E)	An aquatic plant growing in slightly saline stationary or slowly flowing water. Recorded in Hexham Swamp and on Kooragang Island. NSW populations die back every summer.	**Low** There is no suitable habitat (slightly saline stationary or slowly flowing water) within the site.
Litoria aurea Green and Golden Bell Frog (E, V*)	*Litoria aurea* was formerly known to inhabit the eastern seaboard of New South Wales and Victoria from Byron Bay to the Gippsland Lake Region as well as highland sites (New England District, south-western slopes of N.S.W. and Monaro District). Recent literature indicates that it is no longer found on sites above an altitude of 300m above sea level. *L. aurea* species inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. *L. aurea* is thought to be displaced from more established sites by other frog species thus explaining its existence on disturbed sites. Inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. Thought to be displaced from more established sites by other frog species, thus explaining its existence on disturbed sites.	**Low** – This species was not recorded within the site during fieldwork. Potentially suitable habitat occurs at the wetland within the western quarry area however, surveys during the appropriate season failed to identify the species. This species is unlikely to occur within the site.
Litoria littlejohni Little John's Tree Frog (V, V*)	Occurs on the plateaus and eastern plains of the Great Dividing Range from scattered locations between the Watagan Mountains NSW south to Buchan in Victoria. It is pale brown dark speckles. Occurs along permanent rocky creeks with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. Despite its very large distribution there are very few records of the *Litoria littlejohni*. It is known to call through most of the year with a peak in Summer. Clusters of up to 60 eggs are attached to submerged twigs, stems or branches, often near the banks of still pools or clear, slowly flowing streams. Metamorphosis occurs mostly in the months of December and January.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Crinia tinnula Wallum Froglet (V)	Occurs in coastal, low-lying acid Paperbark forest, within the 'wallum country' (often on sandy soils). Known to occur within wet forest habitats in the Lower Hunter and western Lake Macquarie. Its distribution ranges from Maryborough in Queensland south to Kurnell near Sydney. A very small and cryptic frog that breeds in late winter to spring when males are heard calling and females lay approximately 120 eggs. It has a white or light brown belly with a little mottling or flecking and a mid line of white dots along the throat. Due to the species	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.

Species / Community	Habitat Description	Chance of Occurrence On Site
	preference for coastal swamps and associated areas along the east coast, *C. tinnula* is exposed to large habitat loss as this area has the highest growth rate in human population in Australia. Large populations have been recorded in the Myall Lakes National Park area and Moffats Swamp Nature Reserve near Medowie and it has been recorded on the western side of Lake Macquarie on the Morisset peninsula.	
Pseudophryne australis Red-crowned Toadlet (V)	Generally restricted to Hawkesbury Sandstone where it may be found beside temporary creeks, gutters and soaks and under rocks and logs. Breeds in deep leaf litter inundated with heavy rain (Robinson, M, 1998).	**Low** No suitable habitat occurs for the species and the species was not recorded during field surveys.
Mixophyes balbus Stuttering Frog (E, V*)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Breeds in streams during summer after heavy rain, outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Eggs are laid on rock shelves or shallow riffles in small, flowing streams.	**Low** No suitable habitat occurs for the species and the species was not recorded during field surveys.
Mixophyes iteratus Giant Barred Frog (V, E*)	Mostly restricted to wet sclerophyll forest and rainforest, including Antarctic Beech (Nothfagus moorei) forest. Usually found within close proximity to permanent running water (Robinson, M, 1998). Occur within damp leaf litter.	**Low** No suitable habitat occurs for the species and the species was not recorded during field surveys.
Hoplocephalus bungaroides Broad-headed Snake (E, V*)	Largely confined to Triassic sandstones, including the Hawkesbury, Narellan and Shoalhaven formations, within the coast and ranges. Nocturnal, sheltering by day in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. In summer it is known to become semi-arboreal in its search for prey including geckos and skinks, and will shelter in hollows in large trees within 200 m of rocky escarpments. *Hoplocephalus bungaroides* is regarded as potentially dangerous, although it has not been attributed to any human fatalities. Destruction of habitat, particularly the removal of sandstone slabs has lead to a decline in numbers.	**Low** No suitable habitat occurs for the species and the species was not recorded during field surveys.
Oxyura australis Blue-billed Duck (V)	A frequenter of deep freshwater swamps with thick vegetation. This species is wholly aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, buy prefers to dive. Most birds will leave their breeding swamps in favour of larger more open swamps and lakes for over-wintering. Most birds will nest in *Typha* sp. (Cumbungi) over deep water during spring/summer, they will also nest in trampled *Muehlenbeckia* sp. (Lignum) and *Eleocharis obicis* (Spike-rush). In NSW mostly occurring within 300km of the Murray-Darling basin, but may occur in more coastal areas during dry inland conditions.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Ardea ibis Cattle egret (M*)	Shallow open wetlands and mudflats. Moist pastures with tall grass. Often associated with grazing cattle.	**Low - Moderate** This species was not recorded within the site however, potential foraging habitat exists in the grasslands of disturbed land areas.

Species / Community	Habitat Description	Chance of Occurrence On Site
Ardea alba Great egret (M*)	Wetlands, flooded pastures, estuarine mudflats, dams, mangroves and reefs.	**Low - Moderate** This species was not recorded within the site however, potential foraging habitat exists at the small dams on the site.
Ephippiorhynchus asiaticus Black-necked Stork (E)	Inhabits swamps associated with river systems and large permanent pools but sometimes appears on the coast or in estuaries. Also recorded from small isolated swamps. It has also been recorded on farm dams and sewage treatment ponds.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Ixobrychus flavicollis Black Bittern (V)	Solitary species, living near water (estuarine to brackish) in mangroves and other trees which need to form only a narrow fringe of cover. Generally stays close to permanent water and dense vegetation. Has been known to be over permanent water in rainforest. A riparian species that occasionally ventures into the open within estuarine habitats. Roosts in trees or on the ground amongst dense reeds. Nests are built in spring on branches overhanging water and consist of either sticks, or reeds, or both.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Pandion haliaetus Osprey (V, M*)	Requires water bodies for fishing in close proximity (usually <1km) to suitably tall nesting site such as dead tree, power pole etc. Essentially and estuarine species, but an accidental species to inland / freshwater wetland habitats. They occur over habitats such as heath, woodland and forest when travelling to and from foraging sites.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Haliaeetus leucogaster White-bellied Sea Eagle (M*)	Inhabit areas near large bodies of water. Forages on large water bodies. Perches, roosts and nests in trees.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate foraging habitat.
Irediparra gallinacean Comb-crested Jacana (V)	This species inhabits mostly deep permanent freshwater wetlands that are abundant with floating aquatic vegetation that forms dense mats or rafts on the surface of the water. Known to breed as far south as Mandalong within the Hunter.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat. The single small dam on the site is unlikely to provide suitable habitat for the species.
Rostratula australis Australian Painted Snipe (E, V*)	A small freshwater and estuarine wader, which prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat. The single small dam on the site is unlikely to provide suitable habitat for the species.
Ptilinopus magnificus Wompoo Fruit-Dove (V)	Frugivorous bird favouring rainforest, occasionally straying to other forest types containing fruiting trees. A nomadic species that sometimes roosts in dry forest adjacent to rainforest habitats and is known to access small rainforest remnants. Feeds on diverse range of fruits from trees and vines. Follows ripening fruit.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat. While some rainforest species occur within the forest communities on the site, the species generally requires intact rainforest communities and is unlikely to occur.
Ptilinopus regina Rose-crowned Fruit-	Generally lives in rainforest of many variations, though it also frequents brushes of coastal districts as well as Eucalypt forests and mangroves.	**Low** – This species was not recorded within the site during fieldwork. This

Species / Community	Habitat Description	Chance of Occurrence On Site
Dove (V)	Favoured rainforest habitat consists of sub-tropical to dry rainforest and quite commonly littoral rainforest. They feed entirely on fruit from vines, trees and shrubs and mostly feed in the tops of trees or just under the foliage, where the fruit grows. *Ptilinopus regina* can be locally nomadic according to fruiting or part migratory according to fruit ripening.	species is unlikely to occur within the site due to the lack of appropriate habitat. While some rainforest species occur within the forest communities on the site, the species generally requires intact rainforest communities and is unlikely to occur.
Ptilinopus magnificus Wompoo Fruit-Dove (V)	Frugivorous bird favouring rainforest, occasionally straying to other forest types containing fruiting trees. A nomadic species that sometimes roosts in dry forest adjacent to rainforest habitats and is known to access small rainforest remnants. Feeds on diverse range of fruits from trees and vines. Follows ripening fruit.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat. While some rainforest species occur within the forest communities on the site, the species generally requires intact rainforest communities and is unlikely to occur.
Callocephalon fimbriatum Gang-gang Cockatoo (V)	Found in the summer months in tall mountain forests and woodlands, and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas.	**Low - Moderate** This species was not recorded within the site, however potential foraging habitat exists in the three forest vegetation communities of the site.
Calyptorhynchus lathami Glossy Black-Cockatoo (V)	Occurs in forests and woodlands where it forages predominantly on *Allocasuarina* cones, particularly those of *A.littoralis*, *A. torulosa* and occasionally *A. distyla*. Requires large Eucalypt tree hollows for nesting.	**Moderate** This species was not recorded within the site. Suitable foraging habitat occurs in the form of individual trees and small stands of *Allocasuarina* species.
Glossopsitta pusilla Little Lorikeet (V)	*Glossopsitta pusilla* extends from Cairns to Adelaide coastally and to inland locations. Commonly found in dry, open eucalypt forests and woodlands. Can be found in roadside vegetation to woodland remnants. *G. pusilla* feeds on abundant flowering Eucalypts, but will also take nectar from, *Melaleuca* sp and *Mistletoe* sp. *Eucalyptus albens* (White Box) and *E. meliodora* (Yellow Box) are favoured food sources on the western slopes in NSW. On the eastern slopes and coastal areas favoured food sources are *Corymbia maculata* (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. robusta* (Swamp Mahogany) and *E. pilularis* (Blackbutt). Nesting takes place in hollow bearing trees.	**Moderate** This species was not recorded within the site, however potential habitat exists in the three forest vegetation communities of the site.
Lathamus discolor Swift Parrot (E, E*)	On the mainland this species frequents Eucalypt forests and woodlands with large trees having high nectar production during winter. Mainland winter foraging sites often vary from year to year as a consequence of varying eucalypt blossoming cycles. Preferred winter flowering species in NSW include *Corymbia maculata* (Spotted Gum), *Eucalyptus fibrosa* (Broad-leaved Ironbark), *E. crebra* (Narrow-Leaved Ironabrk), *E. sideroxylon* (Mugga Ironbark), *E. albens* (White Box) and *E. tereticornis* (Forest Red Gum). *Lathamus discolour* also uses these species for lerping. Such species include *E. fibrosa* (Broad-leaved Ironbark), *E. moluccana* (Grey Box), *E. tereticornis* (Forest Red Gum). Nests only in Tasmania during	**Moderate** This species was not recorded within the site, however potential foraging habitat exists in the three forest vegetation communities of the site.

Species / Community	Habitat Description	Chance of Occurrence On Site
	spring/summer. *L. discolor* uses some of these tree species for roosting purposes as well.	
Neophema pulchella Turquoise Parrot (V)	Inhabits forests and woodlands with suitable nest hollows and grassy foraging areas. Occurs in more easterly site on the Cumberland Plain and the Hunter Region.	**Low - Moderate** This species was not recorded within the site, however potential foraging habitat exists on the edge of forest vegetation communities and disturbed grasslands (with nearby trees) of the site.
Ninox connivens Barking Owl (V)	Occurs mainly in dry sclerophyll woodland. Nests in large Eucalypt hollows, and roosts in hollows or thick vegetation. Hunts a range of prey species including birds and both terrestrial and arboreal mammals.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate woodland habitat.
Ninox strenua Powerful Owl (V)	Occurs in sclerophyll forests and woodlands where suitable prey species occur (being predominantly arboreal mammals). Requires large hollows, usually in Eucalypt trees, for nesting. Roosts in dense vegetation within such areas.	**Moderate** This species was not recorded within the site, however potential foraging habitat exists in the three forest vegetation communities of the site, and the species is known to occur at least within 6km of the site. No suitable sized tree hollows for breeding were recorded on the site.
Tyto novaehollandiae Masked Owl (V)	Found in a range of habitats, locally within sclerophyll forests and woodlands where appropriate / preferred prey species occur (being predominantly terrestrial mammals). Requires large Eucalypt hollows for nesting and these hollows are also preferred for roosting sites.	**Moderate** This species was not recorded within the site, however potential foraging habitat exists in the three forest vegetation communities of the site, and the species is known to occur at least within 6km of the site. No suitable sized tree hollows for breeding were recorded on the site.
Tyto tenebricosa Sooty Owl (V)	Occurs in wet Eucalypt forest and rainforest with tall emergent trees, often in easterly facing gullies. Within these areas this species hunts for a range of mainly mammalian prey at all levels of the forest strata. Roosts in tree hollow or dense canopy vegetation. Also nests in large Eucalypt tree hollows.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate wet eucalypt forest and rainforest habitat.
Hirundapus caudacutus White-throated Needletail (M*)	High open spaces of sky above all habitat types.	**High** – This species was not recorded within the site during fieldwork however, the species is likely to forage over the site on an occasional basis, particularly ahead of summer thunderstorms.
Apus pacificus Fork-tailed swift (M*)	Low to very high airspace over varied habitats ranging from rainforest to semi-desert.	**High** – This species was not recorded within the site during fieldwork however, the species is likely to forage over the site on an occasional basis, particularly ahead of summer thunderstorms.
Merops ornatus Rainbow Bee-eater (M*)	Migrates throughout mainland from northern Australia in September to April. Occurs in woodland, open forest, semi-arid scrub, grasslands and timbered plains, avoiding dense forest. Nests in ground tunnels.	**Moderate** This species was not recorded within the site, however potential foraging habitat exists across the site for the

Species / Community	Habitat Description	Chance of Occurrence On Site
		species.
Climacteris picumnus Brown Treecreeper (V)	Frequents drier forests and woodlands, particularly open woodland lacking a dense understorey. Also found in grasslands in proximity to wooded areas where there are sufficient logs, stumps and dead trees nearby. Occasionally found in mallee and *Eucalyptus camaldulensis* (River Red Gum) forest bordering wetlands with an open understorey of *acacia* sp., *Muehlenbeckia* sp. (Lignum), *Typha sp*. (Cumbungi) and *Poa* sp. (grasses). Usually found near coastal to inland slopes of the divide. Feeds on invertebrate larvae and small insects, particularly ants. Utilises hollows for roosting/nesting. Appears not to persist in remnants less than 200ha.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Anthochaera phrygia Regent Honeyeater (E, E*, M*)	*A. phrygia* occurs in temperate woodlands and open forest, including forest edges. Seasonal movements appear to be dictated by the flowering of various species of *Eucalypt* sp. that are characteristic of the dry forests and woodlands of South-Eastern Australia. *Anthochaera phrygia* prefers to forage on large-flowered Eucalypts (e.g. *Eucalyptus sideroxylon*, *E. melliodora*, *E. albens, E. leucoxylon*) and also *Corymbia maculata* (Spotted Gum) particularly where these trees grow in more productive areas and yield plentiful and predictable nectar flows. This species has been recorded in Werakata National Park and has also been recorded over several seasons within Aberdare State Forest. Regionally, records exist from a number of conservation reserves including Cattai, Scheyville, Blue Mountains, Brisbane Water, Dharug, Bouddi, Wollemi and Yengo National Parks and Muogamarra Nature Reserve.	**Moderate** This species was not recorded within the site, however potential foraging habitat exists in the three forest vegetation communities of the site.
Melanodryas cucullata Hooded Robin (V)	Primarily known from Eucalypt forest, woodland and scrub, although has been known to use cleared paddocks with regrowth or stumps in close proximity to wooded areas. These areas are favoured due to the feeding habit of perch and pounce. Areas with sparse shrub cover and fallen timber. Occurs on the western slopes and west of the divide, also on the eastern slopes, with occasional records east of the divide. Appears unable to persist in remnants less than 100-200ha.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Monarcha melanopsis Black-faced monarch (M*)	Rainforests, mangroves and adjacent eucalypt woodlands.	**Moderate** This species was not recorded within the site however, potential foraging habitat exists in the two rainforest vegetation communities of the site.
Myiagra cyanoleuca Satin Flycatcher (M*)	Forests and woodlands, mangroves and coastal heath scrubs.	**Moderate** This species was not recorded within the site however, potential foraging habitat exists in the three forest vegetation communities of the site.
Rhipidura rufifrons Rufous fantail (M*)	Rainforest, wet eucalypt forest, paperbark and mangrove swamps, also riverside vegetation. Will use more open habitats when migrating.	**Moderate** This species was not recorded within the site however, potential foraging

Species / Community	Habitat Description	Chance of Occurrence On Site
		habitat exists in the two rainforest vegetation communities of the site.
Chthonicola sagittata Speckled Warbler (V)	Occupies Eucalypt and Cypress woodlands in drier areas and on the western/eastern slopes of the Great Dividing Range. More commonly found on the western slopes, mainly due to habitat. Requires a grassy understorey, a sparse shrub layer and an open canopy. Most foraging takes place on ground around tussocks, around bushes and trees. Appears unable to persist in districts where no forested fragments larger than 100ha remain.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Phascolarctos cinereus Koala (V)	Occurs in forests and woodlands where it requires suitable feed trees (particular *Eucalyptus* spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions.	**Low** This species was not recorded within the site. The preferred feed tree, *Eucalyptus punctata* (Grey Gum) was recorded at greater than 15% of the canopy cover at a single survey site within the site. However the species is unlikely to occur due to the disturbed nature and level of fragmentation of the site.
Dasyurus maculatus maculatus Spotted-tailed Quoll (V,E*)	Found in a variety of forested habitats. This species creates a den in fallen hollow logs or among rocky outcrops. Generally does not occur in otherwise suitable habitats that are in close proximity to urban development.	**Low** This species was not recorded within the site. While possible foraging habitat exists on the site, the high level of disturbance of the site, including the likely presence of domestic/feral cats and stray dogs, suggests that the species is unlikely to occur on the site. The isolated location of the site also suggests that the site is unlikely to form part of an individual home range area.
Petaurus norfolcensis Squirrel Glider (V)	Occurs in eucalypt forests and woodlands where It feeds on sap exudates and blossoms. This species is generally absent from rainforest and closed forest. A wide range of forest types have been recorded as habitat for *Petaurus norfolcensis,* these include, *Euaclyptus camldulensis* (River Red Gum) Forest, Box-Ironbark Forests in the west, *E. pilularis* (Blcackbutt), *E. tereticornis* (Forest Red Gum) and *Corymbia gummifera* (Red Bloodwood) Forest, *Banksia integrifolia* (Coastal Banksia) Heathland and *E.punctata* (Grey Gum)/*C. maculata* (Spotted Gum)/ *E. paniculat* ssp. *paniculata* (Grey Ironabrk) Forests. In these areas tree hollows are utilised for nesting sites. Also requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species. As such *P.norfolcensis* requires habitat with a mix of *eucalyp*t, *acacia* and *bansksia* sp. with winter and summer flowering species and smooth/rough barked Eucalypts.	**High –** This species was not detected during targeted field surveys on site at the time of survey. The 40.78 hectares of three forest vegetation communities provides suitable habitat area to support a viable population of the species. Suitably sized tree hollows occur along the gully habitat areas for the species. The site is potentially linked to other populations of the species to the east of the site via the corridor that extents to the east. North and south from the corridor there are potential links (via aerial photograph interpretation of gaps less than 70 metres) for the species to move between the site and the Blackbutt Reserve area to the north and the Tingara Heights area to the south. Squirrel Gliders have been recorded on properties neighbouring the site and it is therefore likely that they also occur on the site.
Petaurus australis	Usually associated with tall, mature wet Eucalypt forest. Also known from tall dry open forest and	**Low** – This species was not recorded within the site during fieldwork. This

Species / Community	Habitat Description	Chance of Occurrence On Site
Yellow-bellied Glider (V)	mature woodland. The diverse diet of this species is primarily made up of Eucalypt nectar, sap, honey dew, manna and invertebrates found under decorticating bark and pollen. Tree hollows for nest sites are essential, as are suitable food trees in close proximity.	species is unlikely to occur within the site due to the lack of appropriate habitat.
Petrogale penicillata Brush-tailed Rock Wallaby (E, V*)	Occurs in forests and woodlands along the Great Divide and on the western slopes in escarpment country with rocky outcrops, steep rocky slopes, gorges, boulders and isolated rocky areas. The majority of populations favour north-facing aspects, but some southern aspects have been recorded. Apart from the critical rock structure *Petrogale pencillata* also requires adjacent vegetation types, associated types include, dense rainforest, wet sclerophyll, vine thicket, dry sclerophyll forest and open forest. They also require suitable caves and rocky overhangs for shelter and also for 'lookout' posts.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Potorous tridactylus Long-nosed Potoroo (V, V*)	Prefers cool rainforest, wet sclerophyll forest and heathland. Essentially, requires dense understorey with occasional open areas. These open areas most likely consist of sedges, ferns, heath or grass-trees. Sleeps by day in a nest on the ground, and digs for succulent roots, tubers, fungi and subterranean insects. Some diggings seemingly attributable to this species may belong to *Isoodon macrourus* (Northern Brown Bandicoot). Generally east of the divide, hides by day in dense vegetation, sometimes feeds during winter during daylight hours during overcast or low light conditions.	**Low** – This species was not recorded within the site during fieldwork. This species is unlikely to occur within the site due to the lack of appropriate habitat.
Pteropus poliocephalus Grey-headed Flying Fox (V, V*)	Forages over a large area for nectar / fruits etc. Seasonally roosts in communal base camps situated within wet sclerophyll forests or rainforest. Frequently observed to forage in flowering Eucalypts.	**High** This species was recorded foraging on the site during both nights of spotlighting.
Mormopterus norfolkensis Eastern Freetail-bat (V)	This species forages predominantly in dry forests and woodlands east of the divide. It roosts in tree hollows, under bark and within man-made structures.	**Moderate** This species was not recorded within the site however suitable foraging habitat exists.
Miniopterus australis Little Bentwing Bat (V)	Prefers to forage in well-vegetated areas, such as within wet and dry sclerophyll forests and rainforests. Requires caves or similar structures for roosting habitat. Largely confined to more coastal areas.	**High** Recorded during field surveys.
Miniopterus schreibersii Common Bentwing-bat (V)	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat.	**High** Recorded during field surveys.
Scoteanax rueppellii Greater Broad-nosed Bat (V)	Forages in moister gullies and wet sclerophyll forests as well as in lightly wooded areas and open spaces / ecotones. This species roosts in tree hollows, especially *Eucalyptus* sp.	**Moderate** This species was not recorded within the site however potentially suitable foraging habitat exists.

Species / Community	Habitat Description	Chance of Occurrence On Site
Vespadelus troughtoni Eastern Cave Bat (V)	A cave dweller, known from wet sclerophyll forest and tropical woodlands from the coast and Dividing Range to the drier forests of the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally in buildings. In all situations, the roost sites are frequently in reasonably well-lit areas.	**Moderate** This species was not recorded within the site however potentially suitable foraging habitat exists.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat (V)	Range of habitats from rainforest to arid shrubland, roosts in tree-hollows, sometimes roosts in mammal burrows when no hollows available. Seasonal movements are unknown, may migrate to southern Australia in summer. Feeds by foraging for insects over the canopy, but flys low in arid shrubland.	**Moderate** This species was not recorded within the site however potentially suitable foraging habitat exists.
Chalinolobus dwyeri Large-eared Pied Bat (V*)	This species is mainly found in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. Records of this species exist in dry sclerophyll forest and woodland, both to the east and west of the Great Divide. Recordings of this species have also been made in subalpine woodland and at the ecotone of rainforest and wet Eucalypt forest.	**Low** This species was not recorded within the site. While potentially suitable foraging habitat exists within the site the lack of extensive areas of cliffs and caves suggests the species is unlikely to occur.
Falsistrellus tasmaniensis Eastern False Pipistrelle (V)	This species is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m). This species roosts in tree hollows.	**Moderate** This species was not recorded within the site however potentially suitable foraging habitat exists.
Myotis adversus Large-footed Myotis (V)	Usually found near bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Although usually recorded foraging over wet areas, it also utilises a variety of wooded habitats adjacent to such areas including rainforest, wet and dry sclerophyll forest, woodland, and swamp forest. Roosts in small colonies of between 15 and several hundred individuals in caves, mines and disused railway tunnels.	**Moderate** This species was not recorded within the site however despite the small area of waterbodies additional potentially suitable foraging habitat exists in the forested areas.

Key: **(V) =** Vulnerable Species listed under *TSC Act*.

(E) = Endangered Species listed under *TSC Act*.

(EP) = Listed as an Endangered Population under the *TSC Act.*

(V*) = Vulnerable Species listed under *EPBC Act*.

(CE*) = Critically Endangered Species listed under *EPBC Act.*

(M*) = Listed as a Migratory species under the *EPBC Act*.

4 Legislative Considerations

4.1 Threatened Species Conservation Act 1995

4.1.1 Threatened Species

An assessment of the likelihood of occurrence (**Table 3-6**) identified the following threatened species listed on the *TSC Act* as likely to occur on the site:

Vulnerable Species

- Squirrel Glider
- Grey-headed Flying Fox
- Little Bentwing Bat
- Common Bentwing-bat

The assessment also identified the following species with a moderate chance of occurring on the site.

Endangered Species

- Swift Parrot
- Regent Honeyeater
- *Cynanchum elegans*

Vulnerable Species

- *Angophora inopina*
- *Diuris praecox*
- *Syzygium paniculatum*
- *Tetratheca juncea*
- Gang-gang Cockatoo
- Glossy Black-Cockatoo
- Little Lorikeet
- Turquoise Parrot
- Powerful Owl
- Masked Owl
- Eastern Freetail-bat
- Greater Broad-nosed Bat
- Eastern Cave Bat
- Yellow-bellied Sheathtail-bat
- Eastern False Pipistrelle
- Large-footed Myotis

Of the above species the proposed rezoning may impact on the following species for the following reasons:

- **Squirrel Glider**. The Squirrel Glider is considered highly likely to occur on the site (see **Section 3.5.8**). Woodland areas of the three mapped forest vegetation communities provide potential habitat for the Squirrel Glider, either as direct resident habitat areas or as potential movement paths throughout the site. The proposed rezoning may result in the removal of trees for the subdivision or construction of new buildings. To conserve the likely population of the Squirrel Glider within the site, the rezoning should seek to conserve the forest areas within the site as conservation areas for the protection of the Squirrel Glider. The potential removal of forest areas associated with the rezoning could result in a significant impact on the local Squirrel

Glider population (assumed presence) through a reduction in habitat area and a likely increase in the level fragmentation and isolation of the available habitat. Any proposed future removal of forest areas would require further study of the Squirrel Glider to determine the likely level of impact on the species.

- **Grey-headed Flying-fox**. The site provides foraging habitat for the Grey-headed Flying-fox during periods of eucalypt flowering. The potential removal of forest areas as part of the rezoning would have a negligible impact on the Grey-headed Flying-fox through a minor reduction in the area of available habitat. Conservation of forest areas within the site for the Squirrel Glider would also conserve foraging areas for the Grey-headed Flying-fox.
- **Threatened bat species**. Two threatened bat species were identified during field surveys and potentially suitable habitat exists on the site for a further six species (see **Section 3.6**). Forest areas within the site provide potential foraging habitat for all eight species, and potential roosting sites for tree hollow-roosting species. The potential removal of forest areas as part of the rezoning would have a negligible impact on cave roosting bat species through a minor reduction in the area of available foraging habitat. The potential removal of forest areas may have a larger impact on tree hollow roosting bat species through the potential loss of individuals and a reduction in the availability of roosting sites. However, provided a suitable tree felling protocol was established during clearing works, the level of impact on all bat species would be unlikely to be considered significant. Conservation of forest areas within the site for the Squirrel Glider would also conserve foraging areas for micro-bat species.
- ***Tetratheca juncea.*** While the habitat quality of forested areas is of a reduced level for *Tetratheca juncea*, there are small pockets of potentially suitable habitat areas. If areas of forest are to be removed as part of the proposed rezoning, appropriate seasonal survey should be undertaken of forest areas to identify potential habitat areas for the species. If the species is identified on the site an assessment of the likely level of impact could then be undertaken. If forest areas are to be conserved then further survey is not required.

The Proposal would be unlikely to significantly affect any of the other threatened species identified above. Any future development proposal will require the assessment of the likely level of impact on the above species under the *TSC Act* (seven-part tests). Such an assessment would only be possible once the precise nature any proposed future development proposal is known.

4.1.2 Threatened Populations

There is one threatened flora population known within Lake Macquarie LGA. This population is listed within the *TSC Act* as *Eucalyptus parramattensis* subsp. *parramattensis* in the Wyong and Lake Macquarie Local Government Areas. The DECCW website states that approximately 1300 specimens are known within the Wallarah and Porters creek catchments in the Wyong LGA while approximately 10 specimens are known from Lake Macquarie LGA. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (Swamp mahogany), *E. tereticornis* (Forest Red Gum), *E. gummifera* (Sydney Bloodwood) as well

as *Melaleuca* (Paperbark) species. This habitat type is not present within the site therefore it is considered that the presence of this threatened population within the site is unlikely.

4.1.3 Threatened Ecological Communities

One TEC listed on the *TSC Act*, **Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC** was identified on site as the vegetation community Coastal Wet Gully Forest. Areas of the EEC should be conserved where possible. It is likely that the removal of EECs within the site would require the provision of offsets so that the proposal meets the improve or maintain policy of DECCW. Such offsets that may be required by authorities include:

- The dedication of an occurrence of the same EEC within the locality to conservation in perpetuity;
- The dedication of a portion of the EEC within the site to conservation in perpetuity; and/or
- The rehabilitation of the EEC within the site or offsite and conservation in perpetuity.

The conservation of areas of EEC along with the other areas of forest vegetation would not only help to conserve Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC in the local area but would also assist in the conservation of the Squirrel Glider, Grey-headed Flying-fox, threatened micro-bat species and potentially *Tetratheca juncea*. Any future development proposal will require the assessment of the likely level of impact on the Coastal Wet Gully Forest EEC under the *TSC Act*, via a seven-part test.

4.1.4 Key Threatening Processes

Key Threatening Processes (KTPs) are listed under Schedule 3 of the *TSC Act*. While the proposed rezoning is unlikely to increase the operation of any KTPs, activities that may occur within the site as a result of the rezoning may potentially increase the operation of the following KTPs:

- *Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;*

  Potential changes in rezoning that result in an increase in buildings, creation of small farm dams, changes to water drainage, increases in rainfall capture and/or changes in ground cover would likely result in alteration of the natural flow regimes on the site.

- *Anthropogenic climate change;*

  Potential changes in rezoning that result in any increase in human activity or changes to ground cover on the site would likely increase the rate of anthropogenic climatic change in at least the short term.

- *Bushrock removal;*

  Potential changes in rezoning may result in the removal of bushrock as new residents move into the area or areas are cleared for new infrastructure.

- *Clearing of native vegetation;*

  Potential changes in rezoning may result in the clearing of native vegetation across the site resulting in an increase in the operation of the KTP – Clearing of native vegetation.

- *Loss of hollow-bearing trees;*

  Potential changes in rezoning may result in the removal of some trees with hollows, increasing the operation of the KTP – Loss of hollow-bearing trees.

- *Removal of dead wood and dead trees;*

  As the proposed rezoning would likely result in changes of land ownership the proposed changes in rezoning would likely result in the removal of dead wood and dead trees and an increase in the operation of the KTP – Removal of dead wood and dead trees.

4.2 State Environmental Planning Policy No. 44 – Koala Habitat Protection

Assessment of potential koala habitat under SEPP 44 requires the following steps be undertaken:

a) Identification of "potential Koala Habitats" within the proposed development area; if the total tree cover contains 15% or more of the koala food tree species listed in Schedule 2 of SEPP 44 then it is deemed to be "potential" koala habitat. Identification of 'potential koala habitat requires the determination of the presence of 'core koala habitat';

b) Identification of "core Koala habitat" within the development area. "Core Koala habitat" is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (females with young), recent sightings and historical records of a Koala population;

c) Identification of "core Koala habitat" will require that a plan of management must accompany the DA application;

d) If the rezoning of lands, other than to environmental protection, involves potential or core Koala habitat then the Director of planning may require a local environmental study be carried out.

Lake Macquarie LGA is listed on Schedule 1 of SEPP 44 and therefore the proposed rezoning is subject to SEPP 44 assessment.

One tree species listed on Schedule Two of SEPP 44, *Eucalyptus punctata* (Grey Gum), was recorded in the Coastal Foothills Spotted Gum – Ironbark Forest community on the site. Grey Gum was recorded at less than 15 percent of the total canopy cover and was infrequently recorded within the vegetation community. The site therefore does not constitute "Potential Koala Habitat".

Additionally no known records exist for the koala within a four kilometre radius of the site and no signs of the species presence were recorded during spotlight surveys or opportunistically during other survey activities. No koala scats were opportunistically recorded. Given the high density of surrounding residential areas the koala is highly unlikely to be present without previously being recorded in the area by residents. The site does not contain 'core koala habitat'.

4.3 State Environmental Planning Policy No. 14 – Coastal Wetlands

No coastal wetlands as mapped by SEPP 14 occur within the site. The nearest SEPP 14 coastal wetlands occur 1.2 kilometres to the west of the site, on the western side of Cockle Creek where it flows into Lake Macquarie. The proposed rezoning is unlikely to affect any coastal wetlands.

4.4 State Environmental Planning Policy No. 26 – Littoral Rainforest

No littoral rainforests as mapped by SEPP 26 occur within the site. The nearest SEPP 26 area of littoral rainforest occurs 5.8 kilometres to the south of the site in the Green Point area. The proposed rezoning will not affect any areas of littoral rainforest as mapped by SEPP 26.

4.5 Environment Protection and Biodiversity Conservation Act 1999

An *EPBC Act* Protected Matters Database Search was undertaken using the DEWHA on-line database (accessed 8 December 2010) to generate a list of relevant matters of National Environmental Significance (NES) within 10 kilometres of the boundary of the site.

The matters of NES relevant to a flora and fauna assessment are:

- Wetlands of International Significance (RAMSAR sites);
- Threatened ecological communities;
- Threatened species;
- Migratory species; and
- Critical Habitats

4.5.1 Wetlands Protected by International Treaty (the RAMSAR Convention)

The *EPBC Act* Protected Matters Database Search identified that the site is within 10 kilometres one RAMSAR wetland, the Hunter Estuary Wetlands. The proposed rezoning is unlikely to significantly impact on the Hunter Estuary Wetlands as the site is not part of the catchment for the Hunter Estuary Wetlands.

4.5.2 Nationally Listed Threatened Species and Ecological Communities

Section 3.1 lists the threatened species, migratory species and threatened ecological communities identified during the *EPBC Act* Protected Matters Database. Following the above likelihood of occurrence assessment (**Table 3-6**) the following *EPBC Act* species were identified with a moderate chance of occurring on the site on a rare or seasonal basis.

Endangered Species

- *Cynanchum elegans*
- Regent Honeyeater
- Swift Parrot

Vulnerable Species

- *Diuris praecox*
- *Syzygium paniculatum*
- Grey-headed Flying-fox

The above three plant species have a moderate chance of occurrence within the site (see **Section 3.6**). If the proposed rezoning is likely to result in the removal of areas of forest habitat from the site, populations of the three above plant species may be significantly impacted if they occur in the potential impact areas. However if the forest areas of the site are conserved as part of the rezoning proposal then there would be unlikely to be a significant impact on any of the three above plant species.

The site provides potential foraging habitat for the Regent Honeyeater and Swift Parrot during winter periods of heavy eucalypt flowering. The proposed rezoning is unlikely to have a significant impact on either of the species due to their high mobility and the availability of other potential foraging sites within the region. The Grey-headed Flying-fox is also unlikely to be significantly impacted by the proposed rezoning due to the availability of other foraging sites within the region. Incorporation of forested areas into a conservation zone as part of the rezoning proposal would help to conserve foraging areas of the Grey-headed Flying-fox, potential foraging areas of the Swift Parrot and Regent Honeyeater, and protect potential habitat areas of *Cynanchum elegans, Diuris praecox* and *Syzygium paniculatum.*

A search of Matters of National Environmental Significance within an area of 10km of the site revealed the following federally listed TECs:

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Both of these Threatened Ecological Communities are listed as Critically Endangered within the *EPBC Act*. Neither of these communities have suitable habitat nor were they

observed within the site. No TECs listed on the *EPBC Act* are known or likely to occur on the site.

4.5.3 Nationally Listed Migratory Species

A total of nine migratory species listed under the *EPBC Act* (**Sections 3.1** & **3.6**) have been recorded or have suitable habitat within a 10 km radius of the site. The nine species are:

- Great Egret
- Cattle Egret
- White-throated Needletail
- Fork-tailed Swift
- Rainbow Bee-eater
- Black-faced Monarch
- Satin Flycatcher
- Rufous Fantail
- Regent Honeyeater

All nine migratory species may occur on the site on an irregular basis. The Black-faced Monarch and Rufous Fantail may occur in the gully vegetation communities during seasonal movements. The Satin Flycatcher and Rainbow Bee-eater may occur in forest vegetation communities during spring/summer migrations to the region. The Regent Honeyeater may forage on the site during periods of winter flowering eucalypts. The White-throated Needletail and Fork-tailed Swift may occur high over the site, particularly associated with summer storms. The Cattle Egret and Great Egret may occur at the wetlands or disturbed pasture areas at anytime throughout the year. Given the highly mobile nature of all of the above species and the availability of similarly suitable areas within the region, the proposed rezoning is unlikely to have a significant impact on any of the above migratory species. Additionally if the forest areas of the site are conserved as part of the rezoning proposal, the proposed rezoning is highly unlikely to have a significant impact on any of the above migratory species.

4.6 Water Management Act 2000 (WM Act)

Controlled activities carried out in, on or under waterfront land are regulated by the WM Act. The NSW Office of Water (NOW – previously DWE) is required to assess the impact of a controlled activity to ensure that minimal harm will be done to any waterfront land. Waterfront land is defined as “the bed and a distance inland of 40 metres from a river, lake or estuary” (DWE, 2008).

In order to determine the appropriate width for a riparian corridor and the amount of vegetation which should be protected or re-established on a site it is necessary to determine the order of each watercourse onsite. The order of a watercourse is determined using the Strahler System of ordering watercourses.

The Guidelines for Controlled Activities (DWE, 2008) recommend:

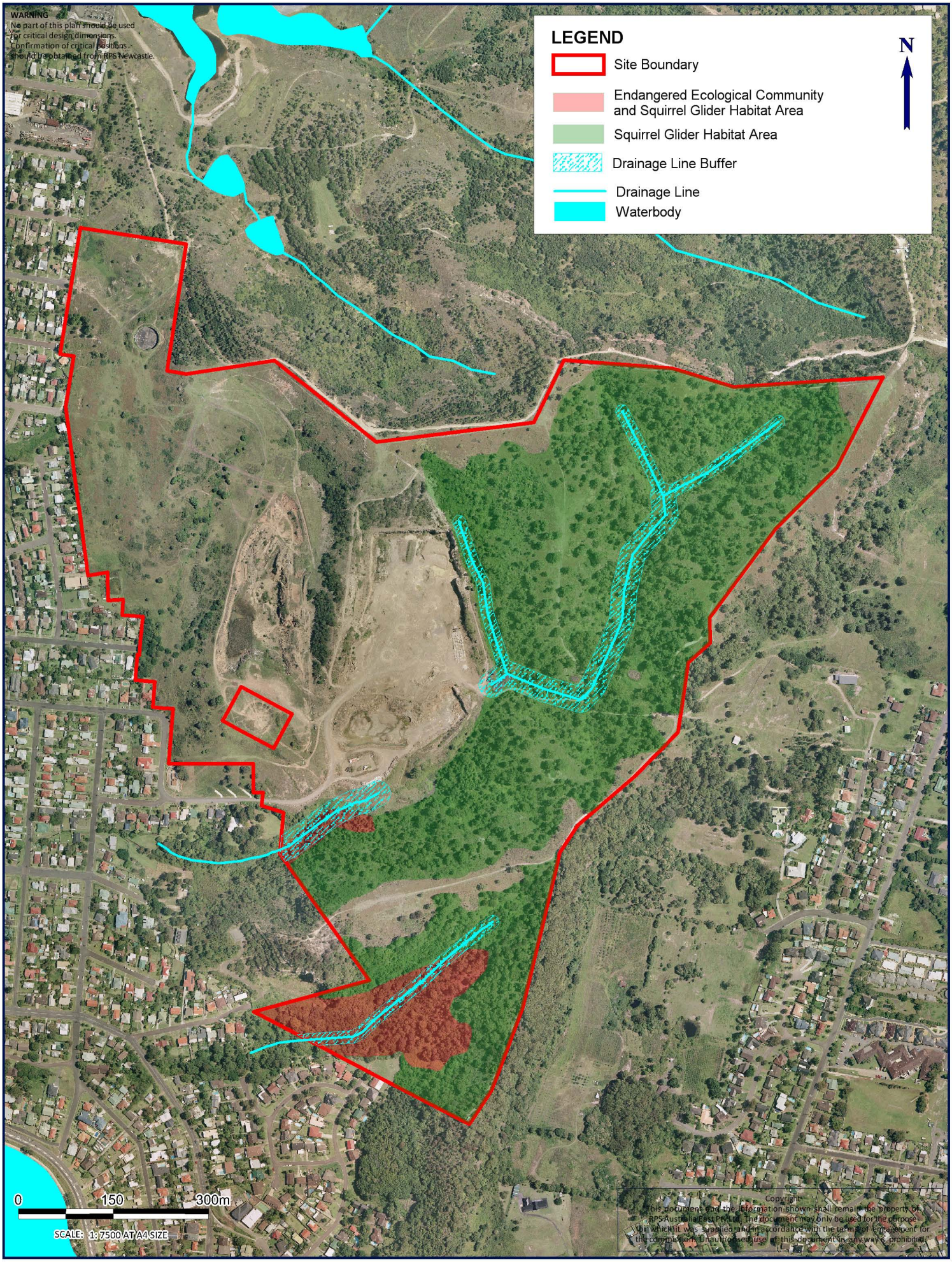
- A Core Riparian Zone (CRZ) of 10m is required for a ‘first’ order stream,
- CRZ of 20 m for a ‘second’ order stream;

- CRZ of 20-40m for a ‘third’ order stream.

CRZ widths should be measured from the top of the highest bank and on both sides of the watercourse. In addition to a CRZ, a vegetation buffer (VB) is recommended of up to 10m.

Within the site “first order” and “second order” watercourses occur. A CRZ of 10m either side of any ‘first’ order stream and a CRZ of 20m either side of any ‘second’ and ‘third’ order stream onsite is demonstrated within **Figure 4-1.** The width of the VB on top of the CRZ is recommended to be 10m; however consultation between the proponent and DWE is required to establish the appropriate riparian corridors necessary.

A Vegetation Management Plan (VMP) may also be required outlining the establishment and management of a riparian corridor and to be submitted to NOW for approval. A VMP may be required to be submitted prior to the issue of approval for works to commence.



TITLE: FIGURE 4-1 CONSTRAINTS MAP

LOCATION: SPEERS POINT

DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 1/7/2010
PURPOSE: REPORT FIGURE

J:\JOBS\26K\26292-Speers Point\10-Drafting\Mapinfo\Report Figures\26292 Figure 4-1 Constraints Map.wor
LAYOUT REF:
VERSION (PLAN BY): A-A4 (SC/SC)

CLIENT: LAKE MCQUARIE CITY COUNCIL
JOB REF: 26292

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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5 Constraints and Opportunities

A discussion of the potential ecological constraints and opportunities for development is given below. **Figure 4-1** has incorporated the potential constraints into an ecological constraints map.

5.1 Threatened Species and Endangered Populations

The proposed rezoning may impact on the following threatened species or endangered populations for the following reasons:

- **Squirrel Glider**. The Squirrel Glider is considered highly likely to occur on the site (see **Section 3.5.8**). Woodland areas of the three mapped forest vegetation communities provide potential habitat for the Squirrel Glider, either as direct resident habitat areas or as potential movement paths throughout the site. The proposed rezoning may result in the removal of trees for the subdivision or construction of new buildings. To conserve the likely population of the Squirrel Glider within the site, the rezoning should seek to conserve the forest areas within the site as conservation areas for the protection of the Squirrel Glider. The potential removal of forest areas associated with the rezoning could result in a significant impact on the local Squirrel Glider population (assumed presence) through a reduction in habitat area and a likely increase in the level fragmentation and isolation of the available habitat. Any proposed future removal of forest areas would require further study of the Squirrel Glider to determine the likely level of impact on the species.
- **Grey-headed Flying-fox**. The site provides foraging habitat for the Grey-headed Flying-fox during periods of eucalypt flowering. The potential removal of forest areas as part of the rezoning would have a negligible impact on the Grey-headed Flying-fox through a minor reduction in the area of available habitat.
- **Threatened bat species**. Two threatened bat species were identified during field surveys and potentially suitable habitat exists on the site for further six species (see **Section 3.6**). Forest areas within the site provide potential foraging habitat for all eight species, and potential roosting sites for tree hollow-roosting species. The potential removal of forest areas as part of the rezoning would have a negligible impact on cave roosting bat species through a minor reduction in the area of available foraging habitat. The potential removal of forest areas may have a larger impact on tree hollow roosting bat species through the potential loss of individuals and a reduction in the availability of roosting sites. However, provided a suitable tree felling protocol was established during clearing works, the level of impact on all bat species would be unlikely to be considered significant.
- ***Tetratheca juncea.*** While the habitat quality of the forested areas within the site are of a reduced level for *Tetratheca juncea*, there are some small pockets of potentially suitable habitat areas. If areas of forest are to be removed as part of the proposed rezoning, appropriate seasonal survey should be undertaken of forest areas to identify habitat areas for the species. If the species is identified on the site an assessment of the likely level of impact could then be undertaken. If forest areas are to be conserved then further survey is not required.

Conservation of forested areas within the proposed rezoning would remove the above potential impacts on the Squirrel Glider, Grey-headed Flying-fox, threatened micro-bat species and *Tetratheca juncea*. Additionally the conservation of forested areas as part of the rezoning proposal would assist in the regional conservation of the Squirrel Glider, Grey-headed Flying-fox, threatened micro-bat species and *Tetratheca juncea,* through the retention of habitat areas of the species within the region.

5.2 Threatened Ecological Communities

One EEC listed on the *TSC Act*, **Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC** was identified on site as the vegetation community Coastal Wet Gully Forest. Areas of the EEC should be conserved where possible. It is likely that the removal of EECs within the site would require the provision of offsets so that the proposal meets the improve or maintain policy of DECCW. Such offsets that may be required by authorities include:

- The dedication of an occurrence of the same EEC within the locality to conservation in perpetuity;
- The conservation of a portion of the EEC within the site to conservation in perpetuity; and/or
- The rehabilitation of the EEC within the site or offsite and conservation in perpetuity.

The conservation of areas of EEC along with the other areas of forest vegetation would not only help to conserve Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC in the local area but would also assist in the conservation of the Squirrel Glider, Grey-headed Flying-fox, threatened micro-bat species and potential *Tetratheca juncea*.

5.3 Riparian Areas

The tributaries of Stony Creek that occur throughout the site may require CRZs and VBs as recommended within the NOW (DWE) Guidelines. Consultation with NOW will be required to determine the final widths of any CRZ and/or VBs of these tributaries. It is likely that focus will be on the larger, well defined creek lines that have remnant riparian vegetation. It may be that smaller “first” and possibly some “second order” creek lines will be able to be developed for the full rehabilitation and protection of the “third order” creek line.

As the drainage lines within the site occur either solely within or on the boundary of the forested areas within the site, the conservation of forested areas as part of the proposed rezoning would likely remove the need for establishment of CRZs and VB’s.

5.4 Wildlife Corridors

The Lake Macquarie Native Vegetation and Corridors Map (LMCC 2009) (**Figure 3-1**), identifies the vegetation on the site as a corridor of partially cleared remnant native vegetation. The only significant corridor linking the vegetation of the site to nearby similar vegetation occurs to the east of the site, mapped as a less than 200 metre wide corridor of remnant native vegetation. All other corridors mapped on the Lake Macquarie Native Vegetation and Corridors Map (LMCC 2009) are unlikely to provide significant paths or corridors of movement for species with moderate or low movement and dispersal abilities. Highly mobile species (mainly birds) may use such corridors to move to and from the site.

The potential removal of forested areas would likely result in a significant reduction in the area of forest habitat in the Speers Point to Macquarie Hills area. While the site represents approximately half of the native vegetation cover in the Speers Point/Macquarie Hills area, aerial photograph interpretation suggests that the native vegetation that occurs to the north of the site is dominated by shrubs and regenerating trees and contains few mature trees in comparison to the proposed rezoning site. Native vegetation areas to the north of the site are likely of a lower habitat quality than the forested areas of the site due a likely reduction in mature tree and tree hollow density, increased fragmentation and isolation of mature tree areas. The potential removal of forested areas within the site would likely significantly reduce the habitat quality of the native vegetation to the north of the site due to increases in fragmentation and isolation of the remaining vegetation.

Potential removal of any or all of the forested areas within the site could significantly impact on the Squirrel Glider in the local area, directly through the loss and reduction of habitat areas and indirectly through a reduction in landscape connectivity. Any proposal to remove areas of forested vegetation from within the site should only be approved after further study into the likely Squirrel Glider population present.

Conservation of the forested areas of the site as part of the rezoning proposal would help to conserve the habitat areas and landscape connectivity for many species in the local area.

5.5 Regional Biodiversity Value

Within Lake Macquarie City Council area, the forest vegetation of the site is one of the few remaining large areas of forest vegetation in Lake Macquarie between the coast and Lake Macquarie/Cockle Creek. The site is positioned approximately centrally between the extensive areas of forest vegetation west of Teralba and the few remaining remnants of forest vegetation in the Hillsborough to Mount Hutton area. Due to its location the site provides an important habitat area for threatened and non-threatened species in an otherwise urban developed landscape. Additionally the sites orientation within the landscape facilitates an important stop-over function for highly mobile species moving within the landscape.

Incorporation of the forested areas into conservation zones as part of the rezoning proposal would assist in the conservation of habitat areas for threatened and non-threatened species within the Lake Macquarie City Council area, and this locality in particular.

6 Recommendations

The following constraints or opportunities are associated with any proposed rezoning and future development of the site.

6.1 Opportunities

The characteristics of the site present the following opportunities:

- Areas to the west and north-west of the eastern boundary of existing quarries are of low conservation value and are thus potentially suitable for future development.
- Impact to remnant habitat areas and constraints as identified in **Figure 4-1** should be avoided as a first priority.
- Conservation of EEC and Squirrel Glider habitat areas as shown on **Figure 4-1** would conserve habitat areas for the ecological community and Squirrel Glider in the local area. Additionally the conservation of such areas would benefit many other threatened and non-threatened ecological communities and, flora and fauna species in the local area.
- As part of a rezoning plan that conserves EEC and Squirrel Glider habitat areas as shown on **Figure 4-1,** revegetation activities should be undertaken along the treeless ridgeline towards the southern end of the site. Revegetating the ridgeline, either through replanting efforts or the promotion of natural regeneration, would increase connectivity and decrease the level of fragmentation and isolation of forest habitat areas within the site.
- Suitable conservation zoning should occur of the constrained areas identified in **Figure 4-1.**
- Potential conservation lands would require management of threats to conservation areas, particularly weed species. A bushland management plan should be developed for any areas that are zoned as conservation lands as part of the rezoning proposal.

6.2 Constraints

The potential removal of forest areas as part of the proposed rezoning presents the following constraints:

- Areas of Coastal Wet Gully Forest (EEC) along drainage lines in the southern part of the site (see Figure 3-2) should be conserved where possible. The removal of any area of Coastal Wet Gully Forest (EEC) is likely to require offsetting.
- The removal of non-EEC forest vegetation will also require offsetting.
- Wetlands identified in Figure 3-2 of this report should be integrated into the development design and retained if possible. Where retention of these wetland environments is not possible, offsetting measures could include:
  - » Incorporation of aquatic habitat into the development design;

- Re-creation of aquatic habitats totalling the same size as those impacted;
- Rehabilitation of retained aquatic environments on the site; and / or
- Use of other habitats as offsets such as the forested areas and / or EEC areas.

- Where possible gully and drainage line vegetation, such as Coastal Wet Gully Forest (EEC) and Coastal Narrabeen Moist Forest should be retained. Hollow-bearing trees were predominately restricted to the gullies and drainage lines of the site. The conservation of such gully vegetation would protect a likely habitat area for the threatened Squirrel Glider (a hollow dependent species).
- All areas of forest vegetation on the site provide potential habitat areas and/or potential linkages in the landscape for the threatened Squirrel Glider. Where possible areas of forest vegetation should be conserved to provide habitat areas for the Squirrel Glider. The removal of forest vegetation areas across all or part(s) of the site may significantly impact on a likely present Squirrel Glider population. An assessment of the likely future level of impact on the Squirrel Glider will only be possible once a detailed development footprint and description has been finalised. The removal of large areas of forest vegetation may result in a significant impact on the Squirrel Glider.
- Further assessment of the likely presence of the Squirrel Glider on the site may be required to definitively determine the species presence or absence on the site. Such further assessment could take two forms. Firstly a detailed analysis of the potential movement corridors (including measurement of gaps) for the species to and from the site and known local populations. And secondly, further targeted arboreal trapping and spotlighting surveys should be undertaken in an attempt to confirm the presence of the species on the site. In the absence of any further survey to confirm the species likely presence on the site, the Squirrel Glider should be assumed to be present due to the moderate suitability of the habitat and the presence of known neighbouring populations.
- Planning for future development within the site should incorporate the retention of mature trees in suitable locations to facilitate the movement of Squirrel Gliders between the site and the corridor to the east.
- Low quality potential habitat exists for cryptic species (Tetratheca juncea, Cryptostylis hunteriana and Diuris praecox) identified as target species by LMCC for this report. It is considered unlikely that any of these species occur on the site however, LMCC may require seasonal surveys for each species where development is proposed in areas of forested habitat.
- Forest vegetation areas also provide potential foraging habitat for the Grey-headed Flying-fox, Little Bentwing-bat and the Common Bentwing-bat, however all three species are highly mobile and would be unlikely to be significantly impacted by the removal of forest habitat areas.
- Forest vegetation on steep slopes and along drainage lines (where construction is unlikely to be suitable) should be conserved to provide natural erosion control and habitat areas for local species.
- Any future development proposal will require seven-part tests of the potential impacts of the proposed development on the 20 threatened flora or fauna species (TSC Act

listed species) identified as species on the site in Section 3.1 above.

- Any future development proposal will require 'significant impact criteria' assessments of the potential impacts of the proposed development on the 13 threatened/migratory species (EPBC Act listed species) identified as species on the site in Section 3.1 above.

7 Conclusion

No threatened flora species were identified during field surveys of the site. Three threatened fauna species (Grey-headed Flying-fox, Common Bentwing-bat and Little Bentwing-bat) and one EEC (Coastal Wet Gully Forest) were identified during field surveys. An additional threatened species, the Squirrel Glider, was not detected during field surveys but is highly likely to occur on the site.

Assessment of the likely level of impact of the proposed rezoning on the above species/communities and additional species/communities identified during a literature review, found that under an ecologically preferred option comprising the conservation of EEC and Squirrel Glider Habitat Areas as shown on **Figure 4-1,** the proposed rezoning was unlikely to have a significant impact on any species or ecological community. Under any alternative rezoning scenario resulting in the removal of forest vegetation communities from the site, a significant impact could potentially occur on the likely Squirrel Glider population. Additionally a development-focused scenario would also require additional survey for cryptic flora species that could not be surveyed due to project timing. Marginal quality potential habitat occurs for *Diuris praecox* in the forest vegetation communities of the site

The rezoning proposal for which this report has been prepared presents an opportunity for a balance between the needs of the community (additional housing, industrial areas, etc) and the needs of threatened species and EECs (conservation of habitat areas) in the local area.

8 Bibliography

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Appendix 1

Flora Species List

Legend:
Quadrat – Values are cover abundance scores.
1 = <5% few individuals
2 = <5% many individuals
3 = 5 - 25% cover
4 = 25 - 50% cover
5 = 50 - 75% cover
6 = 75 - 100% cover
x = cover abundance not recorded – species presence only.
Opp. - Additional species recorded during random meanders and all other non-quadrat activities.
x = species recorded.

Family/Sub-family	Scientific Name	Common Name	Quadrat												Opp.
			1	2	3	4	5	6	7	8	9	10	11	12	
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair					3								
Adiantaceae	*Adiantum formosum*	Giant Maidenhair				3									
Adiantaceae	*Adiantum hispidulum*	Rough Maidenhair				2									
Apiaceae	*Cyclospermum leptophyllum**	Slender Celery													x
Araceae	*Gymnostachys anceps*	Settlers Flax				2							2		
Araliaceae	*Astrotricha latifolia*	Broad-leaf Star-hair													x
Asparagaceae	*Protasparagus plumosus**	Climbing Asparagus Fern				1									
Asteraceae	*Ageratina adenophora**	Crofton Weed			2		3	5	2	2	2	2	3	2	x
Asteraceae	*Bidens pilosa**	Cobbler's Pegs													x
Asteraceae	*Cassinia aculeata*	Dolly Bush		1									1		
Asteraceae	*Cirsium vulgare**	Spear Thistle					2								
Asteraceae	*Conyza albida = C. sumatrensis**	Tall Fleabane			1										
Asteraceae	*Conyza bonariensis**	Flax-leaf Fleabane					2								
Asteraceae	*Hypochaeris radicata**	Flatweed	1		1										
Asteraceae	*Lactuca serriola**	Prickly Lettuce													x
Asteraceae	*Pseudognaphalium luteoalbum*	Cudweed					2								
Asteraceae	*Senecio madagascariensis**	Fireweed			1					2					x
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle													x

Family/Sub-family	Scientific Name	Common Name	Quadrat												Opp.
			1	2	3	4	5	6	7	8	9	10	11	12	
Asteraceae	*Tagetes minuta**	Stinking Roger													x
Bignoniaceae	*Pandorea pandorana*	Wonga Vine										2			
Blechnaceae	*Doodia aspera*	Prickly Rasp Fern				3	2								
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell			1										
Carophyllaceae	*Cerastium glomeratum**	Mouse-ear Chickweed													x
Caryophyllaceae	*Silene gallica**	French Catchfly					2								
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak	1	1						1					
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak		5								3	2		x
Casuarinaceae	*Casuarina glauca*	Swamp Oak			1										
Celastraceae	*Maytenus silvestris*	Orange Bush		1											
Commelinaceae	*Commelina cyanea*	Native Wandering Jew					2				1	2			
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew													x
Convolvulaceae	*Calystegia marginata*	-					2								
Convolvulaceae	*Dichondra repens*	Kidney Weed										2		3	
Convolvulaceae	*Ipomoea indica**	Morning Glory													x
Cunoniaceae	*Schizomeria ovata*	Crab Apple				2									
Cyatheaceae	*Cyathea australis*	Rough Tree-fern													x
Cyperaceae	*Cyperus brevifolius**	Mullumbimby Couch					2								
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge					2								
Cyperaceae	*Cyperus gracilis*	Slender Flat Sedge								2				1	
Cyperaceae	*Cyperus tetraphyllus*	-				x	2								
Cyperaceae	*Eleocharis sphacelata*	Tall Spike-rush													x
Cyperaceae	*Isolepis prolifera**	-													x
Davalliaceae	*Nephrolepis cordifolia**	Fish-bone Fern													x
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	4									2	2		x
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern				3									
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower										2			
Dilleniaceae	*Hibbertia pedunculata*	-									1				
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower					2			2		1			
Dioscoreaceae	*Dioscorea transversa*	Native Yam													x

Family/Sub-family	Scientific Name	Common Name	Quadrat												Opp.
			1	2	3	4	5	6	7	8	9	10	11	12	
Epacridaceae	*Acrotriche divaricata*	-		1											
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush		1		2									
Euphorbiaceae	*Glochidion ferdinandii*	Cheese Tree													x
Euphorbiaceae	*Homalanthus populifolius*	Bleeding Heart													x
Euphorbiaceae	*Phyllanthus gunnii*	Scrubby Spurge					2								
Euphorbiaceae	*Ricinus communis**	Castor Oil Plant													x
Eupomatiaceae	*Eupomatia laurina*	Bolwarra				2									
Fabaceae/faboideae	*Desmodium rhytidophyllum*	-													x
Fabaceae/faboideae	*Desmodium varians*	Slender Tick-trefoil										2	4	2	
Fabaceae/faboideae	*Erythrina sykesii**	Coral Tree													x
Fabaceae/faboideae	*Glycine tabacina*	Twining Glycine								1				2	
Fabaceae/faboideae	*Hardenbergia violacea*	False Sarsparilla										1			
Fabaceae/faboideae	*Jacksonia scoparia*	Dogwood									3				x
Fabaceae/faboideae	*Kennedia prostrata*	Running Postman		1											
Fabaceae/faboideae	*Podolobium ilicifolium*	Prickly Shaggy Pea										1			
Fabaceae/faboideae	*Trifolium arvense**	Haresfoot Clover													x
Fabaceae/faboideae	*Trifolium repens**	White Clover													x
Fabaceae/faboideae /Mimosoideae	*Acacia brownii*	Heath Wattle		1	1		2		2			2		2	
Fabaceae/faboideae /Mimosoideae	*Acacia floribunda*	White Sally Wattle	1												
Fabaceae/faboideae /Mimosoideae	*Acacia irrorata* subsp. *irrorata*	Sydney Green Wattle	1		1		3	1	2				3	3	
Fabaceae/faboideae /Mimosoideae	*Acacia longifolia* var. *longifolia*	Sydney Golden Wattle													x
Fabaceae/faboideae /Mimosoideae	*Acacia longifolia* var. *sophorae*	Coastal Wattle													x
Fabaceae/faboideae /Mimosoideae	*Acacia maidenii*	Maiden's Wattle				1	1								
Fabaceae/faboideae /Mimosoideae	*Acacia ulicifolia*	Prickly Moses	1							1		2			
Fabaceae/faboideae	*Pararchidendron pruinosum var.*	Snow Wood				3									

Family/Sub-family	Scientific Name	Common Name	Quadrat												Opp.
			1	2	3	4	5	6	7	8	9	10	11	12	
/Mimosoideae	*pruinosum*														
Gentianaceae	*Centaurium erythraea**	Common Centaury	1					2	2					2	
Geraniaceae	*Geranium homeanum*	Northern Cranesbill												2	
Haloragaceae	*Gonocarpus teucroides*	Raspwort										1			
Juncaceae	*Juncus acutus**	Sharp Rush													x
Juncaceae	*Juncus usitatus*	Common Rush	1												
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum					2								
Lauraceae	*Cinnamomum camphora**	Camphor Laurel													x
Lauraceae	*Cryptocarya microneura*	Murrogun				2	2								
Lauraceae	*Neolitsea australiensis*	Green Bolly Gum				2									
Lauraceae	*Neolitsea dealbata*	White Bolly Gum				2									
Liliaceae	*Lilium formosanum**	Formosan Lily	2												
Lobeliaceae	*Pratia purpurascens*	Whiteroot								2		2			
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	Wattle Mat-rush		x					2						
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush										3	1		x
Loranthaceae	*Dendrophthoe vitellina*	Mistletoe							1						
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry		1			2					1	2		
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily				2							2		
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne								1				2	
Menispermiaceae	*Sarcopetalum harveyanum*	Pearl Vine				2	2								
Monimiaceae	*Wilkiea huegeliana*	Wilkiea				2									
Moraceae	*Ficus coronata*	Sandpaper Fig				2	2								
Moraceae	*Ficus rubiginosa*	Port Jackson Fig													x
Musaceae	*Musa acuminata** (Cultivar)	Banana				2									
Myrsinaceae	*Myrsine variabilis*	Muttonwood									1	1	2		
Myrtaceae	*Acmena smithii*	Lillypilly													x
Myrtaceae	*Angophora floribunda*	Rough-barked Apple													x
Myrtaceae	*Corymbia gummifera*	Red Bloodwood								3					
Myrtaceae	*Corymbia maculata*	Spotted Gum	1	4				4		x	4	4	3	4	x

Family/Sub-family	Scientific Name	Common Name	Quadrat												Opp.
			1	2	3	4	5	6	7	8	9	10	11	12	
Myrtaceae	*Eucalyptus acmenoides*	White Mahogany					2					4		1	
Myrtaceae	*Eucalyptus paniculata* subsp. *paniculata*	Grey Ironbark		2						1				3	
Myrtaceae	*Eucalyptus punctata*	Grey Gum							3						
Myrtaceae	*Melaleuca linariifolia*	Snow in Summer								1					
Myrtaceae	*Melaleuca stypheloides*	Prickly-leaved Tea Tree					2								
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine													x
Myrtaceae	*Syncarpia glomulifera*	Turpentine					2						4		x
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant				1									
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet					1								
Oleaceae	*Ligustrum sinense**	Small-leaved Privet		2		5	2					1			
Oleaceae	*Notelaea longifolia*	Mock Olive						1		1		1	1		x
Oleaceae	*Olea europaea* subsp. *europaea**	Common Olive Tree													x
Onagraceae	*Oenothera stricta**	Evening Primrose													x
Orchidaceae	*Dipodium punctatum*	Hyacinth Orchid		1											
Oxalidaceae	*Oxalis perrenans*	Yellow-flowered Wood Sorrel													x
Passifloraceae	*Passiflora edulis**	Common Passionfruit													x
Passifloraceae	*Passiflora herbertiana*	Native Passionfruit				1									
Phormiaceae	*Dianella caerulea* var. *producta*	Blue Flax Lily		2			2					2	1		x
Phormiaceae	*Dianella revoluta* var. *revoluta*	Spreading Flax Lily		1											
Phytolaccaceae	*Phytolacca octandra**	Inkweed					2								
Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Blackthorn										3			x
Pittosporaceae	*Hymenosporum flavum*	Native Frangipani													x
Pittosporaceae	*Pittosporaum multiflorum*	Orange Thorn				2									
Pittosporaceae	*Pittosporum revolutum*	Yellow Pittosporum										1	2		
Pittosporaceae	*Pittosporum spinescens* (was Citriobatus pauciflorus)	Orange Thorn													x
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum		4		5	3					3			x
Plantaginaceae	*Plantago debilis*	Slender Plantain													x

Family/Sub-family	Scientific Name	Common Name	Quadrat												Opp.
			1	2	3	4	5	6	7	8	9	10	11	12	
Plantaginaceae	*Plantago lanceolata**	Ribwort	3		3			3		2					
Poaceae	*Andropogon virginicus**	Whisky Grass													x
Poaceae	*Aristida ramosa*	Purple Wiregrass													x
Poaceae	*Aristida vagans*	Three-awn Speargrass		2								1			
Poaceae	*Axonopus affinis** = *A. fissifolius*	Narrow-leaved Carpet Grass	2		2										
Poaceae	*Bothriochloa macra*	Red Grass						1							
Poaceae	*Briza maxima**	Quaking Grass	1				3								
Poaceae	*Briza minor**	Shivery Grass	1												
Poaceae	*Briza subaristata**	-			3			1	2	3				2	
Poaceae	*Chloris gayana**	Rhodes Grass		1											
Poaceae	*Chloris truncata*	Windmill Grass													x
Poaceae	*Cortaderia selloana**	Pampas Grass					2						1		x
Poaceae	*Cynodon dactylon*	Common Couch	2						2	2				2	
Poaceae	*Dichelachne crinita*	Long-hair Plume Grass	1						2						
Poaceae	*Dichelachne micrantha*	Short-hair Plume Grass	1		1			1		2				2	
Poaceae	*Ehrharta erecta**	Panic Veldtgrass													x
Poaceae	*Entolasia marginata*	Bordered Panic											x		
Poaceae	*Entolasia stricta*	Wiry Panic		4											
Poaceae	*Eragrostis brownii*	Brown's Lovegrass		1						2					
Poaceae	*Eragrostis curvula**	African Lovegrass								1					
Poaceae	*Hyparrhenia hirta**	Coolatai Grass													x
Poaceae	*Imperata cylindrica*	Blady Grass	5						3		3	3	1	5	x
Poaceae	*Lachnagrostis aemula*	Blown Grass	1												
Poaceae	*Melinus repens**	Red Natal Grass			2				2					2	
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Rice Grass								3				2	
Poaceae	*Oplismenus aemulus*	Basket Grass													x
Poaceae	*Oplismenus imbecillis*	-					2						3		x
Poaceae	*Panicum simile*	Two Colour Panic										3			
Poaceae	*Paspalum dilatatum**	Paspalum			2			3		2				2	

Family/Sub-family	Scientific Name	Common Name	Quadrat												Opp.
			1	2	3	4	5	6	7	8	9	10	11	12	
Poaceae	*Paspalum distichum*	Water Couch													x
Poaceae	*Paspalum urvillei**	Vasey Grass													x
Poaceae	*Pennisetum clandestinum**	Kikuyu	1		1		2	4		1					
Poaceae	*Phragmites australis*	Common Reed													x
Poaceae	*Poa labillardieri* var. *labillardieri*	Tussock Grass					2					3	2	2	
Poaceae	*Poa seiberiana*	Tussock Grass	1									1			x
Poaceae	*Setaria gracilis**	Slender Pigeon Grass					2			2					
Poaceae	*Sorghum halpense**	Johnson Grass									1	2			x
Poaceae	*Sporobolus elongatus*	Slender Rat's Tail Grass						1							
Poaceae	*Themeda australis*	Kangaroo Grass	5	1	3			3	5	3	3	3	2	5	
Poaceae	*Vulpia bromoides**	Squirrel Tail Fescue						1		2					
Polygonaceae	*Persicaria decipiens*	Slender Knotweed													x
Polygonaceae	*Persicaria lapathifolia*	Pale Knotweed					2								
Primulaceae	*Anagallis arvensis**	Scarlet Pimpernel	1		2		2	1	2	2				2	
Proteaceae	*Hakea sericea*	Needlebush													x
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	1	2					2		2				x
Ranunculaceae	*Clematis aristata*	Old Man's Beard					x						2	1	
Rhamnaceae	*Alphitonia excelsa*	Red Ash													x
Rosaceae	*Rubus moluccanus*	Broad-leaf Bramble					2								
Rosaceae	*Rubus ulmifolius**	Blackberry	2												
Rubiaceae	*Richardia brasiliensis**	White Eye			2					2					
Salicaceae	*Salix babylonica**	Weeping Willow													x
Sapindaceae	*Diploglottis cunninghamii*	Native Tamarind				2									
Sapindaceae	*Guioa semiglauca*	Guioa				2	2								
Scrophulariaceae	*Verbascum virgatum**	Twiggy Mullein			1					1					
Scrophulariaceae	*Veronica plebia*	Creeping Speedwell			1					2					
Sinopteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	Poison Rock Fern		1						2				1	
Smilacaceae	*Ripogonum album*	White Supplejack				2									
Smilacaceae	*Smilax australis*	Lawyer Vine				2									

Family/Sub-family	Scientific Name	Common Name	Quadrat												Opp.
			1	2	3	4	5	6	7	8	9	10	11	12	
Solanaceae	*Nicotiana glauca*	Tree Tobacco					1								x
Solanaceae	*Solanum nigrum**	Black Nightshade													x
Typhaceae	*Typha australis*	Cumbungi													x
Typhaceae	*Typha orientalis*	Cumbungi													x
Ulmaceae	*Trema tomentosa* var. *aspera* (was Trema aspera)	Native Peach													x
Verbenaceae	*Lantana camara**	Lantana		1	2	2	5	2	5	1	4	5	5	5	
Verbenaceae	*Verbena bonariensis**	Purpletop			1		3		2		2				
Verbenaceae	*Verbena rigida**	Veined Verbena			3			2	3	3				2	
Vitaceae	*Cissus antarctica*	Kangaroo Vine													x
Xanthorrhoaceae	*Xanthorrhoea minor* subsp. *minor*	-	x						2			3			x
Zamiaceae	*Macrozamia flexuosa*	-													x

Appendix 2

Recorded Fauna Species List

Fauna Species List

Family sequencing and taxonomy follow for each fauna class:

Birds – Christidis and Boles (2009).

Herpetofauna - Cogger (1996).

Mammals - Strahan (1995).

Appendix Key: ✓ **=** Species Detected
* **=** Introduced species
(E) = Species listed under NSW *TSC Act* as Endangered.
(V) = Species listed under NSW *TSC Act* as Vulnerable.
(V*) = Species listed under the Commonwealth *EPBC Act* as Vulnerable
(E*) = Species listed under the Commonwealth *EPBC Act* as Endangered
(M*) = Species listed under the Commonwealth *EPBC Act* as Migratory
(C) = Species listed under CAMBA
(J) = Species listed under JAMBA
Bold = Threatened and/or migratory species

Data Source: **1 =** Species recorded during this survey

Family Name	Scientific Name	Common Name	1
AMPHIBIANS			
Hylidae (Tree Frogs)	*Litoria fallax*	Eastern Dwarf Tree Frog	✓
Myobatrachidae (Ground Frogs)	*Crinia signifera*	Common Eastern Froglet	✓
	Uperoleia fusca	Dusky Toadlet	✓
REPTILES			
Scincidae (Skinks)	*Tiliqua scincoides*	Eastern Blue-tongued Lizard	✓
BIRDS			
Accipitridae (Hawks, Kites and Eagles)	***Haliaeetus leucogaster***	**White-bellied Sea-Eagle (C, M*)**	✓
Falconidae (Falcons)	*Falco berigora*	Brown Falcon (M*)	✓
	Falco cenchroides	Nankeen Kestrel (M*)	✓
Laridae (Gulls and Terns)	*Chroicoephalus novaehollandiae*	Silver Gull	✓
Columbidae (Pigeons and Doves)	*Ocyphaps lophotes*	Crested Pigeon	✓
	**Streptopelia chinensis*	Spotted Dove	✓

Family Name	Scientific Name	Common Name	1
Cacatuidae (Cockatoos)	*Eolophus roseicapillus*	Galah	✓
Psittacidae (Parrots)	*Platycercus eximius*	Eastern Rosella	✓
Cuculidae (Old World Cuckoos)	*Eudynamys orientalis*	Eastern Koel	✓
Centropodidae (Coucals)	*Centropus phasianinus*	Pheasant Coucal	✓
Podargidae (Frogmouths)	*Podargus strigoides*	Tawny Frogmouth	✓
Apodidae (Typical Swifts)	*Hirundapus caudacutus*	White-throated Needletail (M*,C)	✓
Halcyonidae (Kingfishers and Kookaburras)	*Dacelo novaeguineae*	Laughing Kookaburra	✓
Maluridae (Fairy-Wrens and Emu-Wrens)	*Malurus cyaneus*	Superb Fairy-wren	✓
Pardalotidae (Pardalotes, Scrubwrens, Thornbills)	*Sericornis frontalis*	White-browed Scrubwren	✓
	Gerygone albogularis	White-throated Gerygone	✓
	Acanthiza pusilla	Brown Thornbill	✓
Meliphagidae (Honeyeaters)	*Anthochaera carunculata*	Red Wattlebird	✓
	Manorina melanocephala	Noisy Miner	✓
	Meliphaga lewinii	Lewin's Honeyeater	✓
	Lichenostomus chrysops	Yellow-faced Honeyeater	✓
Cinclosomidae (Quail-thrushes and allies)	*Psophodes olivaceus*	Eastern Whipbird	✓
Pachycephalidae (Whistlers, Shrike-tit, Shrike-thrushes)	*Pachycephala pectoralis*	Golden Whistler	✓
Dicruridae (Monarchs, Fantails and Drongo)	*Rhipidura albiscarpa*	Grey Fantail	✓
	Rhipidura leucophyrs	Willie Wagtail	✓
	Dicrurus bracteatus	Spangled Drongo	
Campephagidae (Cuckoo-shrikes and Trillers)	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	✓
Artamidae (Woodswallows, Butcherbirds, Currawongs)	*Cracticus torquatus*	Grey Butcherbird	✓
	Cracticus nigrogularis	Pied Butcherbird	✓
	Cracticus tibicen	Australian Magpie	✓
	Strepera graculina	Pied Currawong	✓

Family Name	Scientific Name	Common Name	1
Corvidae (Crows and allies)	*Corvus coronoides*	Australian Raven	✓
Passeridae (Sparrows, Weaverbirds, Waxbills)	*Neochmia temporalis*	Red-browed Finch	✓
Hirundinidae (Swallows and Martins)	*Hirundo neoxena*	Welcome Swallow	✓
	Petrochelidon ariel	Fairy Martin	✓
MAMMALS			
Pseudocheiridae (Ringtail Possums, Greater Glider)	*Pseudocheirus peregrinus*	Common Ringtail Possum	✓
Phalangeridae (Brushtail Possums and Cuscuses)	*Trichosurus vulpecula*	Common Brushtail Possum	✓
Pteropodidae (Flying-foxes, Blossom-bats)	***Pteropus poliocephalus***	**Grey-headed Flying-fox (V, V*)**	✓
Molossidae (Freetail-bats)	*Tadarida australis*	White-striped Freetail-bat	✓
Vespertilionidae (Vespertilionid Bats)	***Miniopterus australis***	**Little Bentwing-bat (V)**	✓
	Miniopterus schreibersii	**Common Bentwing-bat (V)**	✓
	Chalinolobus gouldii	Gould's Wattled Bat	✓
	Chalinolobus morio	Chocolate Wattled Bat	✓
	Vespadelus pumilus	Eastern Forest Bat	✓
	Vespadelus vulturnus	Little Forest Bat	✓
Muridae (Murids)	*Rattus fuscipes*	Bush Rat	✓

Appendix 3

Anabat Echolocation Results

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Echolocation Call Sequences from Speers Point, Sydney Basin Region (Newcastle)

Introduction and Methodology

Files recorded by CF Z-caims and downloaded using CFC Read V 4.2a were received by e-mail. Recording occurred over four nights; two at an artificial dam and two nights along forested tracks. Results will be reported separately for the dam and for the forested tracks.

Bat call analysis was undertaken using AnalookW (Version 3.3q 03 October 2006, written by Chris Corben, www.hoarybat.com). Identifications were made using a region based guide to the echolocation calls of microbats in New South Wales NSW (Pennay *et al.* 2004) and the accompanying reference library of over 200 calls from the Sydney Basin (http://www.forest.nsw.gov.au/research/bats/default.asp). Bat calls can be difficult to identify due to intra-specific and geographic variation, therefore a reference library of local calls is a valuable tool for bat call identification.

Bat call analysis is reliant upon the presence of species-specific characteristics such as call shape, characteristic frequency, initial slope and time between calls (de Oliveira 1998, Rinehold *et al.* 2001). Without the presence of definitive species-specific characteristics, a definite identification cannot be made. In addition, some species can never be distinguished (eg. *Nyctophilus* species), while others, such as *Rhinolophus megaphyllus,* are distinctive.

To ensure reliable and accurate results the following protocols (adapted from Lloyd *et. al.* 2006) were followed:

1. Recordings containing less than three pulses were not analysed (Law *et al.* 1999, Law & Chidel 2002).

2. Only search phase calls were analysed (McKenzie *et al.* 2002).

3. Three categories of confidence in species identification were used (Mills *et al.* 1996):

    a. **definite** – identity not in doubt
    b. **probable** – low probability of confusion with species of similar calls; and
    c. **possible** – medium to high probability of confusion with species with similar calls.

4. *Nyctophilus* spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay *et al.* 2004, Law & Chidel 2002).

5. Other species found within the Sydney Basin area in NSW are difficult to differentiate confidently on recordings of poor quality. These calls are assigned to the following species groups (Mills *et al.* 1996, Pennay *et al.* 2004) and are included under each species as a possible call:

    a. *Miniopterus schreibersii oceanensis / Vespadelus darlingtoni*
    b. *Miniopterus schreibersii oceanensis/ Vespadelus regulus*
    c. *Vespadelus regulus / Vespadelus darlingtoni*
    d. *Vespadelus troughtoni / Vespadelus vulturnus / Vespadelus pumilus*
    e. *Chalinolobus gouldii / Mormopterus* spp.
    f. *Mormopterus* sp.2 / *Mormopterus norfolkensis*
    g. *Nyctophilus* spp. / *Myotis macropus*
    h. Scotorepens orion / Scoteanax rueppellii
    i. Scotorepens orion / Falsistrellus tasmaniensis

Results and Discussion

Of the 1210 files that were sent for analysis, 832 contained bat calls. Files not containing bat calls were recordings of static noise or insects. Of those files that contained bat calls, 123 could not be identified as the call quality was too low or the recordings were too short. There were 709 files which were able to be analysed. A summary of this information is shown in Table 1 for each Anabat detector used.

Table 1: Summary of files recorded at Hillsborough, Newcastle, NSW

Anabat	Nights recorded	Files submitted	No bat call present on file	Call quality too low for ID	Call too short for ID	**Files with calls suitable for analysis**
Bern	4-5/01/10 6-7/01/10	63	25	1	12	25
HSO1	5-6/01/10 6-7/01/10 7-8/01/10	644	90	49	39	466
HSO2	4-5/01/10	503	263	5	17	218

Species confidently identified from recordings taken during the survey were;

- Chalinolobus gouldii (**Fig.1**);
- Chalinolobus morio (**Fig. 2**);
- *Miniopterus australis* (**Fig. 3**);
- *Miniopterus schreibersii oceanensis* (**Fig. 4**);
- Tadarida australis (**Fig. 5**);
- Vespadelus vulturnus (**Fig. 6**); and
- Vespadelus pumilus (**Fig. 7**).

A summary of the number of files containing each species is shown for each Anabat in Table 2 below.

Table 2: Number of passes recorded by species per night

Site	**SPECIES**	**DEFINITE**	**PROBABLE**	**POSSSIBLE**
Bern	Chalinolobus gouldii	12	11	-
	Chalinolobus morio	-	-	2
	Vespadelus pumilus	-	-	2
	Vespadelus vulturnus	-	-	2
HSO1	Chalinolobus gouldii	260	1	
	Chalinolobus morio	-	1	36
	Miniopterus australis[#]	-	1	6
	Miniopterus schreibersii oceanensis[#]	1	7	-
	Tadarida australis	1	-	-
	Vespadelus pumilus	22	7	58
	Vespadelus vulturnus	7	2	51
HSO2	Chalinolobus gouldii	163	22	-
	Chalinolobus morio	1	-	4
	Miniopterus australis[#]	7	3	1
	Miniopterus schreibersii oceanensis[#]	1	2	1
	Vespadelus pumilus	16	1	6
	Vespadelus vulturnus	-	-	5

[#] identified species listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act 1995.

The following figures show an example of each species recorded during this survey.

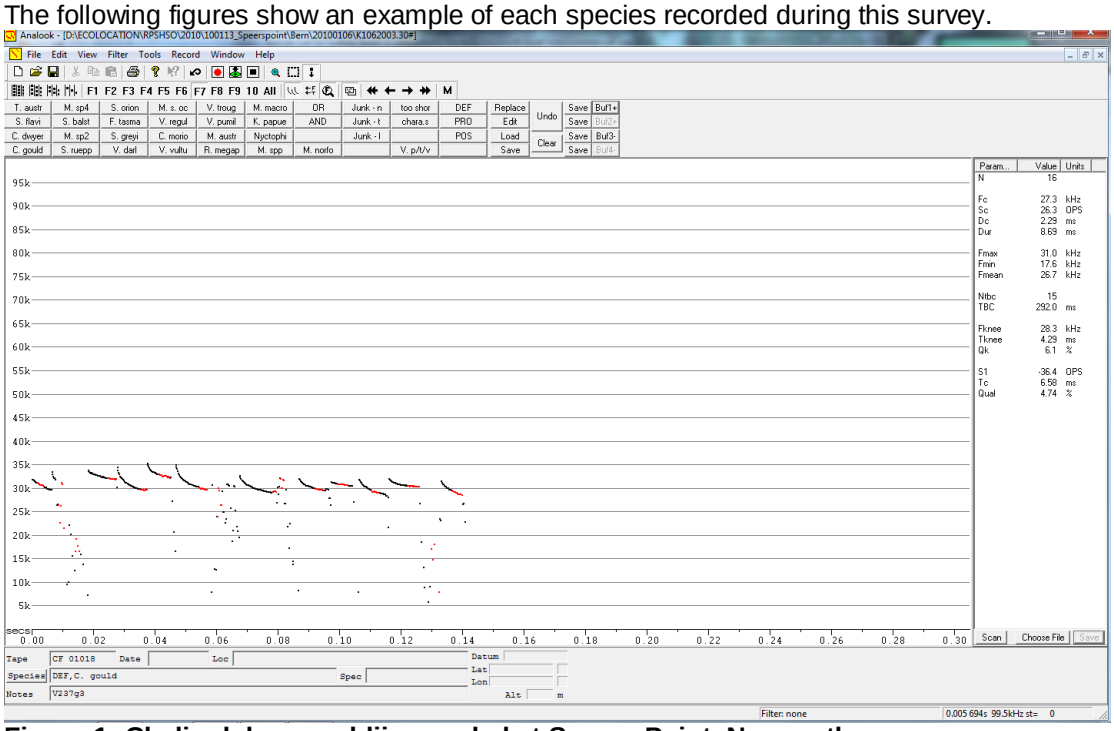

Figure 1: Chalinolobus gouldii recorded at Speers Point, Newcastle.

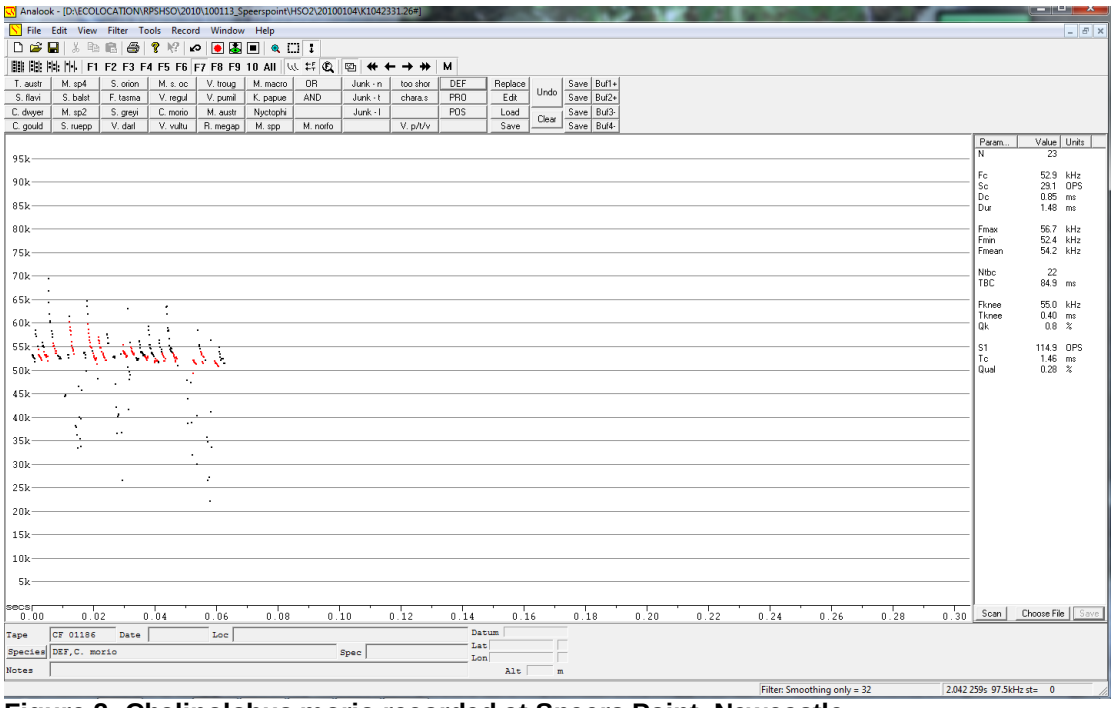

Figure 2: Chalinolobus morio recorded at Speers Point, Newcastle.

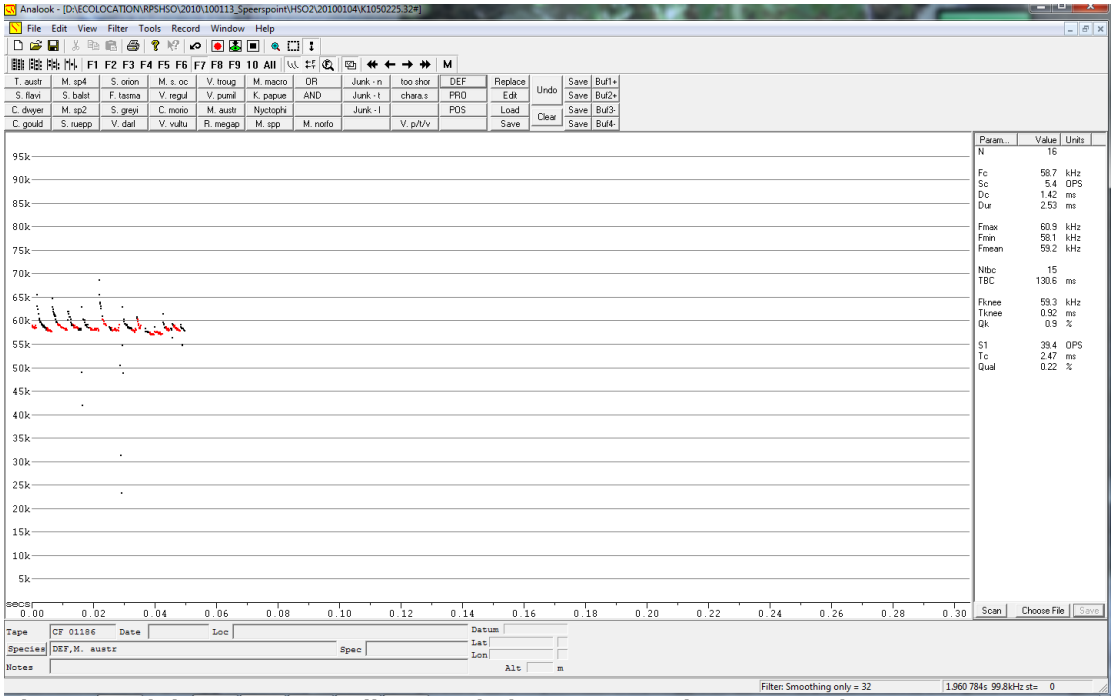

Figure 3: Miniopterus australis recorded at Speers Point, Newcastle.

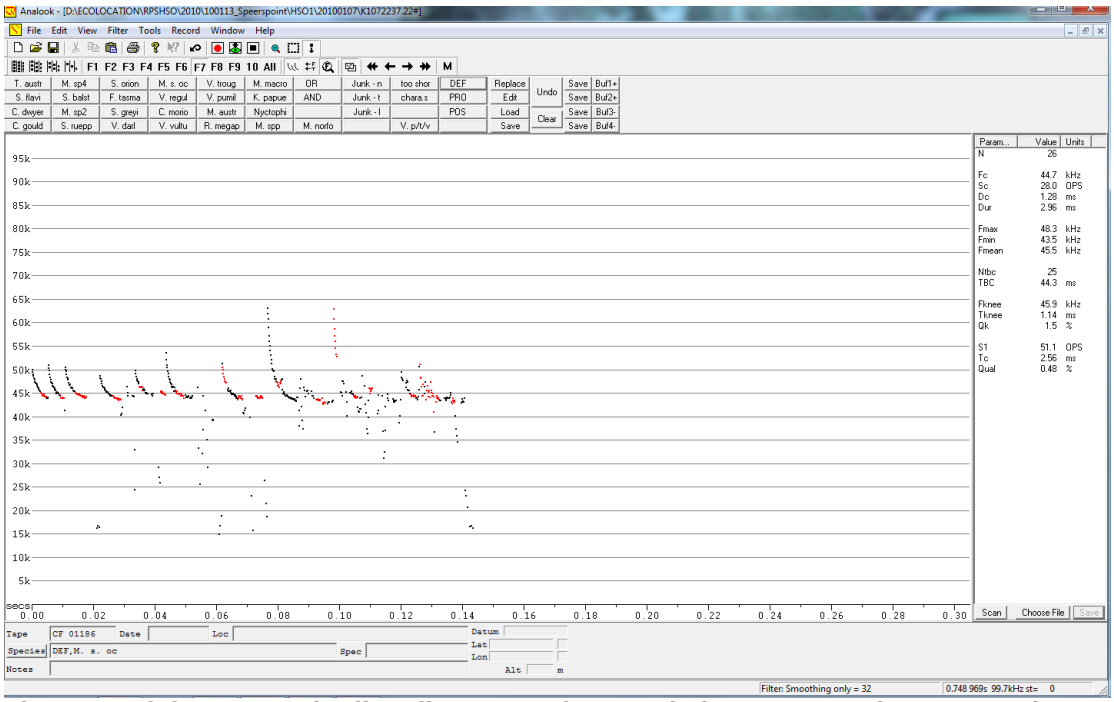

Figure 4: Miniopterus schreibersii oceanensis recorded at Speers Point, Newcastle.

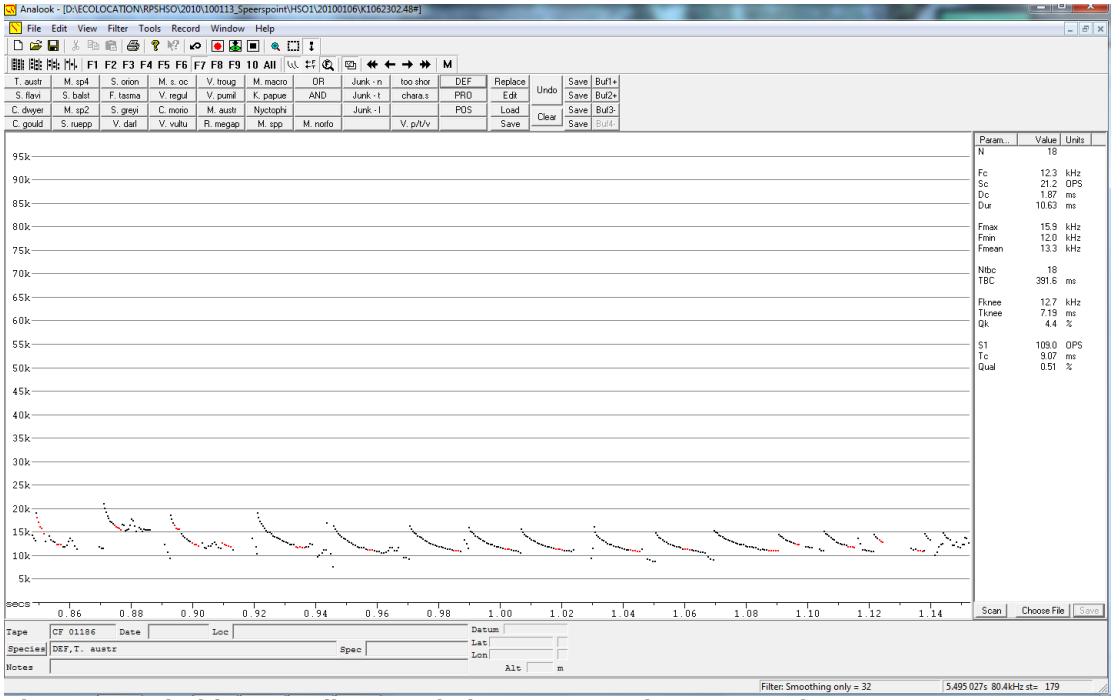

Figure 5: Tadarida australis recorded at Speers Point, Newcastle.

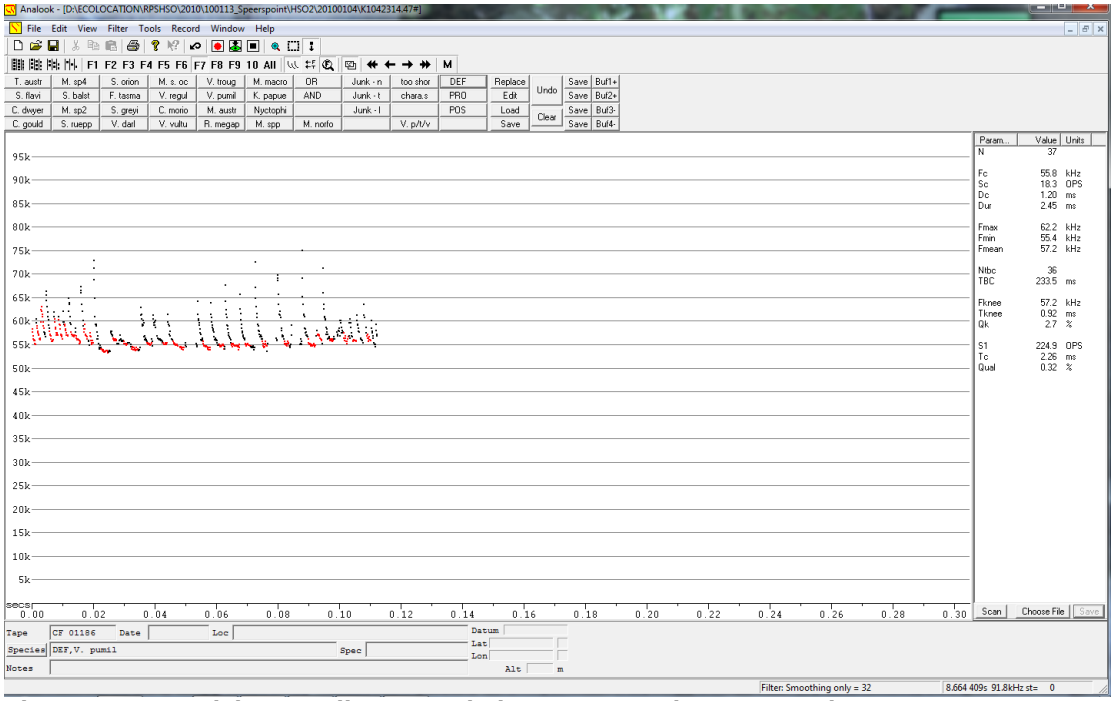

Figure 6: Vespadelus pumilus recorded at Speers Point, Newcastle.

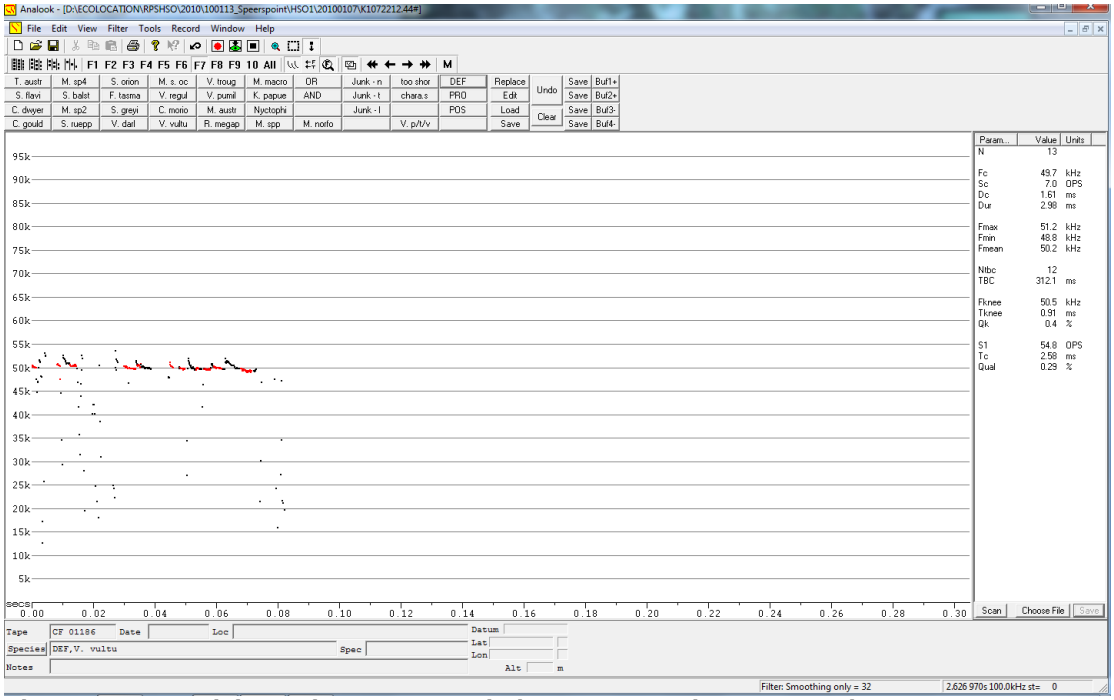

Figure 7: Vespadelus vulturnus recorded at Speers Point, Newcastle.

References

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Appendix 4

Staff Qualifications

RPS

Curriculum Vitae

TOBY LAMBERT

Senior Ecologist / Senior Project Manager

Newcastle, NSW

Bachelor of Environmental Science, University of Newcastle, 1993 - 1996

Accredited BioBanking Assessor, Tafe NSW – Ryde, 2009

NSW Driver's Licence (Class C)

OH&S Induction Training (Green Card)

NPWS Scientific Investigation Licence and NSW Animal Ethics Research Authority

AREAS OF EXPERTISE:

Toby has over fourteen years experience in undertaking and managing a diverse array of ecological and environmental surveys and assessments. As a Senior Ecologist – Senior Project Manager, he supervises all facets of flora and fauna assessment and related reports: planning, supervision of field and reporting staff, project scheduling, budget management, liaising with clients and Government departments and providing advice of all kinds. He has also been called upon to prepare expert evidence for matters at the NSW Land and Environment Court. Toby has produced ecological and environmental documentation for private and public projects ranging in complexity. These include a number of wind farms throughout Australia and New Zealand, coal mines and a range of infrastructure projects within the Hunter region. Toby has also managed ecological master planning for residential projects in Sydney, the Central Coast and the Hunter. Toby's fields of expertise are Environmental Impact Assessment and mediation, flora, fauna and habitat survey method, design and identification, detailed understanding of legislation and threatened species issues, terrestrial fauna surveys and project management. He has experience in conducting comprehensive fauna surveys and preparing related documentation in a broad array of environments throughout New South Wales, with most projects located in the greater Sydney area, Blue Mountains, Central Coast, Hunter and Forster / Great Lakes regions. Toby has also undertaken ecological projects in Western Australia, Queensland, the ACT and New Zealand.

SELECTED PROJECT EXPERIENCE:

Ecology

- **Hunter Economic Zone Industrial Estate -** Project Manager for the environmental component of the development of the Hunter Economic Zone industrial estate at Kurri Kurri, to be the largest industrial estate in NSW.
- **Centennial Coal -** Environmental Project Manager for consultancy works to Centennial Coal covering a broad range of disciplines, but primarily focussed on ecological impact assessments, monitoring and management at six coal mines in the western Blue Mountains and Lake Macquarie NSW.
- **Peabody Energy Australia -** Senior Project Manager for project specific and ongoing monitoring requirements for Wambo Coal Mine at Warkworth in the Upper Hunter Valley. Toby liases directly with the Environmental Manager of the mine in relation to requirements to fulfil consent conditions for the ongoing development and operation of the project.
- **Allco Wind Energy -** This involved undertaking fauna surveys for a 100 turbine wind farm on the North Island of New Zealand and coordinating other ecological specialists to prepare an ecological impact assessment for submission to Taranaki Council. Aspects included regular liason with the Department of Conservation regarding issues of significance, survey methodology, and mitigation and management measures to protect significant ecological features. Local bird groups were also involved and Toby was involved in the public consultation sessions.

- **Stockland Wallarah Peninsula -** This Lake Macquarie, NSW project required a multi-disciplinary approach to an innovative residential proposal on environmentally sensitive land. Project management of, and participation in, a large and diverse planning team were major features of this work. Toby was a pivotal member of the project management team that provided the detailed ecological input and advice that was required from the early stages of the planning process to the point of submission to determining authorities. The proposal required sophisticated and creative impact assessment and reporting. Toby made a major contribution to the production of a series of comprehensive ecological reports that ensured the ecological integrity of the site was maintained in the post-development landscape.

PREVIOUS EXPERIENCE:

Senior Project Manager - Cumberland Ecology, Epping **2005**
Duties included flora and fauna surveying and survey design; overseeing and contribution to the preparation of complex ecological and environmental reports for both small and large projects; flora and fauna surveying and survey design; liaison with both the private sector and federal, state and local government departments.

Principal Consultant / Co-Founder - Keystone Ecological, Kariong **2004 - 2005**
Preparation and development of Keystone Ecological Flora and Fauna Impact Assessment report format; development of client database, including organisation of promotional material, logo design and customer relations; administration including preparation of quotes and invoices and organising accounts and BAS statements; Flora and fauna surveying and survey design; along with Anabat II Data Analysis.

Project Manager - Ecology - Conacher Travers Environmental, Somersby **1998 - 2004**
Supervision of flora and fauna survey design; report quality control; production of technical reports such as Review of Environmental Factors, Flora & Fauna Assessments, Statement of Environmental Effects, Species Impact Statements and Plans of Management, Land and Environment Court Evidence preparation, EPBC Act Referrals and Preliminary Information preparation; Flora & fauna surveying; liaison with Department of Environment and Conservation, Department of Environment and Heritage, Department of Infrastructure, Planning and Natural Resources, Department of Agriculture, Local Governments and private clients; Anabat II Data Analysis; Water Testing; Data Recording and Statistical Analysis.

Volunteer for Green and Golden Bell Frog Survey - Australian Museum, North Avoca **1999 - 2001**
Survey and searches for the endangered species Green & Golden Bell Frog; assisting in weighing, measuring and micro-chipping frogs for on-going research purposes.

Environmental Scientist - Australian Defence Industries (ADI), St Marys **1998**
Bore Water Sampling; statistical analysis of test results; and report production.

Environmental Scientist - Anne Clements & Associates, North Sydney **1997**
Field Assistant to Botanist and data recording.

Research Assistant - University of Newcastle **1996**
Initiation of design of final year project for Biology Dept; research into fire regimes on species composition & regeneration in open woodland; use of advanced scientific equipment including infra red gas analyser in the field, and replication of experiments using computer database; theoretical knowledge on soils, nutrient cycles & vegetation types.

MEMBERSHIPS & ACHIEVEMENTS:

- Ecological Consultants Association of NSW (ECA) – Council Member
- Newcastle Green Drinks for Environmental Professionals organising committee

RPS

Curriculum Vitae

STEVEN COX

Senior Ecologist – Project Manager

Newcastle, NSW

Bachelor of Applied Science (Environmental Science) (Honours)

NSW Driver's Licence (Class C)

OH&S Induction Training (Green Card)

NPWS Scientific Investigation Licence

Senior First Aid

AREAS OF EXPERTISE:

Steven has 12 years experience in the environmental industry with key experience in ecological project management, survey design, field survey, report writing, report review and client relations. In his position as Senior Ecologist, Steven is responsible for the management of ecological projects at all levels, ranging from proposal preparation to report delivery and client liaison. His areas of expertise are design & management of ecological impact assessment projects; flora, fauna and habitat survey methodology design and management; detailed understanding of threatened species legislation and issues; terrestrial fauna and fauna habitat surveys; ecological project management and report writing; along with tree felling supervision and ecological report review.

Steven has project managed and / or participated in numerous mining, energy, local government and private projects, including impact assessments for new coal and gold mines, extensions to existing mines, power substations, power lines, pipelines, access roads and private infrastructure. Steven has designed and / or undertaken the ecological component of structure plans for local government; prepared an affidavit for court proceedings (in an alleged illegal clearing case); and undertaken ecological report reviews for a local council. He has participated in Koala and Platypus field survey and impact assessment; together with nest box installation and monitoring.

SELECTED PROJECT EXPERIENCE:

Ecology

- **Rocglen Coal Mine Extension Project** – Gunnedah NSW (2010).
- **Ecosystem Function Analysis** – Wambo Coal, Singleton NSW (2010).
- **Annual Flora and Fauna Monitoring** – Karuah, NSW (2010).
- **Narrabri Coal Mine Stage 2 Extension Project** – Narrabri, NSW (2009).
- **Muswellbrook Transmission Line Upgrade** – Muswellbrook, NSW (2009).
- **Anvil Hill Flora and Fauna Impact Assessment** – Muswellbrook NSW (2006).
- **Preparation of Expert Witness Affidavit (illegal clearing)** – Forster NSW (2006)
- **Project Management** – Management of numerous land development and mining ecological projects across NSW (2005-2010).

PREVIOUS EXPERIENCE:

Senior Ecologist – Ecotone Ecological Consultants **2008 - 2009**
Duties included flora and fauna surveying and survey design; overseeing and contribution to the preparation of complex ecological and environmental reports for both small and large projects; liaison with both the private sector and federal, state and local government department**.**

PhD Candidate – Koala Ecology, University of Sydney **2007 – 2008**
Steven investigated selected aspects of the ecology of the koala in the Bathurst area of NSW. The project involved the capture and subsequent radio-tracking of up to 50 koalas across a fragmented agricultural landscape. At this stage of the project (2007-2008) activities were limited to data entry, data analysis and report/chapter writing.

Senior Ecologist – Umwelt Australia Pty Ltd **2005 – 2006**
Duties included: preparation of fee proposals; desktop studies and literature searches; flora and fauna surveying and survey design; contribution to the preparation of complex ecological and environmental reports for both small and large projects.

Casual Lecturer / Demonstrator - University of Newcastle **2002 – 2005**
Duties included the delivery of first and second year biology and ecology lectures; demonstration of first and second year biology and ecology laboratory sessions; field trip organisation and management; lecture and laboratory session design; report and exam marking.

Casual Ecologist – Cenwest Environmental Consultants Pty Ltd **1997-2005**
Duties principally comprised all aspects of preparation and completion of fauna surveys across mine sites and development sites within NSW, and the writing of fauna impact assessment reports.

PhD Candidate – Koala Ecology, Charles Sturt University **1997 – 2008**
Steven investigated selected aspects of the ecology of the koala in the Bathurst area of NSW. The project involved the capture and subsequent radio-tracking of up to 50 koalas across a fragmented agricultural landscape. Duties included: project design, site selection, landholder liaison, licensing, koala capture, koala tracking, habitat assessment, data entry, data analysis and report/chapter writing

Platypus Researcher **1996 – 2001**
Steven ran the field component of a long-term platypus research project from 1996 to 2001. Duties included: landholder liaison, volunteer liaison, field preparation, platypus capture and handling, data entry, database creation and management, scientific paper production.

MEMBERSHIPS & ACHIEVEMENTS:

- NSW Animal Ethics Research Authority
- Landscape Function Analysis (LFA)
- Hunter Bird Observer Club (HBOC)
- Birds Australia (BA)
- Ecological Society of Australia (ESA)
- Royal Zoological Society of Australia (RZS)
- Australian Mammal Society (AMS)
- Australian Society of Herpetologists (ASH)

Curriculum Vitae

Name: Shaun Corry

Office: RPS Newcastle

Position in Company: Ecologist

Qualifications / Memberships:
Dip Conservation and Land Mgt
NSW Driver's Licence (Class C)
Waterways Authority Boating Licence
OH&S Induction Training (Green Card)
NPWS Scientific Investigation Licence
NSW Animal Ethics Research Authority

Areas of Expertise:

- Flora and fauna identification and habitat assessment
- Targeted threatened flora and fauna surveys
- Delineation and mapping of vegetation communities
- Endangered Ecological Community (EEC) assessment
- Experience with GPS/GIS for project design and mapping
- Conducting Field Surveys for Flora, Fauna and Habitat Identification
- Report Preparation including Fauna & Flora Assessments
- Ecological Monitoring and Reporting
- Bushfire Threat Assessment & Management reporting
- Understanding of environmental legislation

Recent Experience Includes:

Shaun has a broad range of Ecological Assessment reporting experience and ecological field experience. Experience within the consulting industry has primarily included a wide range of flora assessment disciplines as required by a wide range of public and private clients. Shaun has a strong grounding in threatened flora species, endangered ecological communities and populations throughout NSW. Shaun has undertaken flora and fauna surveys including targeted surveys for threatened flora species within the Blue Mountains, Hunter, Central Coast, Mid North Coast and Southern Queenland.

Curriculum Vitae

Name:	Robert Sansom
Office:	RPS Harper Somers O'Sullivan
Position in Company:	Botanist /Ecologist
Qualifications / Memberships:	Bachelor of Science Bachelor of Science (Honours) NSW Driver's Licence (Class C) OH&S Induction Training (Green Card) Planning for Bushfire Prone Areas (Short Course) Erosion and Sediment Control – Fundamentals of Erosion and Sediment Control NPWS Scientific Investigation Licence NSW Animal Ethics Research Authority

Areas of Expertise:

- Environmental and ecological impact assessment, monitoring and reporting
- Terrestrial flora and habitat survey design, execution, analysis and reporting
- Spatial mapping of vegetation and threatened flora species using differentially corrected GPS accurate to less than 1 metre
- Understanding of threatened species legislation, issues and requirements
- Bushland and vegetation management planning and monitoring
- Threatened Flora Management Plans and Monitoring
- Bushfire Threat Assessments
- Production of a wide variety of reports and assessments
- Targeted threatened flora surveys
- Flora identification and habitat assessment
- Delineation and GPS mapping of vegetation community boundaries
- Ecological Community quality assessments and reports
- Experience in PATN Statistical package

Recent Experience Includes:

Robert has over eleven years experience in undertaking a diverse array of ecological and environmental surveys and assessments. Rob has also produced or sourced background information on ecological and environmental matters for use by expert witnesses in support of clients in the NSW Land and Environment Court.

Rob's fields of special competence are Threatened Flora species searches; Threatened Flora, Vegetation and Bushland Management Plans; delineation and GPS plotting of Vegetation Community boundaries; and species / community / wetland monitoring surveys and reporting.