

Cooranbong Aerodrome: Fauna Constraints Assessment

A report to:

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by

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SUMMARY

The purpose of this report is to identify threatened fauna constraints on the development of Lots 1-11 within the Cooranbong Aerodrome and Avondale College complex and associated group properties totaling about 280 hectares (the Site).

Fauna surveys were conducted on the Site between September 2001 and April 2003 by Harper Somers (2002a, b) and Harper Somers O'Sullivan (2002, 2003). These fauna surveys were reviewed and a targeted supplementary fauna survey was undertaken for this study in October 2004 to provide further information of Squirrel Gliders, forest owls, the Koala, threatened species micro-habitats, and the distribution of threatened species records and habitat in the surrounding region.

A total of fifteen threatened species are known or likely to occur on the Site. Seven species have been confirmed present (Glossy Black Cockatoo, Eastern Free-tailed Bat, Greater Broad-nosed Bat, Large-footed Myotis, Common Bent-wing Bat, Little Bent-wing Bat, and Grey-headed Flying Fox). A further eight species (Spotted-tailed Quoll, Squirrel Glider, Koala, Masked Owl, Powerful Owl, Regent Honeyeater, Swift Parrot, and Green-thighed Frog) were not detected on the Site during any surveys but could occur seasonally, or periodically because suitable habitat is present and individuals have been recorded in adjacent or nearby habitat.

The Site was investigated for the presence of Core Koala Habitat and none was found to be present. Preparation of a Koala Plan of Management and a local environment study is therefore not required under SEPP44.

Fauna macro-habitats and micro-habitats were surveyed and mapped on the Site and used to generate maps showing the potential distribution of each threatened species known or likely to occur on the Site. These maps were used individually and in combination to identify areas of the Site with the greatest conservation significance for threatened fauna.

A series of recommendations were made to constrain development of the Site (see Section 4, Constraints) and to prevent any significant impacts on threatened fauna. These recommendations included:

- protection of all Wet Sclerophyll Forest Habitat on the Site (2.2 ha.);
- protection of all Swamp Forest with Swamp Mahogany trees on the Site (6.5 ha.);
- protection of all vegetation adjacent to drainage lines on the Site for distances of 25m -100m depending on stream order;
- protection (in perpetuity) of a minimum 30% of all extant native vegetation on the Site to be located in areas with the highest conservation significance for threatened fauna; and
- linking of retained vegetation on the Site by protected corridors of not less than 100m width.

A draft Structure Plan was prepared for the Site which took into account all of the above recommendations. An 8 part test applied to the Structure Plan concluded that clearing of native vegetation and fauna habitat would not be likely to have a significant impact on any threatened fauna known or likely to be present. It was also concluded that the proposal would not require referral to the department of Environment and Heritage under the Environment Protection and Biodiversity Conservation Act 1999.

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1.0 INTRODUCTION

1.1 Objectives

The purpose of this report is to review potential fauna constraints on development of Lots 1-11 within the Cooranbong Aerodrome and Avondale College complex and associated group properties (Figure 1), with particular reference to the requirements of the state *Environmental Planning and Assessment (EPA) Act 1979*, *Threatened Species Conservation (TSC) Act 1995*, and the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. This report reviews, consolidates and updates previous fauna assessments of the site by Harper Somers (2002a, 2002b), Harper Somers O'Sullivan (2002, 2003) and Forest Fauna Surveys (2004). This study was carried out in conjunction with an updated flora constraints assessment by Anne Clements and Associates (2004).

The study aims to:

1. identify the habitats and potential distribution of threatened fauna species and ecological communities on the Site;
2. assess the relative conservation significance of threatened fauna habitats on the Site;
3. identify regional and local corridor links on the Site;
4. identify threatening processes on the Site and options for mitigation of threatening processes;
5. recommend constraints on development of the Site consistent with current knowledge and the requirements of planning instruments and biodiversity conservation legislation.

1.2 Site Description

The Site includes four areas (Table 1) totaling 280 hectares including and adjacent to Cooranbong Aerodrome (Figure 1). The Site is bounded by the town of Cooranbong to the south, partially forested rural land to the north, north east and west, Olney State Forest to the south west, Avondale College and Cooranbong aerodrome facilities to the south east.

Regionally the Site is located on forested foothills between the Watagan Mountains to the west and upper tributaries of Dora Creek to the south and east.

Details of the environmental setting, climate, geology, soils, land use and flora on the Site are provided in Anne Clements & Associates 2004.

Table 1. Four areas of land comprising the study Site (Figure 1):

Area	Owned by	Size	Previous studies
1.	Aerodrome land Lots 1 – 11 Cooranbong aerodrome	232.5 ha	Harper Somers (January 2002a)
2.	Pocock's land Lot 1 DP 825266	28.1 ha	Harper Somers O'Sullivan (May 2003)
3.	Avondale Greens Lot 1 DP 170378, Lot 2 DP 825266 & Part Lot 15 DP 182756	15.3 ha	Harper Somers O'Sullivan (September 2002)
4.	Avondale Greens Lot 1 DP 348173 & Lot 21 DP 865588	3.8 ha	Harper Somers (June 2002b)

Figure 1. Site location

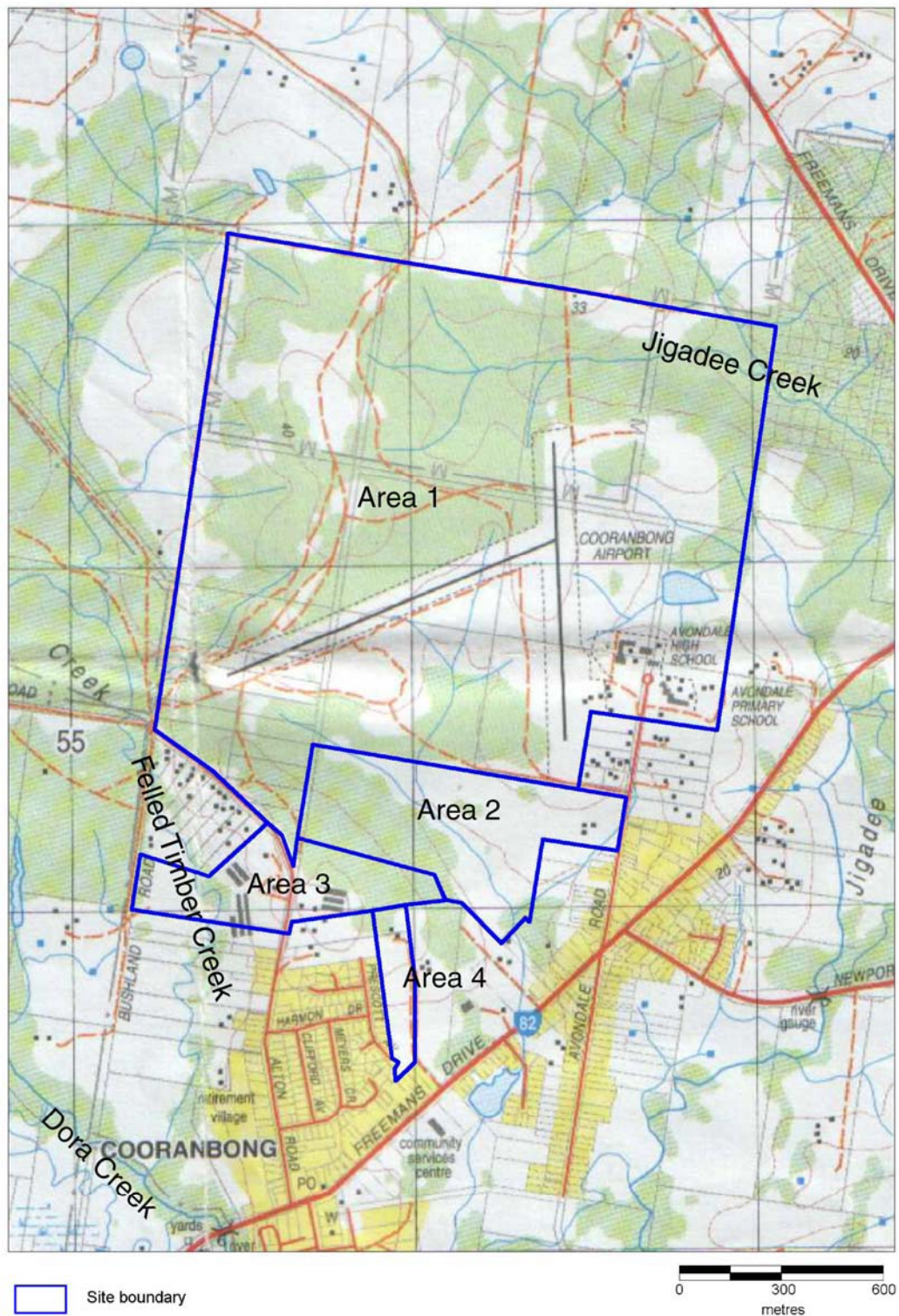


Figure 1.
Site location

1.3 Vegetation

Anne Clements & Associates (2004) found four vegetation communities on the site to be broadly consistent with LHCCREMS (2003) mapping (Figure 2, Table 2).

Table 2 Four vegetation communities mapped on the site by LHCCREMS 2003.

Map unit	Community	Canopy species	Area (ha)
5	Alluvial Tall Moist Forest	<i>Eucalyptus saligna</i> , <i>Syncarpia glomulifera</i> , <i>Glochidion ferdinandi</i>	2.19
30	Coastal Plains Smooth-barked Apple Woodland	<i>Angophora costata</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus capitellata</i> , <i>Eucalyptus umbra</i>	88.71
31	Coastal Plains Scribbly Gum Woodland	<i>Eucalyptus haemastoma</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus capitellata</i> , <i>Angophora inopina</i>	96.31
42	Riparian Melaleuca Swamp Woodland	<i>Melaleuca sieberi</i> , <i>Eucalyptus robusta</i>	10.71
TOTAL			197.92

Figure 2. Vegetation on the Site



2.0 METHODS

2.1 Preliminary Review

A preliminary review of previous surveys and fauna impact assessments in the region including those of Harper Somers (2002a, 2002b), and Harper Somers O'Sullivan (2002, 2003) identified some gaps in the level of knowledge required to clarify ecological constraints on the site. Of particular concern was a lack of information on regional context (habitat extent and continuity on adjoining properties and the surrounding region), vegetation structure and microhabitat type, and limited survey effort for some fauna groups. It was recommended that the following additional surveys and information be collected:

- a) Regional Context. Map the distribution and extent of threatened species habitat extending onto adjoining properties (for a distance of about 10km). Determine the extent of surrounding continuous habitat in secure tenure (at low risk of future clearing) for each threatened species or group of threatened species. Review the occurrence of known threatened fauna records in surrounding (local and regional) secure areas including reserves. Evaluate the effectiveness of vegetation on adjoining property to the west of the Site as a possible corridor link in the event that all vegetation across the centre of the Site is cleared.
- b) Forest structure. Map the age class, condition and disturbance history of the site by overlaying a 100m grid on the site and allocating each grid square or part grid square to one of several or more broad disturbance and structure categories.
- c) Food plants. Determine the distribution of forest with key threatened species food plants (Banksia spp., Casuarinas, Swamp mahogany, Red Bloodwood glider feed trees) concurrently with structure and condition mapping.
- d) Supplementary Fauna Surveys. Carry out further surveys to confirm the distribution of the Squirrel Glider and the Koala on the site.
- e) Fragmentation. Identify and recommend corridor locations and minimum widths for maintaining local and regional habitat connectivity on the Site.

Supplementary studies addressing the above matters were undertaken by Forest Fauna Surveys in September 2004. Results of these surveys are included in Appendix 1. Results of these supplementary surveys are considered in conjunction with previous surveys by Harper Somers (2002a,b) and Harper Somers O'Sullivan (2002, 2003).

2.2 Threatened Fauna Habitats

Threatened fauna macro and micro habitats on the site were determined by review of descriptions in previous studies by Harper Somers (2002a, 2002b) and Harper Somers O'Sullivan (2002, 2003) and by supplementary microhabitat surveys undertaken specifically for this report (Forest Fauna Surveys 2004, Appendix 1). For the purpose of this assessment macrohabitat was determined by grouping mapped vegetation types into fauna macrohabitat types. Microhabitat was determined from a combination of vegetation structure (e.g. age and presence of trees with hollows), floristics (presence of key food plants) and topography (e.g. proximity to streams).

The microhabitat assessment of the Site was undertaken by overlaying a 1 hectare (100m x 100m) grid on the subject land. Within each grid square supporting remnant native vegetation (cleared areas were discarded) a habitat assessment plot was located as close as possible to the centre of the grid. Microhabitat parameters were recorded within an approximate 20m radius of the centre of each plot, including the following:

- Location (easting, northing);
- Structural age class (0-30cm dbh, 30 – 60cm dbh, > 60cm dbh);

- Disturbance (fire, clearing, tracks - + [low], ++ [moderate], +++ [severe]);
- Number of habitat trees (trees with hollows);
- Counts of food trees (*Corymbia gummifera*, *Eucalyptus robusta*);
- Presence of key understorey food plants (*Acacia* sp., *Banksia* sp., *Xanthorrhoea* sp., *Allocasuarina* sp.);
- Aquatic habitat (standing / flowing water, emergent aquatic plants).

Following collation of all habitat assessment data, a habitat quality matrix was generated for individual threatened fauna species or fauna groups known or considered likely to occur on the Site. This matrix ranked habitat quality on each grid as low (poor quality habitat or absent), medium, or high quality habitat. Matrices for individuals species or groups were then combined to produce a single map which ranked individual grid squares on the site from 0 (unsuitable) to 3 (most suitable) for all threatened fauna species.

2.3 Threatened Fauna Species

A list of threatened species that could occur on the site was determined by review of previous surveys in the region including those of Harper Somers (2002a, 2002b), Harper Somers O'Sullivan (2002, 2003) and records in the Department of Environment and Conservation Wildlife Atlas (August 2004).

Threatened species were considered likely to be present if:

- a) they have been recorded on or within dispersal range of the Site (up to 10 km. radius);
- b) suitable macrohabitat is present on the Site;
- c) suitable microhabitat is present on the Site;
- d) the size and connectivity of remnant habitat on the Site is sufficient to support the species;
- e) no threatening processes likely to have caused extinction of the species are evident on the Site;

Threatened species that satisfied all of the above criteria were assumed to be present on the Site unless comprehensive fauna surveys carried out by experienced personnel in appropriate seasons and weather conditions conclusively demonstrated populations of the species to be absent.

2.4 Regional Threatened Species Distribution

The regional distribution of threatened species habitats were assessed by grouping LHCCREMS (2003) regional vegetation types into broad fauna habitat types as shown in Table 3 and relating these habitat types to the known preferences of individual threatened fauna. The pattern of distribution and extent of fauna habitats within 10km radius of the Site was analysed using GIS.

2.5 Fragmentation, Corridors & Links

Patterns of fragmentation and the location of corridors and links on the site and in the surrounding region were determined by: inspection of patterns of remnant vegetation distribution on adjacent holdings from recent aerial photographs overlayed on LHCCREMS regional vegetation mapping (2003); and by using the dispersal / movement requirements of the Squirrel Glider (see also Smith, 2000, 2002) as an umbrella or indicator species for corridor design (after Smith 2000, 2002) for fragmentation sensitive species. Gaps in tree canopy of > 75 metres are considered an isolating distance for the species (Smith, 2000). Patches of forest or woodland with a gap of <75 metres were considered adequately connected to adjoining patches. All patches of forest separated by gaps less than 75m were identified and mapped by analysis of recent ortho-rectified aerial photographs (flown November 1998). All gaps in canopy cover between patches of forest were measured by GIS and individual fragments were numbered. Vegetation communities within fragments were grouped into regional habitat types listed in Table 3 below.

Table 3. Regional Habitat Types

Habitat Type	LHCCREMS Map Unit(s)	LHCCREMS Map Unit Name
Rainforest	1a	Coastal Warm Temperate Subtropical Rainforest
Wet Sclerophyll Forest	1	Coastal Wet Gully Forest
	5*	Alluvial Tall Moist Forest*
	6	Coastal Narabeen Moist Forest
	8	Sheltered Blue Gum Forest
Dry Sclerophyll Forest	7	Sheltered Rough-barked Apple Forest
	9	Coastal Ranges Open Forest
	11	Coastal Sheltered Apple Peppermint Forest
	12	Hunter Valley Moist Forest
	13	Central Hunter Riparian Forest
	15	Coastal Foothills Spotted Gum Ironbark Forest
	17	Lower Hunter Spotted Gum Ironbark Forest
	21	Hunter Range Grey Gum Forest
	22	Coastal Narabeen Shrub Forest
	25	Sheltered Dry Hawkesbury Woodland
	30*	Coastal Plains Smooth-barked Apple Woodland
	31*	Coastal Plains Scribbly Gum Woodland
	33	Coastal Sand Apple Blackbutt Forest*
Swamp Forest	37	Swamp Mahogany Paperbark Forest
	38	Redgum Rough-barked Apple Forest
	40	Swamp Oak Rushland Forest
	41	Swamp Oak Sedge Forest
	42*	Riparian Melaleuca Swamp Woodland
	43	Wyang Paperbark Swamp Forest
	42a	Melaleuca Scrub

* denotes found in study Site

With the exception of frogs and the Squirrel Glider threatened species known or likely to occur on the site are relatively mobile and are not considered sensitive to local fragmentation. Corridor requirements for amphibians were based on identification and design of continuous corridors along drainage lines with buffer widths consistent with those recommended in the adjoining Wyong Shire (Smith et al. 2002).

2.6 Threatening Processes

Threatening process on the site were determined by literature review of listed threatening process under the *Threatened Species Conservation Act (TSCA) 1995* and by site inspection.

2.7 Conservation Significance

The relative conservation significance of macrohabitats on the Site was based on a combination of:

- the listed national, regional, state and local significance of each vegetation community (macrohabitat) type;
- the relative importance of each threatened fauna species present or potentially present;
- the diversity of threatened and regionally significant fauna species present in each macrohabitat type;
- habitat condition.

The relative conservation significance of microhabitats on the site was determined by:

- a) producing grid based maps for each measured microhabitat feature on the site;
- b) producing grid based maps of potential habitat suitability for each threatened species or species group that could occur on the site, and
- c) overlaying grid based maps for all threatened species to produce a single map showing the summed habitat suitability score for each grid square on the site.

2.8 Development Options

Development options were determined by:

- a) identifying areas of key ecological significance that must be retained (eg riparian zones, regionally and nationally significant communities and habitats);
- b) identifying areas that are to be retained for other planning purposes;
- c) identifying areas that support the highest quality habitat for the greatest range of threatened species;
- d) recommending areas and targets for retention and protection of minimum representative areas of threatened fauna habitat on the site;
- e) identifying options for location of corridors to link any retained areas of habitat on the site.

3.0 RESULTS

3.1 Fauna Macro Habitats

Four distinct fauna macro habitats are present on the site:

1. Wet Sclerophyll Forest / Riparian (WSF)
2. Dry Sclerophyll Forest (DSF)
3. Swamp Forest / Riparian (RIP)
4. Cleared / grassland / pasture (Grassland)

Dry sclerophyll forest macrohabitat incorporates two floristic associations, Scribbly Gum (*Eucalyptus haemastoma*) Woodland and Smooth-barked Apple (*Angophora costata*) Woodland. Dry Sclerophyll Forest is the dominant habitat type on the Site comprising 185 hectares or 93% of the native vegetation present (Figure 2).

Wet sclerophyll forest macro habitat includes a single association (alluvial tall moist forest) Blue Gum - Turpentine (*Eucalyptus saligna*, *Syncarpia glomulifera*). It is limited to 2.1 hectares along Felled Timber Creek, a tributary of Dora Creek, in the south west corner of the Site (Figure 2).

Riparian habitat incorporates elements of several floristic associations including Swamp Mahogany – Paperbark (*Eucalyptus robusta* - *Melaleuca linearifolia*), Melaleuca Scrub (*M. sieberi*, *M. linearifolia*, *M. nodosa*) and Blue Gum / Turpentine forest. This habitat type is limited to 10.7 hectares along drainage lines in the north east and south of the Site (Figure 2)

3.2 Microhabitats

A range of key micro habitat components occur on the Site including tree hollows and food plants (Table 4).

Table 4. Fauna micro-habitats on the Site, North Cooranbong.

Macro Habitat	Micro-habitat (structure)	Micro-habitat (key food plants)
DSF	Tree Hollows (gliders, owls, microbats, cockatoos) Age structure (Koala)	Red Bloodwood (glider sap food tree) Black She-Oak (Glossy Black Cockatoo food tree) <i>Banksia</i> spp. (Squirrel glider food plant) <i>Xanthorrhoea</i> (Squirrel Glider food plant) Scribbly Gum (Koala food tree)
WSF/Riparian	Tree Hollows Age structure	Blue Gum (Koala food tree)
Swamp Forest/Riparian	Tree Hollows Age Structure	Swamp Mahogany (Koala food tree, nectar & pollen for Swift Parrot, Regent Honeyeater, Grey-headed Flying Fox, Squirrel Glider)

Tree Hollows and Forest Structure

Harper Somers (2002a) identified a total of 81 trees with large hollows suitable for owls, 433 trees with medium hollows suitable for possums, gliders, tree creepers and parrots and 167 trees with small hollows suitable for threatened microbats on Area 1. Average density of all tree hollows in Area 1 was 2.9 habitat trees per hectare which is relatively low and below optimum levels for arboreal mammals.

Results of microhabitat surveys for this study (Appendix 1) suggest that the Harper Somers over-estimated the number of potential nest trees for forest owls. Forest Fauna Surveys (Appendix 1) found only a small number of habitat trees (< 20) to appear suitable as roost or nest trees for threatened large forest owls. Inspection of the inside of large hollows within a number of these trees (where possible) revealed no evidence of use by large forest owls, and no whitewash or regurgitation pellets were observed in proximity to these trees.

Each tree within each habitat assessment plot was scored into one of three size classes, based on estimated diameter at breast height (dbh in centimetres). The estimated size classes were (<30cm dbh, >30 <60 cm dbh, and >60cm dbh). The forests and woodlands on the Site are dominated by small diameter trees. Only 1.03% of stems were greater than 60cm dbh (1.03%). The proportion of trees in each size class is presented below in Table 5.

Table 5. Tree size class distribution, North Cooranbong

	<30cm dbh	> 30 <60cm dbh	> 60cm dbh	Total
Number of Trees	6,402	209	69	6,680
% Proportion	95.84%	3.13%	1.03%	

Factors responsible for the predominance of small diameter trees are likely to include intense fire, previous clearing, and low site quality.

Food Plants

The Site supports a number of food trees and plants known to be of importance to threatened fauna. Swamp Mahogany is a key food plant for nectar and pollen feeding migratory and nomadic birds (Swift Parrot, Regent Honeyeater, Grey Headed Flying Fox and Squirrel Glider). *Banksia* spp. (*B. marginata*, *B. spinulosa*, *B. oblongifolia*) provide an important source of nectar and protein for Squirrel and Sugar Gliders in summer, autumn and winter. She-Oaks (*Allocasuarina littoralis*) provide food cones for Glossy Black Cockatoos.

Mapping of the food plant distribution of Swamp Mahogany, Red Bloodwood, *Banksia spinulosa* and *Allocasuarina littoralis* on the Site was undertaken during the micro-habitat assessment. Red Bloodwood (a sap feed tree for the Squirrel Glider) is widespread across the Site, with the majority of habitat assessment plots scoring at least low abundance (<10 plants per plot). The extent of

vegetation community supporting Swamp Mahogany is limited on the Site. The LHCCREMS regional vegetation mapping (2003) indicates about 10.71 hectares (or 3.82% of the site) of this habitat type is present.

3.3 Threatened Species

A total of fifteen threatened species are known or likely to occur on the Site (Table 6). Seven threatened fauna species have been recorded on the site. An additional six threatened species are likely to occur on the site at least periodically because suitable macro and micro habitat is present, populations have been observed nearby (within dispersal range, see Appendix 2 for location records), and fauna surveys have not conclusively proven them to be absent. A further two threatened species have not been detected on the site but it is possible that they occur at low densities on the site or nearby and that populations could re-establish or build up in numbers on the site at a future date because suitable habitat is present.

Table 6 Threatened fauna species known and likely to occur on the Site.

Threatened Species	Macrohabitats	Microhabitats	Present	Source
Glossy Black Cockatoo <i>Calyptorhynchus lathami</i>	DSF, WSF, SF	Large hollows Casuarinas	present	Harper Somers 2002a,
Swift Parrot <i>Lathamus discolor</i>	SF	Swamp Mahogany	likely	Harper Somers 2002a, this study
Regent Honeyeater <i>Xanthomyza phrygia</i>	SF	Swamp Mahogany	likely	Harper Somers 2002a, this study
Powerful Owl <i>Ninox strenua</i>	WSF, DSF, SF	Large tree hollows	likely	Harper Somers 2002a, this study
Masked Owl <i>Tyto novaehollandiae</i>	WSF, DSF, SF	Large tree hollows	likely	Harper Somers 2002a, this study
Spotted-tailed Quoll <i>Dasyurus maculatus</i>	WSF, DSF, SF		likely	Harper Somers 2002a, this study
Koala <i>Phascolarctos cinereus</i>	WSF, DSF, SF	Food Trees Mature forest	possible	Harper Somers 2002a, this study
Squirrel Glider <i>Petaurus norfolcensis</i>	SF, DSF	Medium hollows Banksia spp. Swamp Mahogany Red Bloodwood	possible	Harper Somers 2002a, this study
Grey-headed Flying Fox <i>Pteropus poliocephalus</i>	SF	Swamp Mahogany	present	Harper Somers 2002b
East-coast Free-tailed Bat <i>Mormopterus norfolkensis</i>	WSF, DSF, SF	Small hollows	present	Harper Somers 2002a
Little Bent-wing Bat <i>Miniopterus australis</i>	WSF, DSF, SF	Small hollows	present	Harper Somers 2002b
Eastern Bent-wing Bat <i>Miniopterus schreibersii oceanensis</i>	WSF, DSF, SF	All hollows	present	Harper Somers 2002b
Large-footed Myotis <i>Myotis adversus</i>	WSF SF	All hollows	present	Harper Somers 2002b
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>	WSF, DSF, SF	Small hollows	present	Harper Somers 2002b
Green-thighed Frog <i>Litoria brevipalmata</i>	WSF, SF	Riparian Forest Swamp Forest	likely	Harper Somers 2002a, this study

Fauna surveys of Area 1 in September 2001 (Harper Somers 2002a) identified only a single threatened species on Site (Eastern Free-tailed Bat, *Mormopterus norfolkensis*). One additional threatened species was recorded within 100 m of the Site boundary (Glossy Black Cockatoo, *Calyptorhynchus lathami*). Harper Somers (2002a) did not detect the Squirrel Glider (*Petaurus norfolcensis*) on the Site but noted that this species had been detected in previous surveys on the Site by Michael Murray. This record was checked (Michael Murray pers. comm., this study) and found to

be incorrect. It may have been caused by miss-location of a Wildlife Atlas record of Squirrel Glider approximately 400m to the north east of the Site (see Appendix 2 Figure 1).

Fauna surveys of Area 4 in March 2002 (Harper Somers 2002b) identified a further four threatened species on the Site (Fishing Bat, or Large-footed Myotis *Myotis adversus*, Little Bent-wing Bat *Miniopterus australis*, Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis* and Greater Broad-nosed Bat *Scoteanax rueppellii*). A fifth threatened species, the Grey-headed Flying Fox (*Pteropus poliocephalus*) was observed flying over the site.

Fauna surveys of Area 3 in April 2002 (Harper Somers O'Sullivan 2002) confirmed the presence of two species of threatened bats (Eastern Bent-wing Bat, and Eastern Free-tail Bat) and fauna surveys of Area 4 in April 2003 (Harper Somers O'Sullivan 2003) confirmed the presence of four threatened microbat species.

A detailed arboreal mammal trapping and spotlight survey was undertaken in the study area in September 2004 (Appendix 1), with five trapping grids each encompassing about nine hectares effective trapping area, to confirm the presence or absence of Squirrel Gliders. No Squirrel Gliders were detected by arboreal trapping and spotlight survey. Arboreal mammals in general were found to be unusually scarce, probably due to the effects of a severe fire in 2001. However, old glider sap feeding scars were observed on Red Bloodwood trees on the Site and post 1980 DEC Wildlife Atlas records revealed two records of this species within 500m of the Site (see Figure 1, Appendix 2). It was concluded that the Squirrel Glider is not currently present on the site but that suitable habitat is present and that populations of the species could become re-established from adjacent areas over time. Arboreal mammal density has been shown to increase linearly with time since fire in coastal forests of nearby Wyong Shire, peaking about 10 years after fire (Smith and Murray 2003).

The Green-thighed Frog (*Litoria brevipalmata*) has been recorded within 2 km of the site (on Dora Creek, see Figure 4, Appendix 2). This species is extremely difficult to detect by survey. It may only call one night per year (usually in summer) under wet warm conditions and is not likely to have been detected even if present during previous fauna surveys. If present, it is most likely to occur in the Riparian habitat in Area 3 (along Felled Timber Creek) and possibly the north-east corner of Area 1 (along Jigadee Creek).

The Masked and Powerful Owls have very large home ranges (>3 km diameter) and are known to occur throughout the region surrounding the Site. There are a number of DEC Wildlife Atlas records of both species within 5 km of the Site (Figure 3, Appendix 2). Based on the macro- and micro-habitat assessment in September 2004, only a limited number of potential roost trees for the Masked Owl occur on the site. There was no evidence of residence of this species on the Site during investigations in September 2004, or previous surveys by Harper Somers (2002a,b) and Harper Somers O'Sullivan (2003,2003). No occurrence of the species was detected by playback of pre-recorded calls during the September 2004 survey, or previous surveys. The site does not support optimal foraging habitat for the Powerful Owl at present due to very low abundance of key preferred prey (arboreal mammals). The survey in September 2004 recorded very low observation rates of arboreal mammals by spotlight searches. This situation may change as prey populations build up in the absence of further wildfire. At present it is considered likely that both the Masked Owl and Powerful Owl would only utilise foraging and roosting habitats on the Site on an infrequent basis.

The Swift Parrot, Regent Honeyeater and Grey-headed Flying Fox are nomadic or migratory species that are most likely to visit the Site during winter when Swamp Mahogany is flowering. No fauna surveys have been undertaken on the Site during this time of year. These species are likely to be confined to riparian macro habitats with Swamp Mahogany.

3.4 SEPP 44 Koala Habitat

The Site supports two known preferred food trees of the Koala (Swamp Mahogany, *Eucalyptus robusta* and Scribbly Gum, *Eucalyptus haemastoma*) listed in Schedule 2 of SEPP 44. Harper Somers (2002a) noted that scribbly Gum is a dominant or co-dominant species across the site and that Swamp Mahogany occurs sporadically in drainage lines. They concluded that the site would constitute Potential Koala Habitat as defined by SEPP 44. The most suitable potential habitat for the Koala occurs in high site quality, tall forests along drainage lines with a diversity of eucalypt species including Swamp Mahogany. Low site quality Scribbly Gum forests and woodlands which dominate the ridges and higher grounds on the site, are unlikely to be suitable for Koalas. Koalas are known to prefer taller, more productive forests with large diameter stems and a high diversity of preferred food trees (Smith 2004).

In line with the requirements of SEPP 44 Harper Somers investigated the Site for Core Koala Habitat by a combination of methods including spotlighting, scat searches, review of data base records and consultation with local residents. They found no records of the Koala on the Site or adjacent landholdings. The most recent record of Koala in the locality is one individual near Morisset (5km to the SE) in 1997. No recent additional records (<5yrs) occur within 5km of the subject land. As Harper Somers found no evidence of a resident breeding colony of koalas on the Site they concluded that the Site did not constitute Core Koala Habitat within the meaning of SEPP 44. This conclusion was confirmed in subsequent Core Koala Habitat investigations by Forest Fauna Surveys (2004, Appendix 1) who similarly found no evidence of the Koala on the Site. Because no Core Koala Habitat is present on the Site preparation of a Koala Plan of Management and a local environment study is not required under SEPP44.

3.5 Threatened Species Distribution on the Site

The distribution of macro and micro habitat types on the site was used to identify and map potential habitat for all threatened species or species groups known or likely to occur on the site.

Squirrel Glider

The distribution of grid squares with *Banksia* sp., *Allocasuarina* sp., Swamp Mahogany and *Acacia* sp. and *Xanthorrhoea* sp. were mapped to identify suitable habitat for the Squirrel Glider. A map showing habitat suitability for the Squirrel Glider, based on presence of Swamp Mahogany and abundance of *Banksia spinulosa*, is presented in Figure 4 of Appendix 1.

Glossy Black Cockatoo

The potential distribution of the Glossy Black Cockatoo on the site is shown in Figure 5 of Appendix 1, based on the mapped occurrence of key food plants (*Allocasuarina* and *Casuarina* trees). In general, the distribution and abundance of this foraging resource was very limited within the Site which can be considered of marginal or little value for this species relative to habitat in regional national parks and state forests.

Amphibians

Very limited habitat for pond dependent frog species, such as Green & Golden Bell Frog (*Litoria aurea*) is present within the study area. A large pond occurs to the immediate north of the Avondale High School, but presents very low habitat quality for pond dependent frog species. No emergent or fringing aquatic vegetation is present in this water body.

Riparian habitat for stream dwelling frogs is present in the north-eastern section of the Site. This habitat is associated with the Jigadee Creek complex, draining to the south-east from the Site. Frog habitat associated with this creek system comprises small pools in depressions along the creek bed (presently dry), dense fringing riparian vegetation and tall forest containing tree hollows.

The south-western corner of the Site contains riparian habitat associated with Felled Timber Creek. This habitat is of higher quality than the Jigadee Creek system, being more structurally complex and supporting diverse riparian vegetation. The threatened Green-thighed Frog (*Litoria brevipalmata*) is considered likely to be associated with this creek system (Figure 6 of Appendix 1). It has been recorded in the locality (<2km radius of the Site).

Large Forest Owls

Potential habitat for the Powerful Owl is likely to be restricted to the riparian forest associated with Jigadee Creek in the north-east, and Felled Timber Creek in the south-west. The remainder of the Site supports marginal foraging habitat for the Powerful Owl due to the very low abundance of key prey (i.e. arboreal possums and gliders). Suitable foraging habitat for the Masked Owl occurs throughout the Site. The fauna survey by Harper Somers (2002a, 2002b) and Harper Somers O'Sullivan (2002, 2003) documented the diversity (but not abundance) of preferred prey of the Masked Owl (small terrestrial mammals). In parts of the site less impacted by fire, the abundance of small terrestrial mammals would be higher. Pockets of dense understorey vegetation occur within the central part of Area 1 (*Leptospermum trinervium*, *L. polygalifolium*) which is likely to restrict foraging opportunities for the Masked Owl. No evidence of owl species was recorded during field surveys for this report and previous reports. However, there are 8 records of Threatened Owls within a 5km radius of the Site, suggesting a moderate to high likelihood of occurrence of foraging or roosting Masked and Powerful Owls on the Site from time to time given their large home range diameter (approx. 2-5 km). A number of potential roost or nest trees were observed within the Site (refer to locations in Figure 7 of Appendix 1).

Microbats

Habitats for threatened insectivorous bats were not individually mapped and were assumed to be widespread and relatively uniform across the site within preferred macrohabitat types. The only available potential microhabitat predictor for these species (small tree hollows) are well distributed across the site.

Spotted-tailed Quoll

Habitat of the Spotted-tailed Quoll was not mapped but is likely to correspond with that of the Powerful Owl due to use of common prey species (possums and gliders).

Swamp Mahogany

Habitat with Swamp Mahogany was used to identify potential habitat for four threatened species including the Grey-headed Flying Fox, Regent Honeyeater, Swift Parrot and Koala. The distribution of grid squares with Swamp Mahogany is shown in Figure 5.

3.6 Protected Species

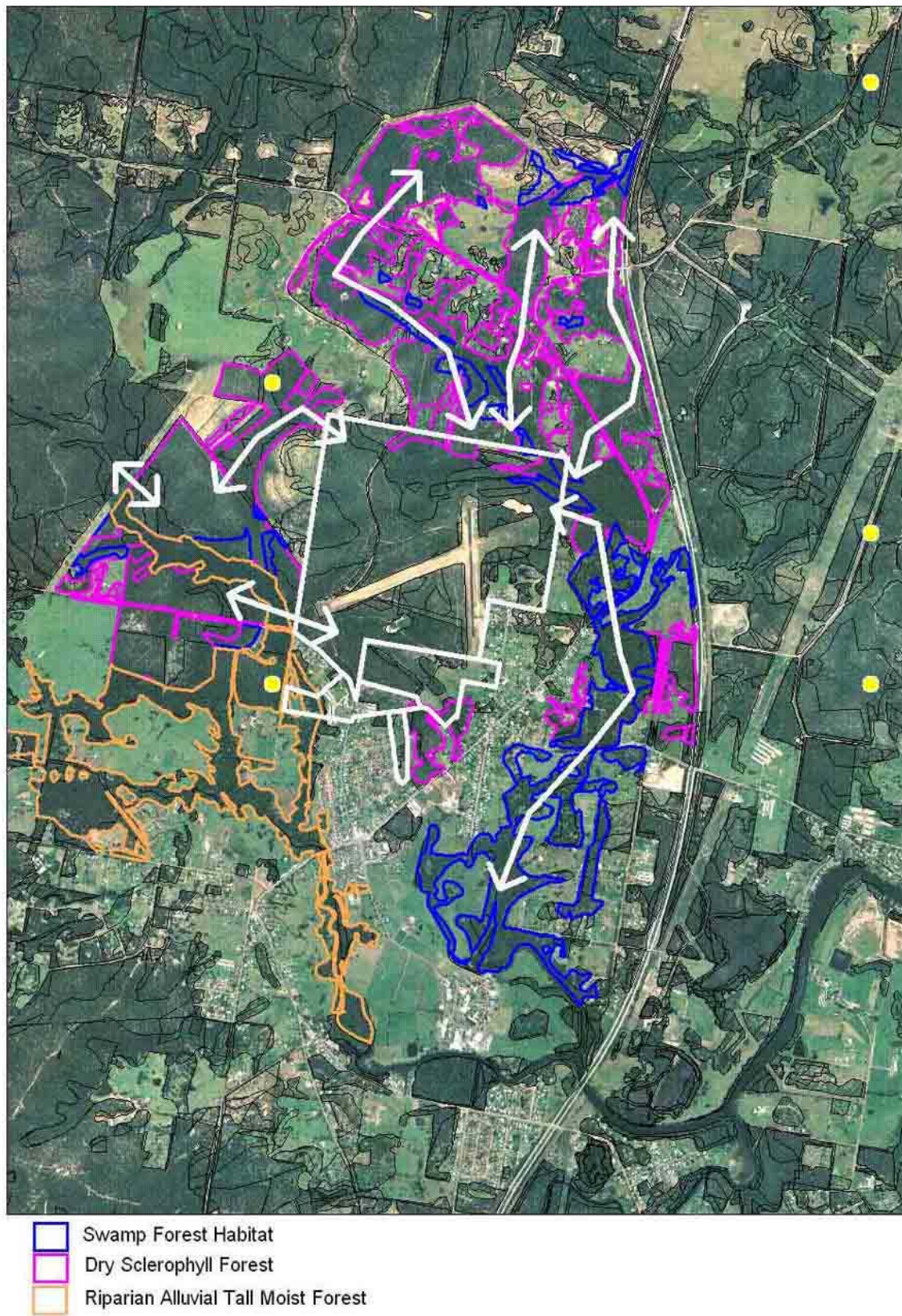
The Site was reported to have an unusually high diversity of protected birds, reptiles and mammals (Harper Somers 2002a). A number of species listed as regionally significant were detected on the Site by Harper Somers (2002a), including the Gang Gang Cockatoo (*Callocephalon fimbriatum*), Eastern Grey Kangaroo (*Macropus giganteus*), Red-necked Wallaby (*Macropus rufogriseus*), Sugar Glider (*Petaurus breviceps*), Echidna (*Tachyglossus aculeatus*), Jacky Lizard (*Amphibolurus muricatus*), Bearded Dragon (*Pogona barbata*) and Yellow-faced whip Snake (*Demansia Psammophis*). Harper Somers (2002a) also reported the Dingo (*Canis lupus dingo*) on the Site which they considered to be significant record. Previous surveys in north east NSW have found that where Dingoes are present native mammal communities are generally in good condition with a full complement of species (Smith and Quin 1998).

3.7 Fragmentation, Corridors and Links

The Site is part of a large vegetation remnant that is bounded to the east by the F3 Freeway, to the south by clearing and to the north and west by powerline easements. The pattern of remnant

vegetation distribution immediately surrounding the site is shown in Figure 3. This figure also shows (arrows) the location and direction of local and regional movement corridors across the Site.

Figure 3. Patterns of vegetation clearing and location of local and regional corridors around the Site.



To the east of the Site, the F3 Freeway is a likely barrier to dispersal and movement of the Squirrel Glider due to a cleared gap of 90m or more. Consequently, habitat connectivity and vegetation corridors linking the Site with adjoining forest were mapped for land west of the F3 Freeway (Figure 3).

To the north of the Site, vegetation linkage to adjoining forest occurs along Jigadee Creek which drains across the north-eastern corner of the Site in a north-west to south-east direction. The main drainage line of Jigadee Creek crosses beneath the F3 Freeway to the east of the site. Immediately north of the Site, a small upstream tributary of Jigadee Creek branches north-west of the main creek, and extends a distance of 2 kilometres. The catchment boundary of this small tributary is Mt. Nellinda Road. The catchment of this small upstream tributary retains a significant component of remnant native vegetation. Outside this small catchment, forest habitat is continuous north of Mt. Nellinda Road to a cleared easement associated with a 330kV electricity transmission line. The gap in tree canopy cover in the powerline easement is 60 metres.

In the north-western corner of the Site, a riparian vegetation corridor extends onto private land and from there on to Olney State Forest. This corridor is currently considered insecure due to the risk of habitat clearing on this landholding.

Vegetation on the site is continuous with Olney State Forest but is cut by a 330 kV transmission line easement about 1 km to the west. Whilst the majority of this powerline easement is cleared and underscrubbed, remnant vegetation is retained along a 320m riparian strip along Felled Timber Creek. This strip of riparian vegetation effectively maintains vegetation connectivity between the Site and a very large fragment of forest incorporating Olney State Forest and Watagans National Park.

To the south of the Site, remnant vegetation is retained along the riparian zone of Felled Timber Creek, which eventually links to Dora Creek 860m further south. The vegetation community along Felled Timber Creek south of the Site is Alluvial Tall Moist Forest (MU 5 – LHCCREMS, 2003). This vegetation type is considered suboptimal habitat for the Squirrel Glider, but would enable movement and dispersal of gliders, in addition to providing foraging resources and movement corridor for many additional threatened species, such as mega-chiropteran and micro-chiropteran bats, terrestrial mammals, birds and frogs.

3.8 Regional Habitat Distribution

The distribution of vegetation communities and fauna macrohabitats within a 10km radius of the Site was analysed by GIS. The results are presented in Table 7. This analysis shows that fauna macrohabitats on the Site are extensively distributed in the local region. Within the region the extent of Map Unit 30 and 31 (dominant habitats on the Site) is 13,598 and 3,760 hectares respectively. The extent of Riparian Melaleuca Swamp Woodland is 1,452 hectares. The extent of similar habitat west of the F3 Freeway within a 10 km radius of the Site is: Map Unit 30, 2,148 hectares, and Map Unit 31, 1,071 hectares.

Vegetation on the site is continuous with more extensive areas beyond the arbitrary 10 km radius. No significant barriers (gaps >75m) isolate vegetation on the Site from an extensive area remnant vegetation in adjoining State Forest and national park to the north and west.

It can be concluded that threatened species habitats on the site are extensively distributed in the surrounding region. In the case of the Squirrel Glider which is the most fragmentation and barrier sensitive threatened species approximately 229 hectares of potential habitat (Map Unit 30) occurs within a compartment of Olney State Forest immediately adjacent to the site. This area is sufficient to sustain a viable local population in the short term (Smith 2000).

The distribution of threatened fauna species recorded in the local region (<10 km radius of Site) is shown in a series of figures in Appendix 2.

Table 7 Extent of vegetation communities within a 10km radius of the Site.

LHCCREMS Map Unit Name	Map_unit	Fauna Habitat	Area in Hectares
Coastal Wet Gully Forest	1	Wet Sclerophyll Forest	3,772.258
Coastal Warm Temperate- Subtropical Rainforest	1a	Rainforest	868.613
Alluvial Tall Moist Forest	5*	Wet Sclerophyll Forest	527.426
Coastal Narrabeen Moist Forest	6	Wet Sclerophyll Forest	9,577.321
Sheltered Rough Barked Apple Forest	7	Dry Sclerophyll Forest	5.572
Sheltered Blue Gum Forest	8	Wet Sclerophyll Forest	2.867
Coastal Ranges Open Forest	9	Dry Sclerophyll Forest	5,237.338
Coastal Sheltered Apple - Peppermint Forest	11	Dry Sclerophyll Forest	53.495
Hunter Valley Moist Forest	12	Dry Sclerophyll Forest	1.263
Central Hunter Riparian Forest	13	Dry Sclerophyll Forest	4.804
Coastal Foothills Spotted Gum - Ironbark Forest	15	Dry Sclerophyll Forest	11,706.135
Lower Hunter Spotted Gum - Ironbark Forest	17	Dry Sclerophyll Forest	3.516
Hunter Range Grey Gum Forest	21	Dry Sclerophyll Forest	39.408
Coastal Narrabeen Shrub Forest	22	Dry Sclerophyll Forest	1,450.932
Sheltered Dry Hawkesbury Woodland	25	Dry Sclerophyll Forest	306.352
Coastal Plains Smooth-barked Apple Woodland	30*	Dry Sclerophyll Forest	13,598.816
Coastal Plains Scribbly Gum Woodland	31*	Dry Sclerophyll Forest	3,760.899
Coastal Sand Apple - Blackbutt forest	33	Dry Sclerophyll Forest	304.558
Swamp Mahogany - Paperbark Forest	37	Swamp Forest	87.325
Redgum Rough Barked Apple Forest	38	Swamp Forest	115.95
Swamp Oak Rushland Forest	40	Swamp Forest	108.383
Swamp Oak Sedge Forest	41	Swamp Forest	18.46
Riparian Melaleuca Swamp Woodland	42*	Swamp Forest	1,453.848
Wyong Paperbark Swamp Forest	43	Swamp Forest	18.312
Freshwater Wetland Complex	46	Wetland	0.558
Mangrove-Estuarine Complex	47	Estuarine	30.584
Coastal Clay Heath	48	Heath	36.697
Rushland	40a	Wetland	32.572
Melaleuca Scrub	42a	Swamp Forest	9.929
Saltmarsh	47a	Estuarine	7.667
Total Area			53,141.86

* denotes found in study Site

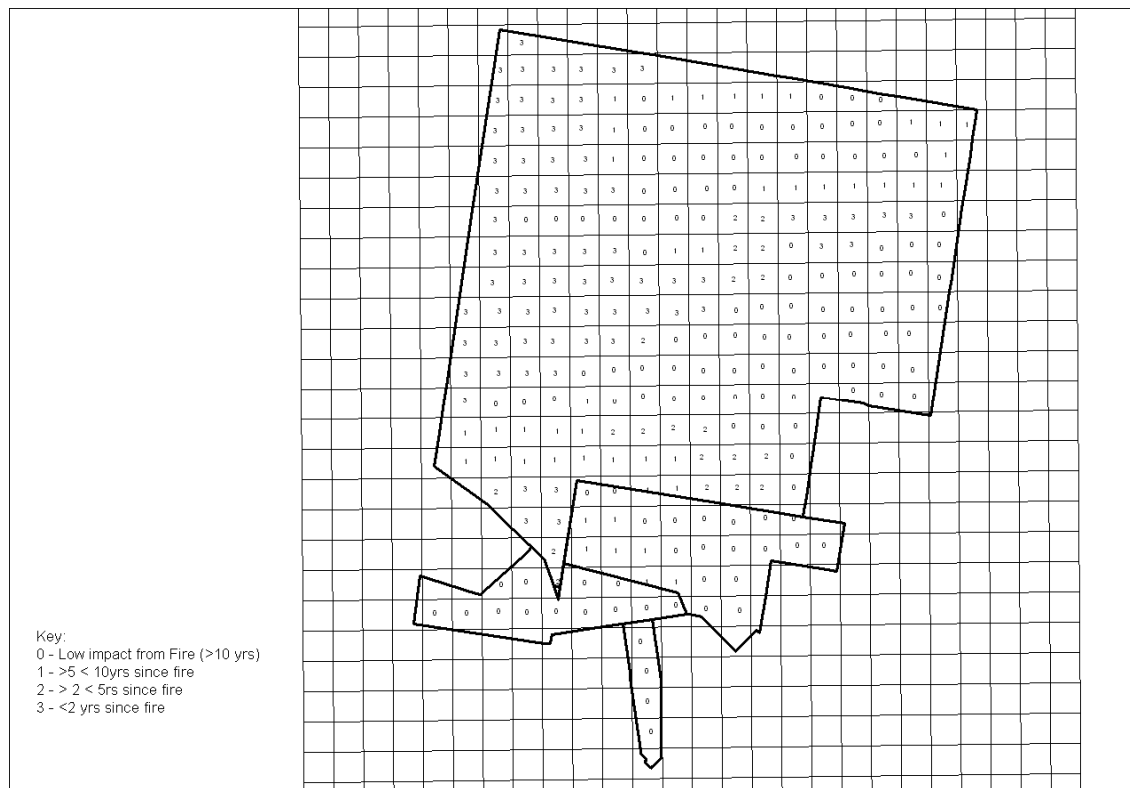
3.9 Threatening Processes & Conservation Significance

The principal threats to remnant vegetation and fauna habitat on the Site are clearing and intense or frequent fire. There has been relatively recent clearing of parts of the Site for construction of fence lines, resulting in a patchwork of forest fragments. Remnant vegetation within the north-eastern corner has been slashed in the past. The site is currently almost divided into two halves by an airstrip.

The north-western and western portion of the Site has been impacted by a relatively recent wildfire (2001, Figure 4). Part of the middle and north-eastern portion of Area 1 appears to have been less affected by fire as evident from a very dense growth of understorey and ground cover vegetation. The

Site is dissected by vehicle tracks, which has resulted in dumping of domestic rubbish and incursion of exotic weeds.

Figure 4. Fire History Habitat Assessment (after Forest Fauna Surveys 2004)



Vegetation Communities and Habitats

Regionally significant vegetation communities and fauna habitats in the Lake Macquarie region are listed in the Lake Macquarie State of the Environment Report 2003. This report classifies all vegetation communities on the Site as “regionally” or “nationally” significant.

Alluvial Tall Moist Forest is classified by the Council State of Environment Report as nationally significant and vulnerable as only 19% of pre-European distribution remains in the region. Within the Site this community provides important potential habitat for amphibians including the Green-thighed Frog.

Riparian Melaleuca Swamp Woodland is classified as nationally rare and regionally significant with only 40% of pre-European distribution remaining. Within the Site this community provides important potential habitat for winter nectar feeding threatened and protected fauna in areas with Swamp Mahogany trees.

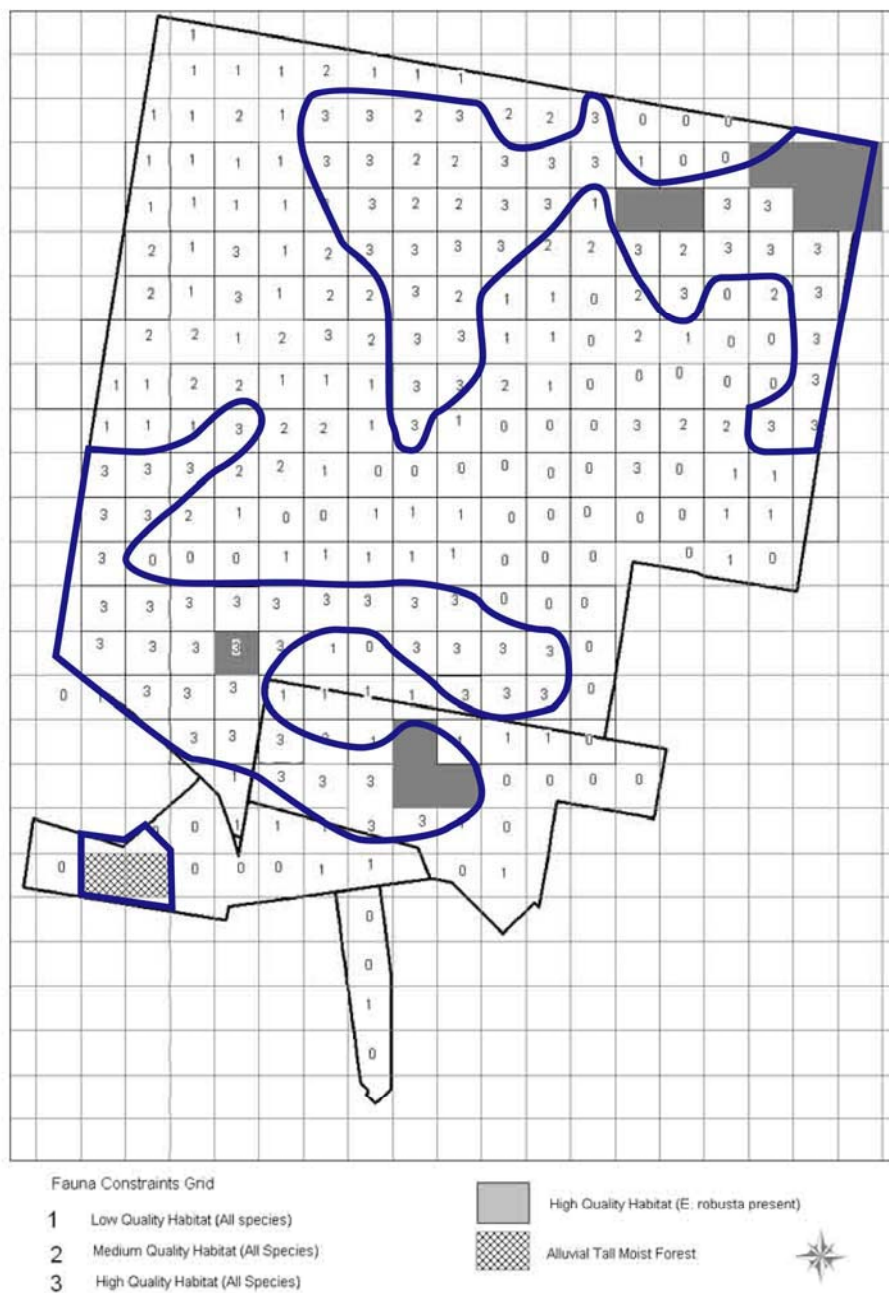
Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland are both classified as regionally significant. Within the Site this community provides potential habitat for Squirrel Glider where *Banksia spinulosa* is present in the understorey. This community provides habitat for four species of threatened insectivorous microbats known to occur on the Site.

The Lower Hunter and Central Coast Regional Environmental Strategy (LHCCREMS) has developed a Regional Biodiversity Conservation Strategy (RBCS) for the Hunter region. This strategy identified Alluvial Tall Moist Forest, Swamp Mahogany Paperbark Forest, and Riparian Melaleuca Swamp Woodland as nationally significant vegetation considered highly likely to be listed as vulnerable or endangered under the TSC Act in future (Port Stephens State of the Environment Report 2003).

Threatened Fauna

The relative importance of different parts of the site for threatened fauna was predicted by overlaying potential habitat maps for individual threatened species and species groups (Appendix 1) to produce a single map ranking all grid squares on a scale of 0-3 according to summed suitability for all threatened species (Figure 5). The resulting map shows a high concentration of optimal habitat in two bands across the north and south of the site. Much of the central area of the Site has reduced suitability due to past fire disturbance (Figure 4) and poor understorey development.

Figure 5. Map showing the ranked suitability (0-3) of each grid square for all threatened species known or likely to occur on the Site, the smoothed area of highest rank (blue outline) and grid squares with key or rare habitats (swamp mahogany and riparian tall moist forest).



4.0 CONSTRAINTS

4.1 Riparian habitats

Riparian habitats and drainage lines should generally be protected to maintain continuity of habitat for frogs, reptiles and small mammals and to protect water quality. It is recommended that native vegetation buffers be retained on streams shown on the 1:25000 topographic map as follows: 25m width on first order streams, 50m on second order streams, 75 m on third order streams and 100 m on higher order streams (after Smith et al. 2002).

4.2 Swamp Mahogany Habitats

It is recommended that all vegetation with Swamp Mahogany on the Site be protected from development. Swamp Mahogany is a key food plant for four threatened species likely to occur on the site (Table 4). Swamp Mahogany flowers during winter and provides nectar and pollen at a time when energy requirements are high and other sources of food are scarce.

4.3 Tree Hollows

Tree hollows are required by 10 species of threatened fauna known or likely to occur on the site (Table 4). Surveys by Harper Somers (2002a) and Forest Fauna Surveys (Appendix 1) have shown that trees with small to medium sized hollows are relatively well dispersed across the site. It is recommended that small and medium tree hollow protection should be approximately proportional to habitat area protection (see below). Trees with large hollows considered suitable for forest owl nesting are, however, limited on the site to 8 specific locations (see Figure 7 of Appendix 2). It is recommended that a minimum 7 of the 8 trees with large hollows be protected on the Site.

4.4 Habitat Clearing and Protection

Clearing of native vegetation is a recognized threatening process under the TSCA 1995. Clearing causes cumulative threatened species habitat loss and increased fragmentation. Species most at risk are those with poor or limited powers of dispersal such as the Squirrel Glider, amphibians, and reptiles, and those whose habitat is inadequately represented in regional and state conservation reserves.

Cumulative habitat loss is generally mitigated by setting limits to the maximum area or percentage of remnant vegetation that may be cleared on a Site or within a region. This strategy is well advanced in neighboring Wyong Shire Council (2002) but no specific conservation targets or clearing limits have yet been developed by Lake Macquarie Shire Council. However, the LHCCREMS fauna modeling project (LHCCREMS 2004) which includes Lake Macquarie Shire has identified habitats that it recommends be protected to meet the regional conservation requirements for a limited number of threatened fauna including the Squirrel Glider, Masked Owl and Powerful Owl (LHCCREMS 2004). It has adopted a conservation target of 30% of the pre-European extent of habitat in the region and has generated predictive models identifying recommended areas for habitat protection. Examination of these models indicates that vegetation on the subject Site has been partially or wholly included within areas recommended for protection of these species.

In order to limit cumulative habitat loss it recommended that a significant proportion (>30%) of existing native vegetation be retained on the Site and that this retained vegetation be protected from future development by a mechanism such as a covenant in perpetuity on title, either under a voluntary conservation agreement with the NSW National Parks and Wildlife Service, or as a covenant under the Nature Conservation Trust Act 2001, or as a Property Vegetation Plan under the Native Vegetation Conservation Act 2003 or through an equivalent legislative mechanism.

4.5 Threatened Fauna

Threatened fauna constraints were determined by drawing a smoothed line around collections of continuous (3 or more) adjoining grid squares on the site with a high threatened species rating (3) and then incorporating additional grid squares considered necessary to:

- protect rare and significant habitats (Swamp Forest and Riparian Tall Moist Forest);
- take into account specific requirements of individual threatened species (eg large hollows, riparian zones);
- establish a local linking corridor between two large occurrences of high quality habitat in the north and southern parts of the site;
- establish regional corridors between vegetation on the site and regional corridors on adjoining lands (after Figure 3) .

It is recommended that habitat to be retained and protected on the site to meet conservation targets include as much as possible of the area outlined in Figure 5 which includes grid squares with the highest conservation rating for threatened fauna.

4.6 Fragmentation

It is recommended that any patches of vegetation to be retained on the Property be linked by corridors not less than 100m wide. This recommendation is taken into account in the draft Structure Plan which provides a central north south corridor to link habitats associated with Jigadee Creek in the north-east to Felled Timber Creek in the south-west. This corridor currently includes cleared gaps on and adjacent to the runway area. It is recommended that these gaps be replanted and restored with native vegetation and natural ground cover to provide a functional corridor for gliders, reptiles and small mammals within a period of less than 10 years. In the interim period limited fauna movement may occur through an existing narrow corridor link across private land running from the north west corner of the Site, through Olney State forest to the south west corner of the Site (see Figure 3 for location of this western corridor link). Vegetation in this corridor is at risk of clearing at the junction area with the north west corner of the Site over the long term.

4.7 Mitigation of Impacts: Structure Plan

A draft Structure Plan has been developed for the Site (Figure 6) which shows areas of native vegetation on the Site that will be retained and restored for ecological purposes and areas that will be cleared. Some additional tree cover (not included in Figure 6) may be retained in bushfire asset protection zones. The Draft Structure Plan was prepared after consideration of recommendations in this report and was designed to avoid a significant impact on any threatened fauna.

Riparian Habitat

The draft Structure Plan retains all vegetation along drainage lines with increasing width of protection for higher order streams. This measure should be sufficient to prevent any significant impact on threatened amphibians (Green-thighed Frog) and the Fishing Bat (Large-footed Myotis).

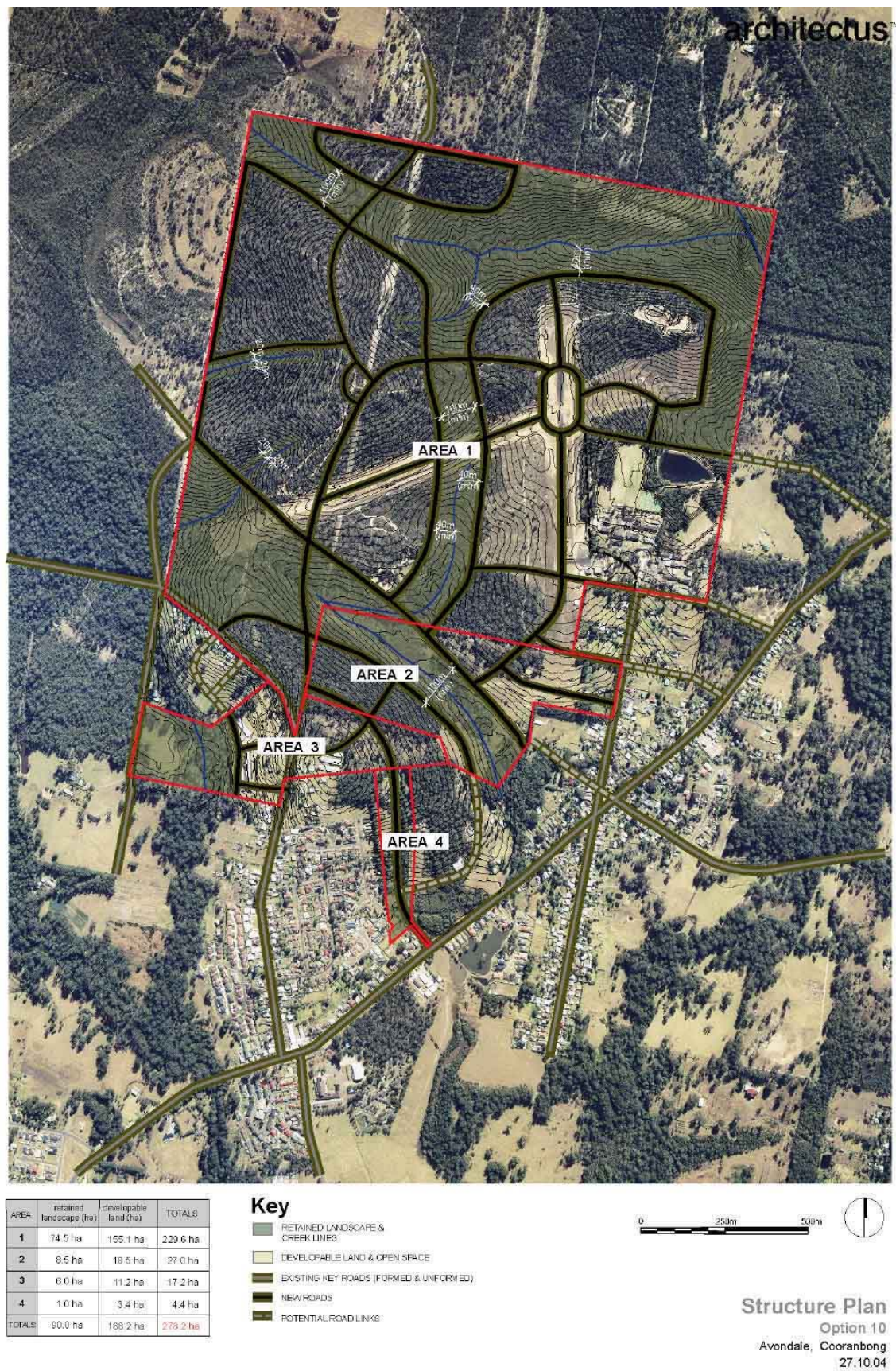
Swamp Mahogany

The draft Structure Plan retains all habitat with Swamp Mahogany. This measure should be sufficient to prevent a significant impact on the Swift Parrot, Regent Honeyeater and Grey-headed Flying Fox.

Tree Hollows

The draft Structure Plan retains trees with small and medium hollows in approximate proportion to the area of native vegetation retained, and retains all but one of the trees with large hollows suitable for forest owls (see Figure 7 of Appendix 1). This measure should be sufficient to prevent any significant impact on most micro-bats (Greater Broad-nosed Bat, Little Bent-wing Bat, East-coast Free-tailed Bat), forest owls (Masked Owl, Powerful Owl) and the Glossy Black Cockatoo.

Figure 6. Draft Structure Plan



Habitat Clearing

Under the draft Structure Plan (Figure 6) approximately 88 hectares or 44% of the native vegetation on the site will be retained and given increased protection (Table 8). Some additional tree cover may be retained in bushfire asset protection zones. Habitat clearing will also be mitigated by habitat restoration of some previously cleared and disturbed areas. Approximately 14 ha. of previously cleared land will be re-vegetated on the western end of one runway, the north east property boundary, the south-east tip of the southern vegetation corridor, the south west corner of the property and in the centre of the main east west runway (Figure 6). In conjunction with habitat in the adjoining Olney State forest, Watagan National Park and environment protection zones on freehold land, this retained habitat should be sufficient to sustain viable local populations of all threatened species known or likely to occur on the Site.

Table 8. Area of fauna habitats to be retained under the Structure Plan relative to current extent on the Site and in the region (adjacent, adjoining areas within a 10 km radius). These figures do not include any additional areas that may be retained within bushfire asset protection zones.

Habitat Type	Area on Site (ha.)	Area retained on Site (ha.)	Area Cleared on Site (ha.)	% retained on Site	Area in Region (ha.)
Alluvial Tall Moist Forest	2.2	2.2	0	100	527
Coastal Plains Scribbly Gum woodland	88.7	18.1	70.6	20	3761
Coastal Plains Smooth-Barked Apple Woodland	96.3	46.2	50.1	48	13,598
Riparian Melaleuca Swamp Woodland	10.7	6.5	4.2	60	1454
Total Native Vegetation	197.9	72.9	125	37	19,340

Threatened Species

The draft Structure Plan protects the majority of grid squares with a high ranking for threatened species (Figure 5). Limited removal of grid squares with a high ranking for threatened species is compensated for by restoration of some previously cleared lands (approximately 14 hectares) and by incorporation of some lower ranking grid squares in areas to be retained to provide regional and local corridor links. Retention and protection of threatened species habitats as shown in the Draft Structure Plan should be sufficient to prevent any significant impact on Threatened Species, within the meaning of the 8 part test under the Threatened Species Conservation Act 1995, and considerations under the Environment Planning and Biodiversity Conservation Act 1999, provided that habitats are protected from disturbance during construction and covenanted to provide protection against future land clearing and development.

4. 8 Eight Part Test (TSC Act 1995)

An Eight Part Test under Section 5a of the Environmental Planning and Assessment Act 1979, is strictly only necessary to accompany a Development Application and is not essential for a re-zoning application. However, as the draft Structure Plan was specifically designed to prevent any significant impact on threatened fauna known or likely to occur on the Site, an Eight Part Test is provided to assess the impact of the proposed development and determine if the Structure Plan meets this objective. This test is based on the assumption that all native vegetation shown as being retained in the draft Structure Plan (Figure 6) will be protected from degradation during the construction and development process and that appropriate monitoring, management plans and legislative mechanisms will be adopted to ensure that retained vegetation is protected and maintained in the foreseeable future.

For the purpose of the Eight Part Test threatened fauna species have been grouped into the following Guilds with similar habitat requirements:

1. Riparian species (Green-thighed Frog, Large-footed Myotis)

2. Swamp Mahogany Species (Regent Honeyeater, Swift Parrot, Grey-headed Flying Fox, Koala)
3. Hollow dependent Species (Powerful and Masked Owls, Glossy Black Cockatoo, Squirrel Glider and micro-bats).
4. Fragmentation Sensitive Species (Squirrel Glider, Koala, Spotted-tailed Quoll).
5. Upland Wet Sclerophyll Forest Species (Powerful Owl, Glossy Black Cockatoo, Spotted-tailed Quoll, Common Bent-wing Bat, Greater Broad-nosed Bat, Koala and the East-coast Free-tailed Bat).
6. Lowland and coastal Dry Sclerophyll Forest species (Large-footed Myotis, Little Bent-wing Bat, Grey-headed Flying Fox, Regent Honeyeater, Swift Parrot, Squirrel Glider, East-coast Free-tailed Bat and Masked Owl).

The habitat of Riparian and Swamp Mahogany Guilds will be entirely retained and protected and will not be cleared or degraded under the proposal. The habitat of hollow-dependent species will be partially reduced under the proposal but the portion of habitat retained will have increased protection. No habitat will become isolated or fragmented under the proposal. Habitat of Upland Wet Sclerophyll Species is well represented in adjoining national parks. Habitat of lowland Dry Sclerophyll species is generally poorly represented in National Parks and threatened species in this community are more dependent on protection of habitat on private land.

(a) in the case of threatened species, whether the life cycle of these species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The only threatening process that will be implemented by the proposal is habitat clearing. The proposal will result in the loss of 121 hectares of Dry Sclerophyll Forest (DSF) habitat and 4.3 hectares of Swamp Forest habitat. The Swamp Forest habitat to be removed will not include areas with Swamp Mahogany trees. Threatened species in the Riparian and Swamp Mahogany guilds will not be affected by clearing.

All other threatened species known or likely to occur on the Site could suffer some reduction in population size or carrying capacity as a result of habitat loss. However, loss of 125 hectares of habitat on the Site is not sufficient to cause a reduction in population size of any threatened species to the extent that a viable local population will be placed at risk of extinction. The area of threatened species habitat to be lost on the Site is insignificant relative to the extent of habitat that will remain on the Site (64 hectares of DSF and 6.5 hectares of Swamp Forest) and the extent of adjacent and adjoining habitat within a 10 km radius in the surrounding region (17,359 hectares of DSF and 1,454 hectares of Swamp Forest).

The threatened species most sensitive to habitat loss is the Squirrel Glider which may be used as an indicator or umbrella species for all other threatened species on the Site. Approximately 229 hectares of potential Squirrel Glider habitat (Map Unit 30) occurs within Olney State Forest immediately adjacent to the Site and extensive additional areas of potential Squirrel Glider habitat occur on freehold lands to the north of the Site. These areas are sufficient to sustain a viable local population of the Squirrel Glider in the local region (Smith 2000) provided that proposed connective corridors and links between retained remnants are maintained.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The regional distribution of some threatened species on the Site (Squirrel Glider, Spotted-tailed Quoll, Powerful Owl, Masked Owl, Koala) has been modeled by LHCCREMS (2004). The regional distribution of other threatened species on the Site can be inferred from the distribution of macro-habitat in the region (summarized in Table 7) and from the distribution and occurrence of known records of threatened species within a 10 km radius (illustrated in Appendix 2). All threatened species that are known to occur or likely to occur on the Site are widely distributed in the surrounding local region and more extensively within the bioregion.

The area of habitat that will be lost on the Site (125ha.) is insignificant relative to the area of equivalent habitat in the surrounding local region and the broader bioregion. The area of Dry Sclerophyll Forest habitat to be lost on Site (121 ha.) represents 0.8% of the area of equivalent habitat within a 10 km radius of the Site. The area of Swamp Forest habitat to be lost on Site (4.2 ha.) represents 0.3% of the area of equivalent habitat within a 10 km radius of the Site.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

No threatened fauna habitats will become fragmented or isolated as a result of the proposal. A 100m wide connecting corridor of vegetation will be maintained between retained habitat to the north and south of the Site (Figure 6). This corridor should facilitate movement and dispersal of the Squirrel Glider and sedentary protected fauna. Existing local and regional corridors along drainage lines that connect habitat on the Site with similar habitat on adjacent lands will be retained (see Figure 3).

(e) whether critical habitat will be effected

No critical habitat occurs on the Site.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

Watagan National Park and Olney State Forest are continuous with habitats on the Site. These protected areas are dominated by moist high elevation forests that provide extensive areas of habitat for Wet Sclerophyll Forest fauna including the Powerful Owl, Glossy Black Cockatoo, Spotted-tailed Quoll, Common Bent-wing Bat, Greater Broad-nosed Bat, Koala and to a lesser extent the East-coast Free-tailed Bat.

Habitats of dry Sclerophyll Forest fauna that prefer foothills and lowlands including the Large-footed Myotis, Little Bent-wing Bat, Grey-headed Flying Fox, Regent Honeyeater, Swift Parrot, Squirrel Glider, and Masked Owl are not well represented in the local Watagan National Park but are represented in the local Munmorah, Glenrock and Lake Macquarie State Recreation Areas and Awabakal Nature Reserve (Harpers Somers 2002a). Within the bioregion they are represented in Myall Lakes, Brisbane Waters, Ku-ring-gai Chase and Royal National Parks. Locally it is likely that habitat of the Squirrel Glider is not adequately reserved, as the majority of its preferred habitat appears to be distributed on freehold or unprotected land (see LHCCREMS 2004).

The proposal will increase the area of Dry Sclerophyll Forest and Swamp Forest habitat on private land to be protected in "private reserves" in the region if all retained native vegetation on the Site is protected by covenant in perpetuity or provided equivalent legislative protection.

(g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The proposed activity will involve Clearing of Native Vegetation which is a listed threatening process under the TSC Act 1995. The proposed activity will result in the loss of 50 hectares of Coastal Plains

Smooth-barked Apple Woodland, 71 hectares of Coastal Plains Scribbly Gum Woodland, and 4.2 hectares of Swamp Forest.

This loss will be mitigated by retaining 88 hectares or 44% of the native vegetation on the site, increasing protection of retained vegetation, and restoring approximately 14 ha. of previously cleared land on the Site. Retained native vegetation on the Site will be protected by mechanism such as a covenant in perpetuity under a voluntary conservation agreement with the NSW National Parks and Wildlife Service, or a covenant under the Nature Conservation Trust Act, or a Property Vegetation Plan (in perpetuity) under the Native Vegetation Conservation Act 2003, or equivalent legislative protection to ensure long term conservation use.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution.

No threatened species known or likely to occur on the Site are at the limits of their known distribution.

4.9 EP&BC Act 1999

A number of species listed as threatened under the TSC Act 1995 are also listed as endangered or vulnerable under the EPBC Act 1999. These species include the Swift Parrot, Regent Honeyeater, and Grey-headed Flying Fox. All of these species fall within the Swamp Mahogany (winter nectar feeding) Guild. As the habitat of species in this Guild will all be protected under the Structure Plan no impact is likely, and no referral of the proposal to the Department of Environment and Heritage is considered necessary.

Two listed migratory species have been reported to occur on the Site, the Cattle Egret (*Ardea ibis*) and the Channel Billed Cuckoo (*Scythrops novaehollandiae*) (Harper Somers 2002a.b, Harper Somers O'Sullivan 2002, 2003). These species may be considered transients or vagrants as no suitable, long term seasonal foraging habitat for either species is present on the Site. No referral of the proposal to the Department of Environment and Heritage is considered necessary for these species.

5.0 REFERENCES

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Appendix 1 Supplementary Fauna Survey, Forest Fauna Surveys 2004

Supplementary Fauna Survey
and Habitat Assessment,
North Cooranbong
City of Lake Macquarie

Report to

Johnson Property Group

24 September 2004

Forest Fauna Surveys Pty Ltd (ABN 17 082 708 521)
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1.0 INTRODUCTION

A targeted fauna survey and habitat assessment was undertaken on approximately 280 hectares of land (Lots 1 – 11 Cooranbong Aerodrome and Lot 1 DP 825266, North Cooranbong)(hereafter referred to as the subject land). The subject land comprises 4 properties encompassing about 280 hectares in total. Details of each property are presented in Table 1 and illustrated in Figure 1.

The subject land is located to the immediate north of the township of Cooranbong in the City of Lake Macquarie. It is bounded by partially forested rural land to the north, Avondale College and Cooranbong Airport facilities in the east, the township of Cooranbong to the south and private rural land and Olney State Forest to the west.

Table 1. Areas comprising the Subject Land

Area	Property Owner	Area (ha)	Previous studies
1.	Aerodrome land Lots 1 – 11 Cooranbong aerodrome	232.5 ha	Harper Somers (2002a)
2.	Pocock's land Lot 1 DP 825266	28.1 ha	Harper Somers O'Sullivan (2003)
3.	Avondale Greens Lot 1 DP 170378, Lot 2 DP 825266 & Part Lot 15 DP 182756	15.3 ha	Harper Somers O'Sullivan (2002)
4.	Avondale Greens Lot 1 DP 348173 & Lot 21 DP 865588	3.8 ha	Harper Somers (2002b)

The climate, soils, geology, land use and vegetation of the subject land have been described in detail by Clements & Associates (2004). Vegetation of the subject land (Table 2) has been described by the Lower Hunter Central Coast Regional Environmental Management Strategy (2003).

Table 2. Vegetation Communities within the Subject Land

LHCCREMS Vegetation Unit	Area in Hectares	% of Area
Alluvial Tall Moist Forest	2.189	0.78
Coastal Plains Scribbly Gum Woodland	88.713	31.68
Coastal Plains Smooth-barked Apple Woodland	96.314	34.40
Riparian Melaleuca Swamp Woodland	10.711	3.82
Total Vegetation Area.	197.927	70.36
Cleared	82.0	29.30
Total Area	~ 280.00	

Fauna surveys have previously been undertaken over parts of the subject land at different times (Harper Somers 2002a, 2002b) (Harper Somers O'Sullivan, 2002, 2003). These investigations were reviewed by Dr. A. Smith (Austeco Environmental Consultants, unpublished) to determine whether sufficient information was available to identify areas of the subject land that could be developed without significantly impacting upon threatened fauna and their habitats. It was concluded that additional information was required in several key areas, including regional context, microhabitat suitability for threatened fauna, and habitat continuity and security on adjoining properties. These additional requirements are listed in Table 3.



Figure produced by Forest Fauna Surveys Pty Ltd (Sept. 2004)

Figure 1. Subject Land, North Cooranbong.

Table 3. Summary of additional information required to clarify ecological constraints on the Subject Land that was the subject of this investigation.

Issues to Address	Methodology
1. Regional Context	(a) Map the distribution and extent of threatened species habitat extending onto adjoining properties (for a distance of about 10km).
	(b) Determine the extent of surrounding continuous habitat in secure tenure (at low risk of future clearing) for each threatened species or group of threatened species.
	(c) Review the occurrence of known threatened fauna records in surrounding (local and regional) secure areas including reserves.
	(d) Evaluate the effectiveness of vegetation on adjoining property to the west of the Site as a possible corridor link in the event that all vegetation across the centre of the Site is cleared.
2. Forest structure	(a) The age class, condition and disturbance history of the site needs to be mapped. It is recommended that this be undertaken by overlaying a 100m grid on the site and allocating each grid square or part grid square to one of several or more broad disturbance and structure classes (details to be determined on site)
3. Food plants	(a) The distribution of forest with key threatened species food plants (Banksia spp., Casuarinas, Swamp mahogany, Red Bloodwood Glider feed trees) needs to be mapped. It is recommended that this be done concurrently with structure and condition mapping.
	(b) The boundary of nationally significant communities (Alluvial Tall Moist Forest, Riparian Melaleuca Swamp Woodland and Swamp Mahogany Forest) in good condition to be retained and protected should be confirmed and mapped on the ground by GPS.
4. Supplementary Fauna Surveys	(a) Further surveys are required to confirm the distribution of the Squirrel Glider and the Koala on the site.
	(b) It is recommended that the Site be stratified by macro and micro habitat type, and that trapping for Squirrel Gliders be undertaken over a minimum 3 nights at a minimum of 6 grids (10 traps at 100m intervals in 5x2 formation)
	(c) Koalas can be surveyed by scats searches on grid squares supporting suitable macro and micro habitat.
5. Fragmentation	(a) Identify and recommend corridor locations and minimum widths for maintaining habitat connectivity on the Site.

Forest Fauna Surveys Pty Ltd was engaged by Johnson Property Group to undertake the supplementary fauna survey and habitat assessment (points 2a, 3a, 4a, 4b and 4c of Table 3) and to address other matters (1a, 1b, 1c, 1d, 5a) in an upgraded constraints report, to be read in conjunction with this report.

2.0 SURVEY METHODOLOGY

2.1 Habitat Assessment

The habitat assessment of the subject land was undertaken by generating a series of 1 hectare grids (100m x 100m) and overlaying the grid on the subject land. Within each grid supporting remnant native vegetation (cleared areas were discarded), a habitat assessment plot was located as close as possible to the centre of the grid. Within an approximate 20m radius of the centre of the plot, the following habitat assessment parameters were recorded, including:

- Location (easting, northing);
- Structural age class (0-30cm dbh, 30 – 60cm dbh, > 60cm dbh);
- Disturbance (fire, clearing, tracks - + [low], ++ [moderate], +++ [severe]);
- Number of habitat trees;
- Counts of food trees (*Corymbia gummifera*, *Eucalyptus robusta*);
- Food plants (understorey)(*Acacia* sp., *Banksia* sp., *Xanthorrhoea* sp., *Allocasuarina* sp.)
- Aquatic habitat (standing / flowing water, emergent aquatic plants).

Following collation of all habitat assessment data, a habitat quality matrix was generated for each threatened fauna species or fauna group either recorded in the study area, or considered likely to occur based on known records in the locality. The habitat assessment matrix rates the habitat quality of each grid as low (poor quality habitat or absent), medium or high quality habitat.

The location of each habitat assessment plot within the subject land is presented below in Figure 2.



Figure 2. Location of Fauna Habitat Sampling Plots

2.2 Supplementary Fauna Survey

Previous fauna investigations of parts of the subject land have been undertaken. These investigations include:

Area 1. Harper Somers (2002a).

Area 2. Harper Somers O'Sullivan (2003).

Area 3. Harper Somers O'Sullivan (2002).

Area 4. Harper Somers (2002b).

Fauna investigations include specific surveys for birds, mammals, bats (echolocation call recording only), reptiles and amphibians. Threatened fauna species recorded within the subject land, or immediately adjacent habitat are listed below in Table 4.

Table 4. Threatened Species recorded within Subject Land, North Cooranbong.

Area	Common Name	Scientific Name	Report
1	Eastern Freetail Bat	<i>Mormopterus norfolkensis</i>	Harper Somers (2002a)
	* Glossy Black Cockatoo	* <i>Calyptorhynchus lathami</i>	
	* Squirrel Glider	* <i>Petaurus norfolcensis</i>	
3	Eastern Bent-wing Bat	<i>Miniopterus schreibersii oceansis</i>	Harper Somers O'Sullivan (2002)
	Eastern Freetail Bat	<i>Mormopterus norfolkensis</i>	
4	Large-footed Myotis	<i>Myotis adversus</i>	Harper Somers (2002b)
	Eastern Bent-wing Bat	<i>Miniopterus schreibersii oceansis</i>	
	Little Bent-wing Bat	<i>Miniopterus australis</i>	
	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	
	* Grey-headed Flying-fox	* <i>Pteropus poliocephalus</i>	

Note: Species denoted with asterisk* in Table 4 above indicate recorded in proximity to subject land.

A number of additional threatened species have been recorded in the locality (<10km radius) and could utilise habitats within the subject land as part of their wider foraging requirements. Those species include birds (Glossy Black Cockatoo, Swift Parrot, Regent Honeyeater, Powerful Owl, Masked Owl) and mammals (Spotted-tail Quoll, Koala, Squirrel Glider). Other threatened species recorded in the locality require specific habitats such as swamps, of which the Green-thighed Frog and Green & Golden Bell Frog have been recorded <5km from the subject land.

The focus of this supplementary fauna survey was to target the arboreal mammals, and document additional opportunistic observations and recordings of threatened species whilst undertaking the survey. Additional fauna survey methodologies include playback of pre-recorded calls of threatened large forest owls and spotlight searches of potential amphibian habitat.

The supplementary fauna survey targeting arboreal mammals, nocturnal large forest owls and amphibians was conducted during the period Monday 6 to Thursday 16 September 2004. The arboreal mammal survey consisted of a tree trapping program, spotlight searches and stag watching for the threatened Squirrel Glider, and scat searches and spotlighting for the Koala.

2.2.1 Arboreal Tree Trapping

Arboreal trapping for possums and gliders was undertaken with Elliott Type B (15 x 16 x 45 cm) folding aluminium traps mounted on platforms attached to the tree trunk. Five survey sites were established within the subject land, and 1 site in the adjoining Olney State Forest. At each site, Elliott type B traps were mounted on trees at a height of 5 metres. Traps were established in a trapping grid configuration of 2 lines of 5 traps, with each trap spaced 100 metres apart.

The effective trap area of this grid configuration (4.0 hectares), plus a boundary strip of 45 metres wide is 9.3 hectares. Each trap grid was active for three consecutive nights, resulting in 180 arboreal trap nights for this study. Each trap was baited with a mixture of peanut butter, rolled oats and honey and the trunk of the tree adjacent to the trap sprayed with a mixture of water and honey to act as an attractant.

The dates of trapping of each grid is presented below in Table 5, and location of trapping grids presented in Figure 3.

Table 5. Arboreal Trapping Grid details, North Cooranbong.

Trap Grid #	Easting	Northing	Dates Surveyed	No. Trap nights
1	356035	6341494	6 – 9 Sept. 2004	30
2	355651	6341232	6 – 9 Sept. 2004	30
3	356131	6341559	6 – 9 Sept. 2004	30
4	355789	6340981	7 – 10 Sept. 2004	30
5	355372	6340240	13 - 16 Sept. 2004	30
6	354540	6341020	13 - 16 Sept. 2004	30
Total				180

Note: The coordinates above in Table 5 refer to Trap #1 of each trapping grid. Coordinates are presented in AMG (AGD66).

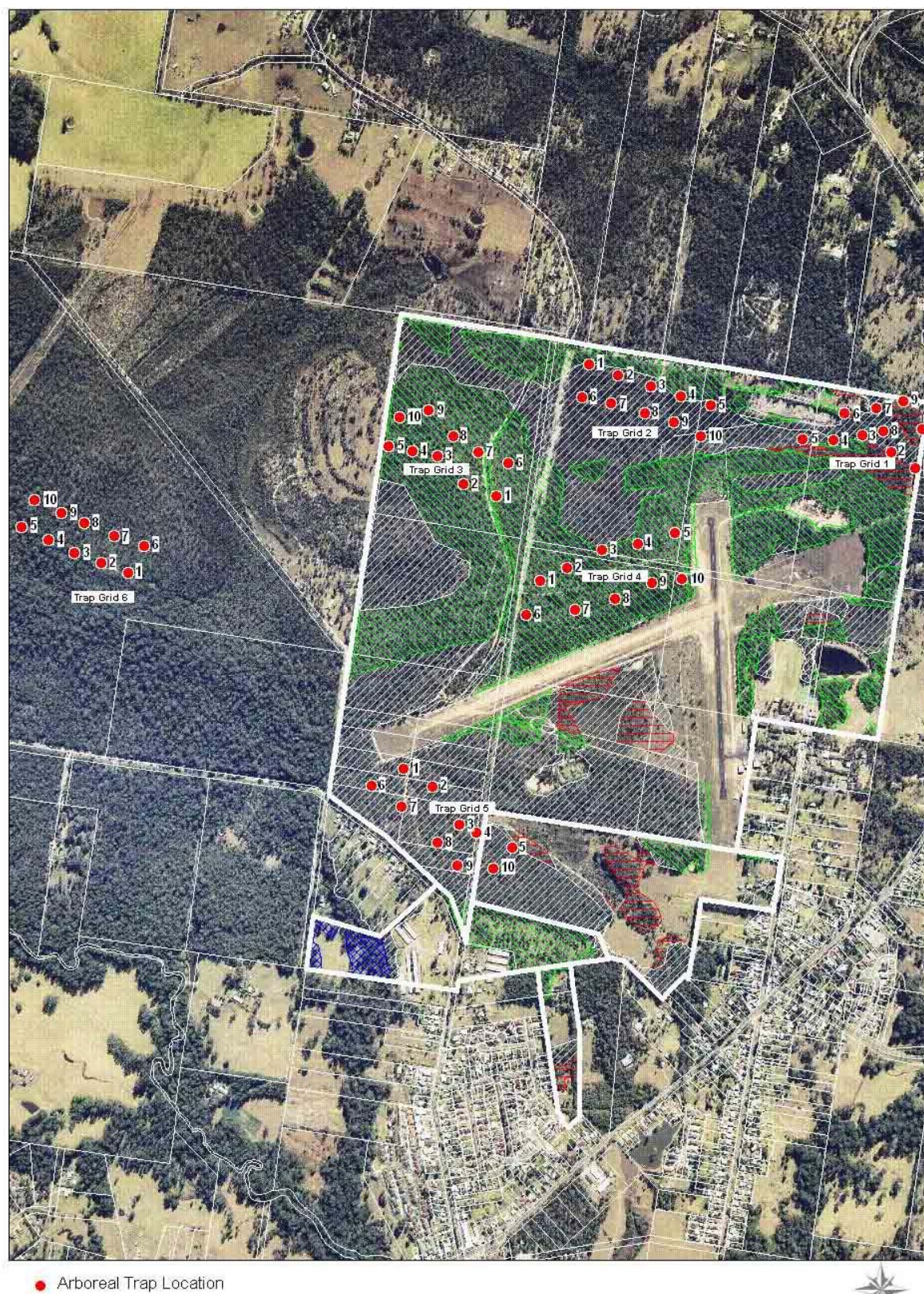
2.2.2 Spotlight Searches

Spotlight searches undertaken by foot across the subject site for approximately 60 minutes in proximity to each trapping grid with a 55 watt spotlight, followed by quiet listening in darkness to detect any animal movements or vocalisations. Particular attention was paid to trees in flower as these provide a source of blossom and nectar for arboreal mammals such as gliders.

Spotlight searches were conducted on the evenings of Monday 6, Thursday 9, Monday 13, Tuesday 14 and Wednesday 15 September 2004. A total of 8.0 hours spotlight searches was undertaken during the survey period. Two nights of spotlight searches were cancelled due to storms and rainfall (Tuesday 7 and Wednesday 8 September 2004).

2.2.3 Stag-watch Observations

Stag watching involves direct counts of nocturnal animals emerging from tree hollows at dusk. The technique involves observers stationed beneath hollow bearing dead or living trees in a defined area and recording the identity and number of emergent animals following dusk for a period of about 40 minutes. This technique is useful as it provides an accurate measure of absolute abundance providing all individuals emerge following dusk, and all individuals in a population or group den in tree hollows (Smith *et al.*, 1989).



Map produced by Forest Fauna Surveys Pty Ltd (Sept. 2004)

Figure 3. Location of Arboreal Trap Grids, North Cooranbong

2.2.4 Nocturnal Owl Census

The nocturnal owl census was conducted at selected survey sites and involved stag-watching at dusk and a 30 minute nocturnal owl census.

Nocturnal census follows the standardised survey methodology. This involves quiet listening for calls of owls following dusk for a period of approximately 15 minutes to determine the presence of nest or roost sites on, or in close proximity to the survey site. Following the 15 minute census period, playback of pre-recorded calls of the threatened Sooty Owl, Powerful Owl, Masked Owl and Barking Owl is broadcast through a 20 watt portable amplifier from the survey site into adjacent bushland.

Calls of each species is broadcast for a period of five minutes, coupled with short periods of quiet listening for any vocal response from the owls. Following playback calls, a period of 10 minutes quiet listening for vocal responses, and 15 minutes spot-lighting the area is undertaken.

Details of the nocturnal owl census is presented below in Table 6.

Table 6. Nocturnal Owl Census details, North Cooranbong.

Survey Site	Easting	Northing	Dates Surveyed
Near Trap Grid 1	356770	6341520	6 Sept. 2004
Near Trap Grid 2	355900	6341650	9 Sept. 2004
Near Trap Grid 5	355260	6340430	13 Sept. 2004
Near Trap Grid 6	354650	6340970	15 Sept. 2004

Note: The coordinates above in Table 6 are presented in AMG (AGD66).

3.0 SURVEY RESULTS

The weather conditions during the fauna survey period are presented in Table 7 below.

Table 7. Weather Conditions, North Cooranbong.

Data collected from Norah Head Weather Station (24 kms to the south-east of subject land)

Date	Min. Temp °C	Max. Temp °C	Wind Speed (knots) and Direction		Cloud Cover	Rainfall (mm) 24 hrs	Moon
			9 am	3 pm			
6/9/2004	9	19	NW 5	NW 5	0/8	0.0	0/4
7/9/2004	12	20	Calm	E 5	4/8	Trace	0/4
8/9/2004	14	24	Calm	W 6	6/8	5.0	0/4
9/9/2004	14	21	W 5	calm	7/8	5.4	0/4
10/9/2004	10	21	W 5	W 5	6/8	5.0	0/4
13/9/2004	7	18	W 5	E 5	4/8	0.0	0/4
14/9/2004	9	18	Calm	E 5	2/8	0.0	0/4
15/9/2004	11	20	SW 10	SE 5	2/8	0.0	0/4
16/9/2004	11	19	SE 5	E 10	1/8	0.0	0/4

Rainfall was experienced during the first week of the fauna survey. The rainfall experienced did not result in pooling of surface water, or filling of small impoundments. Surface water was present in a small number of vehicle track depressions, and deeper depressions along drainage lines. Conditions for the amphibian surveys was poor, with cold nights during the first week and low humidity levels recorded during the second week of survey.

3.1 Habitat Assessment

3.1.1 Structural Age Class and Habitat Trees

Each tree within each habitat assessment plot was scored into 1 of 3 structural age classes, based on size of diameter of tree at breast height (dbh in centimetres). The structural age classes are <30cm dbh, >30 <60 cm dbh and >60cm dbh. The forest / woodland age structure within the subject land is characterised by relatively juvenile aged forest, with very few mature trees greater than 60cm dbh (1.03%). The proportion of trees in each age class is presented below in Table 8.

Table 8. Structural Age Class, North Cooranbong.

	<30cm dbh	> 30 <60cm dbh	> 60cm dbh	Total
Number of Trees	6,402	209	69	6,680
% Proportion	95.84%	3.13%	1.03%	

Factors responsible for such a skewed distribution of smaller diameter trees is possibly due to events such as fire and lower nutrient soils across the majority of the subject land. Parts of the forest in proximity to the aerodrome appear to be regrowth from past clearing, although no historical aerial photographs were available to confirm this.

Habitat trees within the study area are relatively evenly disbursed across the subject land (refer to Habitat Tree Mapping of Harper Somers, 2002a). The average density of habitat trees per hectare in Area 1 is 2.9 trees per hectare, based on counts of habitat trees by Harper Somers (2002a). The number of very large mature habitat trees suitable for owls was considered to be 81 trees in Area 1 (Harper Somers, 2002a). However, this is considered an over-estimate following habitat assessment undertaken for this study. Only a small number of habitat trees (i.e. < 20) appear suitable as roost or nest trees for threatened large forest owls. Inspection of the inside of large hollows within a number of these trees (where possible) revealed no evidence of use by large forest owls, and no whitewash or regurgitation pellets were observed in proximity to potential owl habitat trees.

3.1.2 Disturbance

The major disturbances to remnant vegetation and fauna habitat on the subject land is clearing and fire, with most of the site impacted to varying degrees. There has been relatively recent clearing of parts of the subject land for construction of fence lines, creating a patchwork of forest fragments with cleared gaps up to 33 metres wide. Remnant vegetation within the north-eastern corner has been slashed in the past.

The north-western and western portion of the subject land has been impacted by a relatively recent wildfire about 3 years previous. In contrast, parts of the middle and north-eastern portion of Area 1 has not experienced a high intensity fire for a considerable period of time. This is evident by very dense growth of understorey and ground layer vegetation. This subject land is dissected by vehicle tracks, which has resulted in dumping of domestic rubbish and incursion of exotic weeds.

3.1.3 Distribution of Food Trees

The abundance of key food trees for several threatened fauna species was assessed in the habitat assessment. Tree species essential for threatened species include Swamp Mahogany (*Eucalyptus robusta*) for a suite of species and Red Bloodwood (*Corymbia gummifera*) as sap source for Squirrel Glider.

The extent of vegetation community supporting Swamp Mahogany is low for the subject land. The LHCCREMS regional vegetation mapping (2003) indicates about 10.71 hectares (or 3.82%) occurs. Based on the habitat assessment for this study, the location of stands of Swamp Mahogany is presented below in Figure 4. Anne Clements & Associates has also mapped the extent of this vegetation type (2004).

Red Bloodwood is widespread across the subject land, with the majority of habitat assessment plots scoring at least low abundance (<10 plants per plot).

3.1.4 Distribution of Food Plants (Understorey)

The distribution of key food plants for threatened species was assessed within the subject land. Key food plants in the understorey and ground layer include *Banksia sp.*, *Allocasuarina sp.*, Swamp Mahogany and *Acacia sp.* and *Xanthorrhoea sp.*

For the threatened Squirrel Glider, Smith (2000) found no significant correlation between *Banksia sp.* abundance and Squirrel Glider abundance in Wyong Shire. However, there was a significant positive correlation between *Banksia sp.* abundance and female reproductive performance. *Banksia* provide pollen and nectar for the species, and *Xanthorrhoea sp.* and bipinnate *Acacia sp.* which provide gums (Smith, 2000).

From the matrix of data collected on each habitat assessment plot, mapping of habitat quality for the Squirrel Glider was determined based on the presence of Swamp Mahogany (high quality) and abundance of *Banksia spinulosa*. *Banksia oblongifolia* was also present within the study area, but was deemed less significant to the Squirrel Glider due to its flowering in autumn, whilst *Banksia spinulosa* is a winter flowering species. The determination of habitat quality for the Squirrel Glider, based on presence of Swamp Mahogany and abundance of *Banksia spinulosa*, is presented below in Figure 4.

The Glossy Black Cockatoo key food plant is species of *Allocasuarina* and *Casuarina* trees. In general, the distribution and abundance of this foraging resource was very limited within the subject land. The distribution is presented below in Figure 5. In comparison to the regional distribution of this foraging resource for the Glossy Black Cockatoo, the subject land supports only marginal foraging habitat for the species. Habitat of the Glossy Black Cockatoo is well represented in adjacent state forests and national park and protection of habitat on private land is not considered necessary for the regional protection of this species.



Figure 4. Squirrel Glider Habitat Assessment, North Cooranbong.

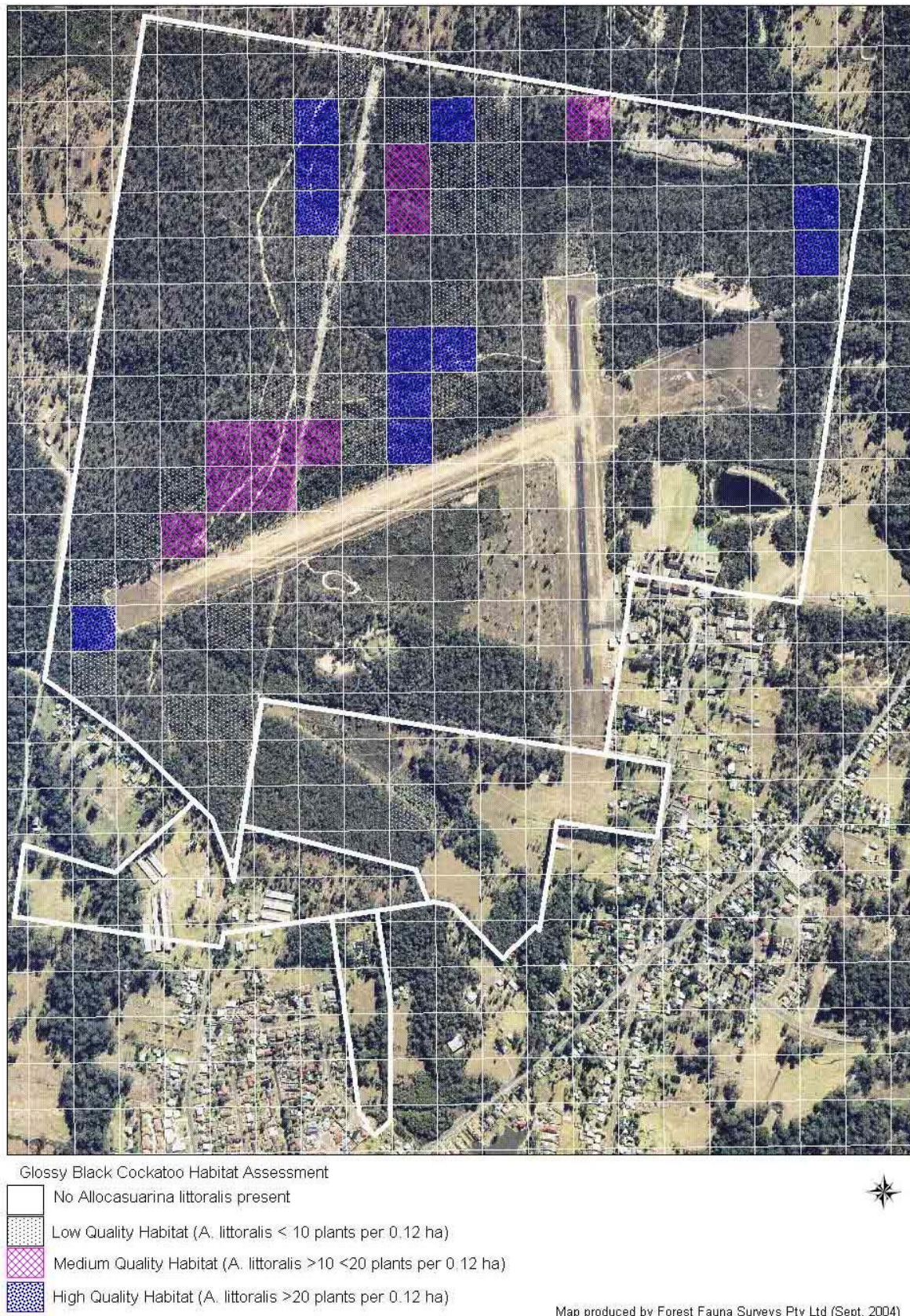


Figure 5. Glossy Black Cockatoo Habitat Assessment, North Cooranbong.

3.1.5 Aquatic Habitat

The presence of standing or flowing water in small streams and ponds was assessed within the study area. It must be noted that during this fauna habitat assessment, conditions for frogs was considered poor, due to very dry conditions. A small amount of rainfall was experienced during fieldwork, but had no impact on frog activity. Very limited habitat for pond dependent frog species, such as Green & Golden Bell Frog (*Litoria aurea*) is present within the study area. A large pond occurs to the immediate north of the Avondale High School, but presents very low habitat quality for pond dependent frog species. No emergent or fringing aquatic vegetation is present in this water body. Frogs associated with this habitat include Common Eastern Froglet (*Crinia signifera*), Spotted Grass Frog (*Limnodynastes tasmaniensis*), Smooth Toadlet (*Uperoleia laevis*) and Broad-palmed Frog (*Litoria latopalmata*). A small number of depressions along vehicular tracks occur throughout the study area. Similar frog species were associated with these small temporary ponds.

Riparian habitat for stream dwelling frogs is present in the north-eastern section of the subject land. This habitat is associated with the Jigadee Creek complex, draining to the south-east from the subject land. Frog habitat associated with this creek system comprises small pools in depressions along the creek bed (presently dry), dense fringing riparian vegetation and tall forest containing tree hollows. Frog species associated with this habitat type include Lesueur's Frog Frog (*Litoria lesueuri*) and the widespread Common Eastern Froglet.

In the south-western corner of the subject land contains riparian habitat associated with Felled Timber Creek. This habitat is of higher quality than the Jigadee Creek system, being more structurally complex and supporting diverse riparian vegetation. Frog species recorded in this creek system during fieldwork include Lesueur's Frog Frog (*Litoria lesueuri*). No additional frog species were active during investigations for this study, but likely to support frog species associated with rainforest and wet sclerophyll forests.

The threatened Green-thighed Frog (*Litoria brevipalmata*), and possibly Barred River Frog (*Mixophyes balbus*) and Giant Barred Frog (*M. iterates*) are considered likely to be associated with this creek system. All three species have been recorded in the locality (<10km radius of the subject land).

3.1.5 Large Forest Owl Habitat

No large forest owls were recorded during surveys for this report. Potential habitat for the Powerful Owl is likely to be restricted to the riparian forest associated with Jigadee Creek in the north-east, and Felled Timber Creek in the south-west. The remainder of the subject land supports marginal foraging habitat for the Powerful Owl due to the very low abundance of key prey (i.e. arboreal possums and gliders). Suitable foraging habitat for the Masked Owl occurs throughout the subject land. The fauna survey by Harper Somers (2002a, 2002b) and Harper Somers O'Sullivan (2002, 2003) documented the diversity (but not abundance) of preferred prey of the Masked Owl (small terrestrial mammals). In parts of the site less impacted by fire, the abundance of small terrestrial mammals would be higher. Pockets of dense understorey vegetation occur within the central part of Area 1 (*Leptospermum trinervium*, *L. polygalifolium*) which is considered to restrict foraging opportunities for the Masked Owl. No evidence of the species was recorded during field surveys for this report and previous reports. There are 4 records of the species within a 5km radius of the subject land, suggesting moderate to high likelihood of the species. A number of potential roost or nest trees were observed within the subject land (refer to locations in Figure 7). An inspection of the interior of the hollows of several suitable trees revealed no evidence of use by the Masked Owl.

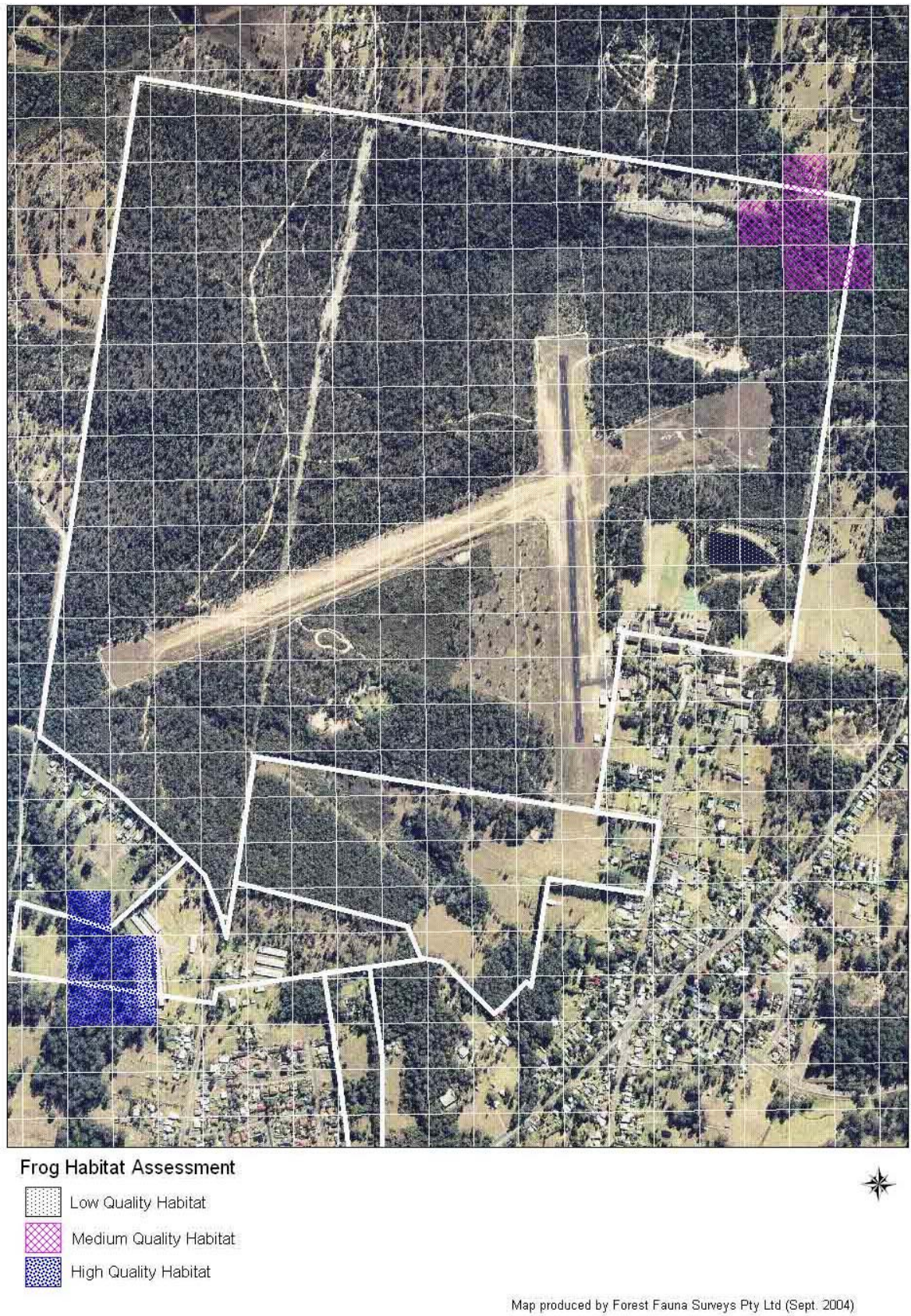


Figure 6. Frog Habitat Assessment, North Cooranbong.

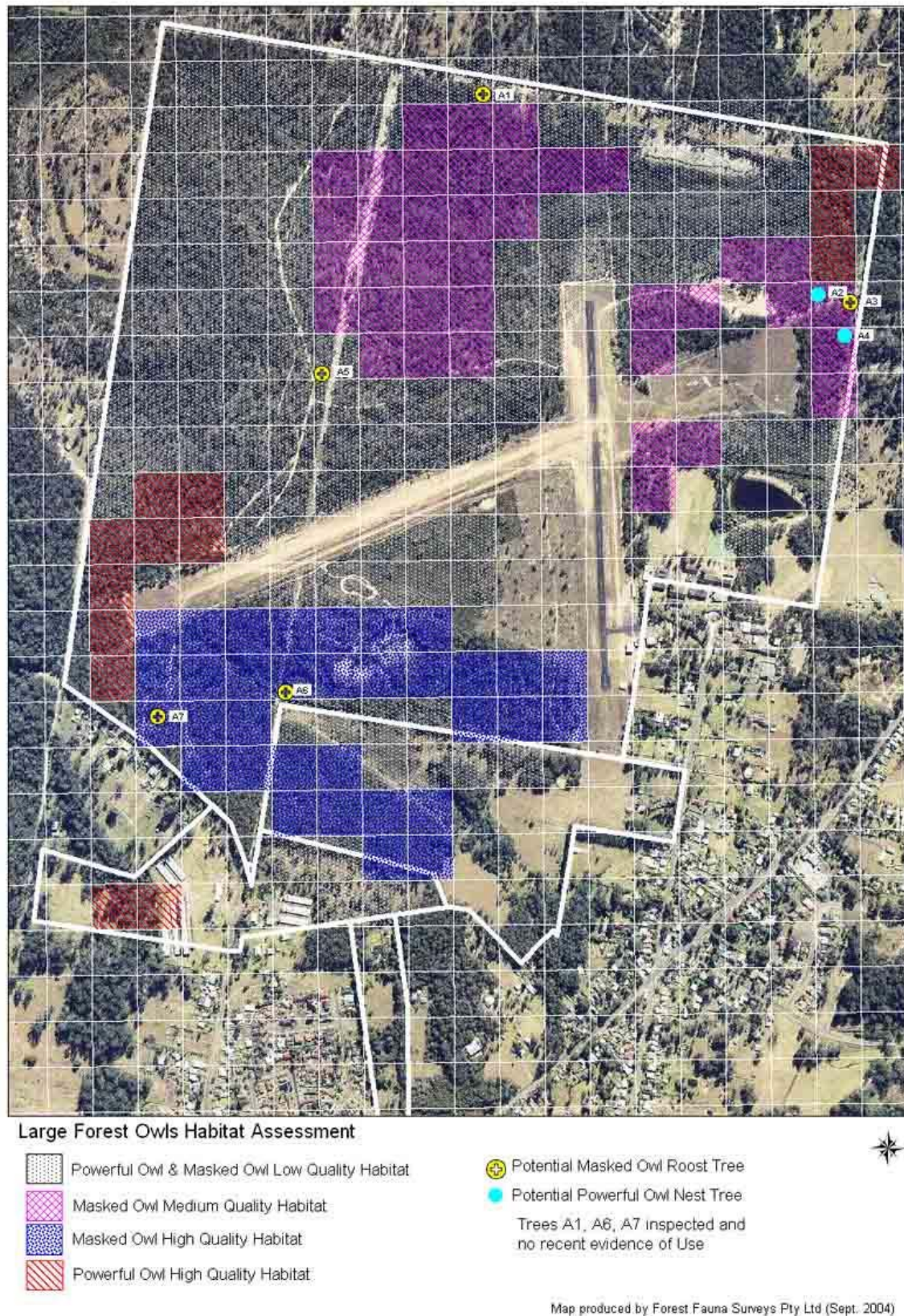


Figure 7. Large Forest Owl Habitat Assessment, North Cooranbong

3.2 Supplementary Fauna Survey

3.2.1 Arboreal Tree Trapping

No gliders or possums were captured by arboreal tree trapping during the survey period. Previous investigations of the subject land by Harper Somers trapped the Sugar Glider (*Petaurus breviceps*). The absence of gliders from the subject land during this investigation is unusual and unexpected given the quality of habitat present. The site has been disturbed to varying degrees, but is presently continuous with larger fragments of forest with suitable habitat for the Squirrel Glider. A regional survey of the Squirrel Glider undertaken in Wyong Shire detected the presence of the Squirrel and Sugar Glider in most forest remnants ranging in size from <5 hectares to > 200 hectares (Smith, 2000).

Disturbance from fire may have influenced the occurrence of gliders on the subject land. Smith (2000) noted that populations of gliders decline following fire due to interruption of food availability. Tree hollows are low in density (average of 2.9 per hectare) but widespread within the subject land

3.2.2 Spotlight Searches

Spotlight searches detected the presence of the following arboreal species, Common Brushtail Possum and Common Ringtail Possum. No gliders were detected by spotlight searches within the subject land. The detectability of possums within the subject land is very low, with only 6 individuals recorded for approximately 8.0 hours of spotlight searches.

No evidence of Koala was noted from spotlight searches, which is consistent with previous investigations of the subject land.

3.2.3 Stag-watch Observations

Stagwatch observations resulted in detection of one species, the Common Brushtail Possum. No gliders or owls were observed emerging from tree hollows within the subject land during field investigations.

3.2.4 Nocturnal Owl Census

No threatened large forest owls were detected by nocturnal owl census during the survey period and no threatened large forest owls were detected in the subject land during previous investigations (Harper Somers 2002a, 2002b; Harper Somers O'Sullivan 2002, 2003). However, habitat on the subject land is suitable for forest owls and is within home range diameter of previous survey records in the surrounding region so it is likely that habitat on the subject land will be used by forest owls from time to time.

4.0 CONCLUSION

The habitat assessment indicates the site supports a relatively young forest with the majority of tree species less than 30cm dbh (95.84%). The abundance of habitat trees is considered low, with an average of 2.9 habitat trees per hectare. Smith (2000) recorded peak abundance of arboreal possums and gliders in forest and woodland with more than 10 habitat trees per hectare.

Mapping of habitat quality was determined for the Squirrel Glider based on abundance of the key food resource Swamp Mahogany (*Eucalyptus robusta*) and *Banksia spinulosa*. These are important winter foraging resources (nectar and pollen) for the species. Swamp Mahogany was restricted in abundance within the subject land, while *Banksia spinulosa* was more widespread. No Squirrel or Sugar Gliders were detected on the site or adjacent state forest despite intensive surveys. Old feed scars indicate that Sugar or Squirrel Gliders have occurred on the site in the past and there are existing records of the Squirrel Glider in habitat adjacent to the site and the Sugar Glider on site. It is concluded that the Squirrel Glider population has become locally extinct or severely depleted in this remnant, probably due to recent fire.

For the Glossy Black Cockatoo, the occurrence of *Allocasuarina littoralis* was sparsely distributed, indicating the subject land supports marginal foraging habitat for the species.

No evidence of Koala activity was recorded within the subject land, although preferred food trees (Swamp Mahogany, Sydney Blue Gum *E. saligna* and Broad-leaved Scribbly Gum *E. haemastoma*) (as listed on Schedule 2 of SEPP44) are present. The widespread occurrence of Broad-leaved Scribbly Gum on the subject land is probably marginal potential habitat as a foraging resource for the species, due to the low nutrient soils. In contrast, the Swamp Mahogany and Sydney Blue Gum is restricted in abundance (<5% of total vegetation cover) but should provide good quality habitat for any koalas in the locality. The most recent record of Koala in the locality is one individual near Morisset (5km SE) in 1997. No recent additional records (<5yrs) occur within 5km of the subject land. No evidence of core habitat was noted during the previous investigations of the subject land (Harper Somers 2002a, 2002b, Harper Somers O'Sullivan, 2002, 2003). It is concluded that the koala has become locally extinct on the site, possible due to past fire.

No habitat suitable for the threatened Green & Golden Bell Frog was observed within the subject land. However, areas of suitable habitat for threatened riparian frogs (Giant Barred Frog, Barred River Frog and Green-thighed Frog) occur along the drainage lines of Jigadee Creek in the north-east and Felled Timber Creek in the south-west of the subject land. No evidence of these species was recorded during this investigation due to the extended dry conditions experienced over the past 2 years.

In summary, no threatened fauna species were recorded during the supplementary fauna survey in September 2004. However, the habitat assessment indicates the subject land supports potential habitat for a number of threatened species, including Squirrel Glider, Koala, Glossy Black Cockatoo, Powerful Owl and Masked Owl, Green-thighed Frog, Giant Barred Frog and Barred River Frog.

A separate fauna constraints report has been prepared to address the potential impact of development of the subject land on threatened species and on their habitat. The threatened species for consideration include those indicated above, and additional threatened species recorded on the subject land and locality. The fauna constraints report also assesses the significance of the habitats on site in a regional context.

5.0 REFERENCES

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APPENDIX 2 Regional Threatened Species Distribution Maps

Figure 1. Threatened Arboreal Mammal records, 10km radius.



Figure 2. Threatened Bird records, 10km radius of North Cooranbong Site.

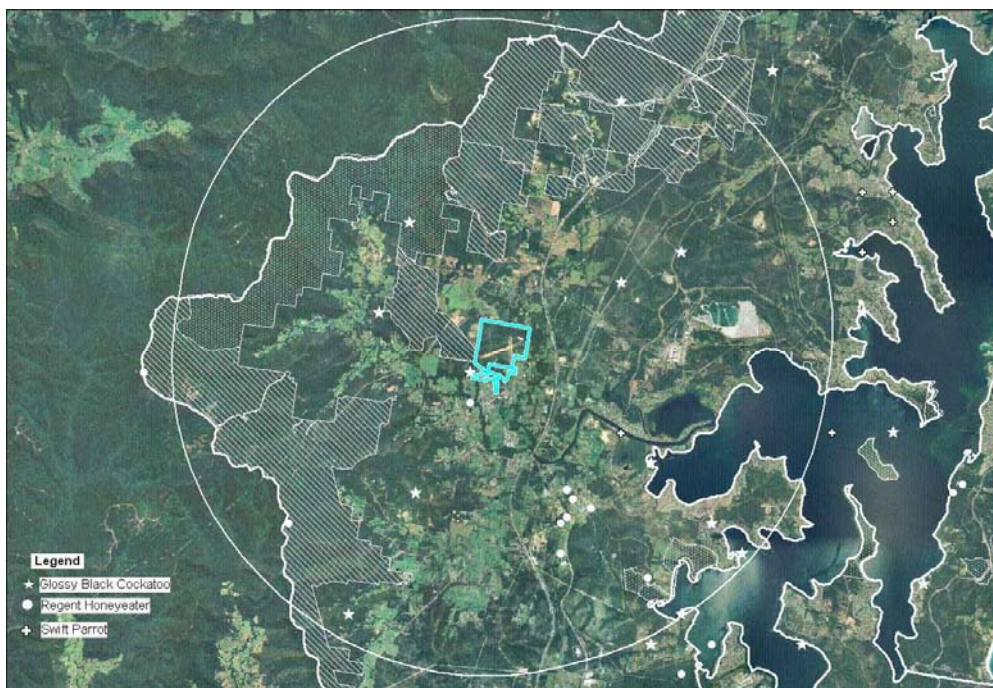


Figure 3. Threatened Owls, 10km radius of North Cooranbong.

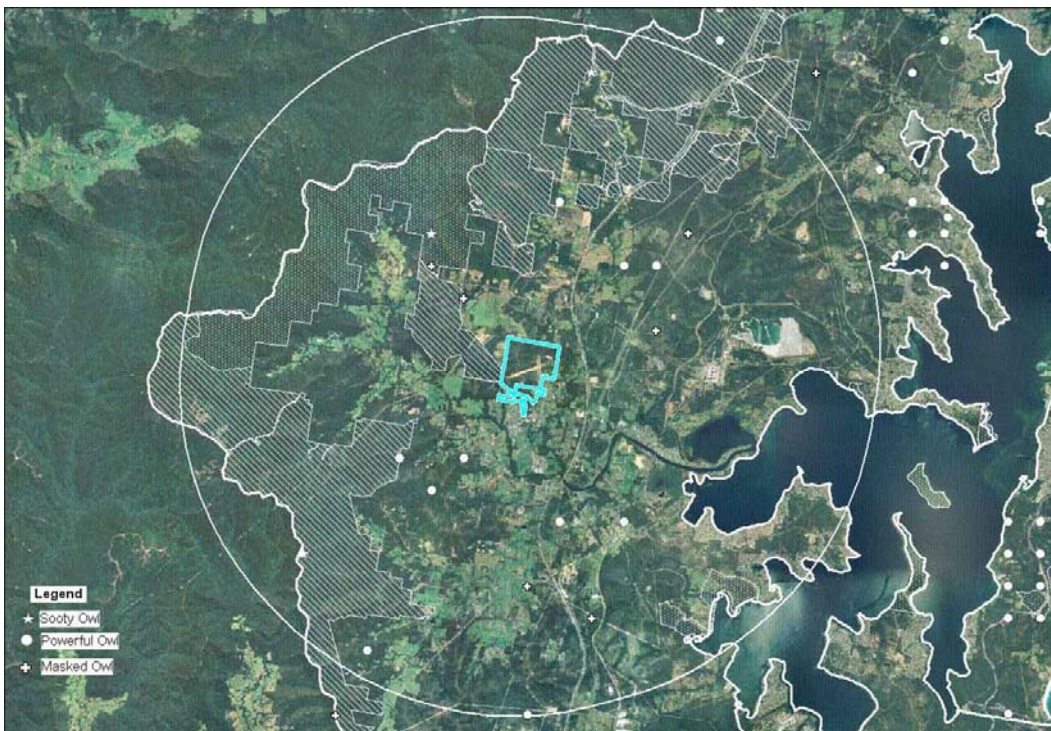


Figure 4. Threatened Frogs, 10km radius of North Cooranbong.



Figure 5 Threatened Bats, 10km radius of North Cooranbong.

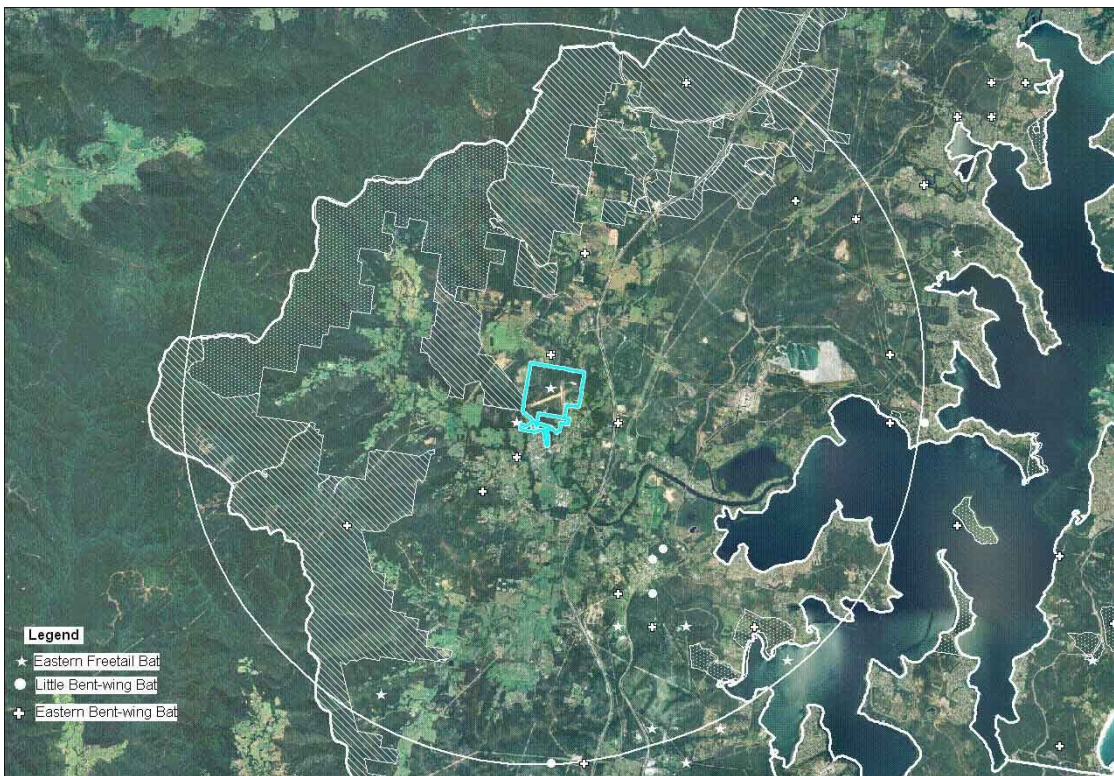


Figure 5 Threatened Bats, 10km radius of North Cooranbong.

