FAUNA INVESTIGATIONS

LAND OFF GEORGE BOOTH DRIVE
EDGEWORTH
CITY OF LAKE MACQUARIE

Report to

GeoLINK Consulting Pty Limited

10 September 2010

Forest Fauna Surveys Pty Ltd

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City of Lake Macquarie

Report prepared for

GeoLINK Consulting Pty Limited

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Acknowledgements.
Veronica Silver (Ecologist) is thanked for engaging the services of Forest Fauna Surveys Pty Ltd, and also assistance in the field and provision of resources for the project. Angel Troke from LMCC is also thanked for provision data and aerial photographs.

Document History

Document No.	Prep. Date	Version	Checked by	Date
00155.a	19 December 2008	Working draft	V. Silver GeoLINK	10 January 2009
00155.b	15 January 2009	Working draft	V. Silver GeoLINK	20.08.2010
00155.c	10 September 2010	Final draft	V. Silver GeoLINK	

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EXECUTIVE SUMMARY

Fauna investigations were conducted on land off George Booth Drive, Edgeworth between the period May 2008 to March 2010 to assist in assessment of the ecological significance of the subject site. In total, 59 bird species, 16 mammal species, 3 reptiles and 7 frog species were recorded within, or immediately adjacent to the subject site. A total of 6 threatened species were recorded by the surveys, including:

- Masked Owl *Tyto novaehollandiae*
- Squirrel Glider *Petaurus norfolcensis,*
- Little Bent-wing Bat *Miniopterus australis,*
- Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis,*
- Large-eared Pied Bat *Chalinolobus dwyeri,* and
- Grey-headed Flying-fox *Pteropus poliocephalus.*

An additional threatened species was possibly recorded on site, either the Greater Broad-nosed Bat *Scoteanax rueppellii* or Eastern Falsistrelle *Falsistrellus tasmaniensis.* However, either species was detected by echolocation call recording, which was of insufficient quality to confirm the identification to a high degree of accuracy. Analysis of threatened fauna species recorded in the locality (<10km radius) reveal an additional 29 threatened species. However, for many of the additional 29 species, no suitable habitat exists in the subject site to suggest their likely occurrence.

Two habitat types were defined for the subject site, Open Forest and Open Grassland, although there is variation in dominant tree species within the Open Forest distributed across the site. The subject site has experienced a high degree of disturbance to the native vegetation by impacts of logging (past and present), vehicle and pedestrian tracks, dumping of domestic and commercial waste, weeds, clearing of easements for infrastructure utilities (powerlines), and fire. Parts of the subject site experience a high to very high fire frequency. The general age of the forest structure is juvenile aged trees with an average of 1.3 habitat trees per hectare (very low). Vegetation within the subject site is fragmented due to wide cleared easements for three powerline easements, and is also fragmented from adjoining bushland areas by both major and minor roadways surrounding the perimeter.

Land use zones under the LMCC LEP (2004) immediately to the north of the subject site support a mix of developments with limited opportunities for retention of native vegetation, fauna habitat and vegetation corridors. To the west of the subject site, corridor connectivity to remnant forest is also fragmented due to clearings for power line easements, minor roads (Appletree Road) and residential allotments. To the south and east of the subject site is residential suburbs with no habitat values for the majority of fauna species that utilise the site. However, a narrow corridor of remnant forest exists which connects the subject site to Cockle Creek. This large creek retains riparian vegetation and provides connectivity to large areas of remnant vegetation and fauna habitat in the creek's upper catchment. The only barrier to dispersal of fauna between the subject site is a power line easement and Northville Road.

Potentially, there are two options for creation of, or maintenance of vegetation and habitat corridors between the subject site and adjoining forested areas. Based on the distribution of endangered ecological communities within the subject site, the potential exists for the establishment of a north-south vegetation and fauna habitat corridor along a small drainage line on the eastern boundary of the subject site. However, examination of the LMCC LEP (2004) indicates land the north of George Booth Drive (Pambulong Development),which would link to the potential north-south site corridor, will be developed in time. This will result in removal of native

vegetation and the potential for corridor connectivity to remnant forest north of George Booth Drive. Therefore, any north –south corridor that is retained on the subject site will not link to any significant adjoining forested areas.

The Lake Macquarie City Council Local Environmental Plan (2004) provides guidance for land use within the City. Based on the existing LEP 2004, there is limited opportunity for establishment of a vegetation corridor network north of George Booth Drive. However, an east-west corridor along the southern boundary of the subject site has the potential due to existing land use zones sympathetic to conservation of remnant vegetation and fauna habitat. Land to the immediate south-east of the subject site is Zoned 7(2) – Conservation Secondary, with the riparian zone of Cockle Creek also zoned 7(2) – Conservation Secondary.

In the south-western corner, land adjoining the subject site also includes a mix of conservation zonings to suggest potential for establishment of a corridor network linking to Slatey Creek. The riparian zone of Slatey Creek and parts of the adjoining land support 7(3) – Environmental General. Several of the objectives of the 7(3) zone support the implementation of a formal corridor pathway linking the subject site to Slatey Creek. Objective (a) of the 7(3) zone is to maintain and enhance biodiversity, scenic quality and native riparian vegetation and habitat, and objective (b) is to protect, manage and enhance corridors to facilitate species movement, dispersal and interchange of genetic material.

A land use constraints map has been prepared for the subject site. The potential development land represents approximately 46.74 hectares, or 48.75% of the subject site. The remaining area (49.13 hectares, or 51.25%) represent recommended conservation zoning due to the higher ecological values. The constraints mapping has acknowledged the presence of the Masked Owl nest and roost tree and a conservation buffer of 150 metres has been applied to each habitat tree. This is a considered a good outcome for protection of their key habitat roost and nest sites, and should assist in persistence of the Masked Owl on the subject site once development proceeds. The recommended east to west vegetation corridors in the southern portion of the subject site also is a good ecological outcome due to the width (~240 metres) of retained vegetation, fauna habitat and connectivity between Slatey Creek in the west to Cockle Creek in the east.

Six threatened species were recorded on the subject site during fauna investigations between the period May 2008 to March 2010. A further two species, the Greater Broad-nosed Bat or Eastern Falsistrelle, could possibly occur on the subject site as calls resembling both species were tentatively identified from Anabat call recordings. A summary discussion on the potential impact of proposed development area (46.74 hectares, or 48.76%) of the subject site, based on the constraints mapping reproduced above, indicate a proposed development footprint would not significantly impact on threatened species, or their habitat, based on assessments conducted under national and state threatened species legislation.

1.0 INTRODUCTION

1.1 Background

Lake Macquarie City Council, at its meeting of 9 October 2006, resolved to prepare a draft amendment to Lake Macquarie Local Environmental Plan 2004 for approximately 95 hectares of zone 10 Investigation land off George Booth Drive, Edgeworth to accommodate urban development and conservation. The NSW Department of Planning has since directed Council to prepare a Local Environmental Study (LES) in accordance with section 57 of the Environmental Planning and Assessment Act, 1979 and issued specifications for the LES. The environmental study will be used to inform the preparation of a draft Local Environmental Plan (LEP) for the study area and will form part of public exhibition material

The study area contains approximately 95 hectares of mostly vegetated land. The context of the study area is illustrated in **Figure 1** below. The study area contains the following properties:

- Lot 88 DP 755262 and Lot 107 DP 100048. Owned by Hammersmith Management Pty Ltd.
- Part Lots 6 & 7 DP 4647. Owned by private land owners..
- Lot 17 DP 849003. Owned by the State Transit Authority.

The study area has a number of characteristics relevant to the environmental study:

1. The site is currently zoned 10 Investigation.
2. There are a number of different land uses that adjoin the Zone 10 Investigation land. The rezoning is to the south of the proposed Pambulong Town Centre which is currently zoned 3(1) Urban Centre (Core) Zone, 2(2) Residential (Urban) Living and 2(1) Residential. The rezoning of the site to the south of George Booth Drive, Edgeworth will provide new urban development opportunities and strengthen the proposed Pambulong urban centre as well as providing for employment generating opportunities. There are already a number of 2(1) Residential zones that adjoin the area to the west, south and east. Conservation zones adjoin the site with 7(3) Environmental (General) land to the west and 7(2) Conservation (Secondary) land to the south-east. There is a small section of rural land uses to the west.
3. The land is located partly in the localities of Edgeworth, Barnsley and Holmesville.
4. The site is mostly vegetated with Open Eucalypt Forest and is identified on Council's Native Vegetation and Corridor Map. Two major electricity easements run through the site and are partly cleared with some regrowth.
5. The land has been subject to disturbances as a result of past transport undertakings and easements and the land supports a large number of motorcycle and four wheel drive tracks and rubbish dumping is prevalent along George Booth Drive and the tracks.
6. Council mapping identifies the site as bushfire prone land.
7. There are no defined watercourses on the site. The site drains to Slatey Creek, north east of Cocked Hat Creek through Edgeworth and south east to Cockle Creek.
8. The site is undulating. The slope is generally down the north west and south east from the central ridge. The major electricity easement follows the ridge.
9. Local soils, based on studies to the north, are yellow podsolics and are well to imperfectly drained with a high erosion hazard. There appears to be no acid sulphate soils.

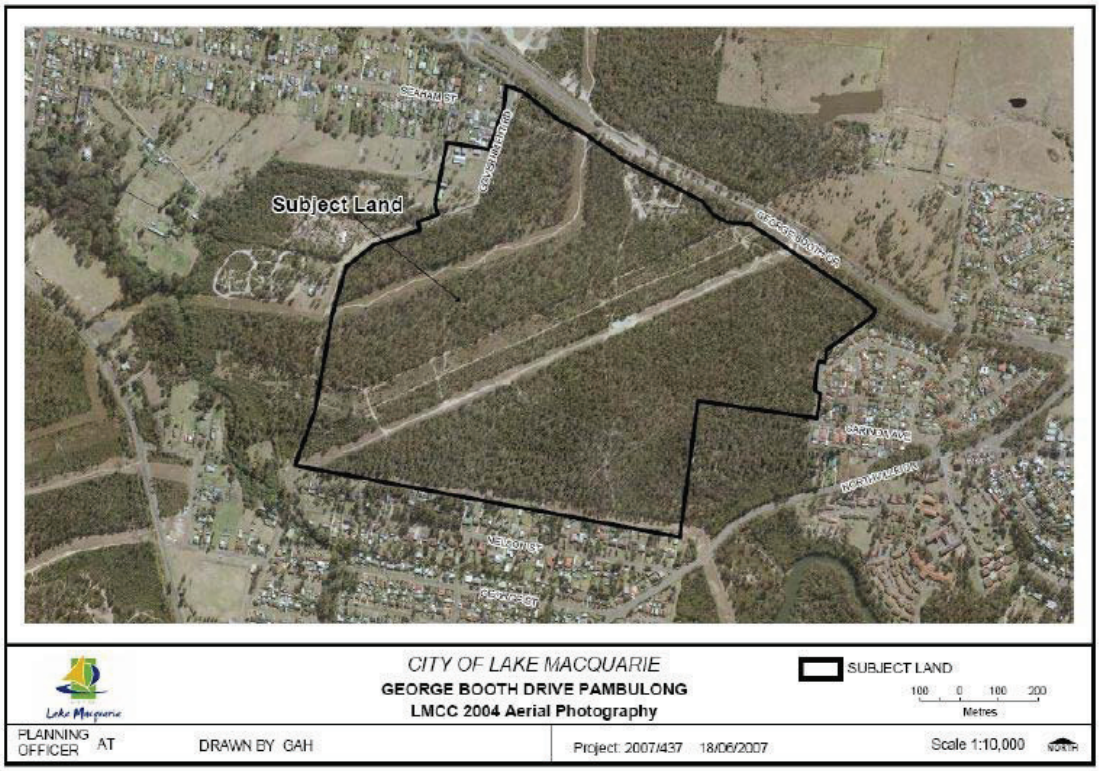

Figure 1. Study Area

GeoLINK Pty Ltd was engaged by Lake Macquarie City Council to prepare the Local Environmental Study for land off George Booth Drive. GeoLINK Pty Ltd engaged Forest Fauna Surveys Pty Ltd to undertake the fauna investigations of the subject site and assist in the assessment of the biodiversity values of the site.

1.2 Objectives of the Flora and Fauna Study

The overall objective of the study is to provide comprehensive information on landscape scale and site biodiversity values to facilitate the determination of the most appropriate future land use for the site. The objectives of the review should be to:

1 Review available information for the land and its vicinity (including regional context, databases and studies undertaken for the site and land in the general area).

2 Undertake field surveys to confirm biodiversity values of the site, targeting threatened species and endangered ecological communities. Survey and reporting is required to meet the requirements of the Lake Macquarie Flora and Fauna Survey Guidelines (Forest Fauna Surveys *et. al.* 2001). This would quantify as far as possible the quality, condition, extent, significance, and connectivity of native vegetation and habitat on the site.

3 Summarise the ecological values of the land (at landscape and site scales), and identify issues relating to the ecological requirements and viability of each significant species, population and/or vegetation community occurring within the area.

4 Identify the strategic biodiversity planning issues (e.g. key biodiversity values, population viability and landscape context, fragmentation of native vegetation, connectivity requirements, zoning requirements). This is to enable:
   i subsequent review of the ecological consequences of options for future urban structure, and
   ii. evaluation of the extent to which these options meet Council's Lifestyle 2020 Strategy objectives.
5 Recommend principles for long-term conservation of important biodiversity values on the site.

In addition to the Study Objectives outlined above, the required tasks need to be undertaken:

1. Review appropriate literature and databases, and compile information from previous studies (including existing site and regional studies). A summary of properly referenced existing data is required.
2. Identify the landscape scale (regional) biodiversity context of the site.
3. Undertake vegetation community and flora survey (terrestrial and aquatic species).
4. Undertake fauna and fauna habitat survey (terrestrial and aquatic species).
5. Undertake targeted surveys for national and state listed threatened species and endangered ecological communities as well as migratory species as required.
6. Document biodiversity values of the site in a comprehensive species list.
7. Identify and analyse, short, medium and long term threats to the biodiversity values of the site.
8. Undertake a strategic review to inform decisions in relation to the preferred future use of the land (including reference to Council and regional biodiversity conservation policies and principles).
9. Identify biodiversity values that should be retained on the land (potentially could extend to a review of alternative land use options).
10. Identify principles and development guidelines to be incorporated in the future planning and development of the land (eg minimum areas of habitat to be retained, EEC retention and buffer widths, riparian corridor widths, minimum and desirable corridor widths, road and culvert design, hydrological regime, desirable bush fire regime).
11. Review appropriateness of existing Conservation and Environment Protection zone boundaries with regard to future land use and management.
12. Based on the findings of the flora and fauna study, the consultant is required to recommend applicable zones for any conservation areas.
13. Determine under what circumstances a development would be likely to have a significant effect on threatened species, populations, or ecological communities within the area. That is, when Council could anticipate that a species impact statement would be required for subsequent development.
14. Assess vegetation and habitat condition and management issues that are relevant to the study objectives.
15. Make recommendations with regard to firstly avoiding and secondly minimising or offsetting impacts from subsequent land uses.
16. Document the limitations of the ecological surveys conducted and any assumptions made in deriving recommendations.
17. Make recommendations with regard to additional surveys or supplementary studies that should be conducted.

Requirements for these tasks are specified in the Lake Macquarie Flora and Fauna Survey Guidelines, with the following additional requirements for rezoning assessments:

Minimum survey period – Surveys shall be carried out in all seasons over a minimum period of 12 months to ensure all species can be adequately surveyed. Note that Conservation and Environment Protection zones require at least 2 years survey, and some sites may require a longer period of survey to provide scientifically reliable survey results to a reasonable degree of certainty.

Whilst the study brief indicates a minimum period of 12 months, this is considered to be a recommendation to enable surveys to be conducted in each of the annual seasons. For this investigation, surveys were conducted in each of the four seasons to account for seasonally active and also migratory fauna. The timing of the surveys was designed to optimise detection of fauna species rather than complying with a calendar schedule. For example, trapping for smaller mammals was conducted in May when smaller dasyurids are abundant. Winter bird surveys were conducted to coincide with flowering of eucalypt species and occurrence of migratory nectar feeding species such as nationally endangered Swift Parrot and Regent Honeyeater. Small microchiropteran bats were sampled in late Autumn and late Spring.

Offset areas – Where offsets are proposed as part of a rezoning proposal, adequate biodiversity survey of proposed offset sites is required in addition to surveys of the land proposed to be rezoned. Survey requirements of other government agencies – Additional survey requirements may be applicable under guidelines prepared by the Department of Environment and Conservation or Department of Primary Industries (Fisheries).

Habitat corridor and connectivity assessment – Where species require interconnected habitat, an assessment of this is required, including connections at the site, local, landscape, and regional scale as appropriate

2.0 METHODOLOGY

2.1 Fauna Habitat Assessment

An assessment of the habitat types occurring within the subject site was undertaken based on selected criteria to indicate the habitat attributes essential for fauna. Such attributes include:

i the dominant vegetation type(s) within the study area;
ii the density of mature trees with hollows for hollow dependent birds such as owls, arboreal marsupials such as possums and gliders, and microchiropteran bat species;
iii density of ground litter such as fallen tree limbs, ground logs, decorticated bark, leaf litter and ground vegetation;
iv degree of disturbance to habitats from impacts including clearings for vehicular tracks, infestations of introduced plant species;
v frequency of fire regime to canopy, understorey and ground layer vegetation;
vi presence of standing or flowing water and water soaks for amphibians, and
vii presence of food trees for Koala as a requirement of SEPP 44 (Koala Habitat Protection).

The habitat attributes are determined by sampling within a one hectare plot of each vegetation community. Attributes are scored along a 100 metre line intercept transect, recording all plant species (canopy, understorey, ground layer vegetation). All species were identified where possible, and all canopy species were rated into size categories. Abundance of all species is recorded within a 100 x 50 metre quadrat, and scores are doubled to determine density per hectare.

2.2 Habitat Tree Mapping

Habitat trees were located by walking the entire site. When a habitat tree was located, the following data was recorded:

- Tree ID,
- Tree species,
- Location recorded as easting and northing in GDA94 projection,
- diameter at breast height (dbh) (cm),
- height of tree (metres),
- % dead,
- number of major and minor limb spouts or hollows, number of trunk hollows or spouts, and
- assessment of likely fauna species to utilise hollows.

The assessment of likely fauna to utilise hollows was based on a size class of each hollow, where the following rating applied:

(1) Hollows with small openings <20mm or small fissures on dead branches, main trunk or split bark were classed as potential hollows for microchiropteran bats and small reptiles,
(2) Hollows with small openings >20mm <50 mm were classed as potential hollows for gliders and small birds (i.e. treecreepers),

(3) Hollows with medium sized openings >50mm <150mm were classed as potential hollows for possums and larger birds (i.e. Eastern Rosella)

(4) Hollows with large openings >150mm diameter were classed as potential hollows for large birds such as owls, cockatoos and ducks, and reptiles such as Lace Monitor and Diamond Python.

The habitat tree data is presented in **Appendix 2** below.

2.3 Fauna Survey

Identification of fauna in the subject site was undertaken by surveys targeting the following fauna groups;

- birds,
- mammals (including microchiropteran and megachiropteran bats),
- reptiles,
- amphibians.

Within the study area, three general fauna survey sites were established to sample all fauna groups. Following is a description of the survey procedures employed for each fauna group. A summary of fauna survey effort is summarised below in **Table 1** and the location of each fauna survey site is mapped in **Figure 2**.

Table 1. Fauna Survey Site Details and Survey Dates.

Survey Technique	**Survey Effort Per site**	**Survey Sites**	**Survey Dates**					**Total Survey Effort (all sites)**
Diurnal Birds	20 min census	FA1, FA2, FA3	6-9/5/08	22/7/08	15/8/09	8-9/9/08	27-30/10/08	6.0 hrs diurnal birds
Nocturnal Birds	40 min census	FA1, FA2	6-9/5/08	22/7/08		8-9/9/08	27-30/10/08	3.0 hrs nocturnal census + 13.5 hrs spotlight searches
Terrestrial trapping	75 trap nights	FA1, FA2, FA3	6-9/5/08					225 terrestrial trap nights
Arboreal trapping	30 trap nights	FA1, FA2, FA3	6-9/5/08					90 arboreal trap nights
Cage trapping	6 trap nights	FA1, FA2, FA3	6-9/5/08					18 cage trap nights
Harp Trap	2 harp trap nights	FA1, FA2, FA3	6-9/5/08				27-28/10/08	10 harp trap nights
Anabat Detector	2 all nights	FA1, FA2, FA3	6-9/5/08				27-30/10/08	12 all night surveys [~120 hours]
Spotlight Search	1.5 hr	FA1, FA2, FA3	6-9/5/08			8-9/9/08	27-30/10/08	13.5 spotlight hours
SEPP 44 Assessment	1.0hr search	FA1, FA2, FA3	6-9/5/08					3.0 hrs search
Diurnal Herp	1.0 hr	FA1, FA2, FA3	6-9/5/08				27-30/10/08	6.0 hrs search
Nocturnal Herp	1.5 hrs	FA1, FA2, FA3	6-9/5/08			8-9/9/08	27-30/10/08	13.5 spotlight hours
Large Forest Owl Habitat Tree Assessment – November 2009 and February 2010								
Habitat Tree ID		**No. minutes**	**Survey Dates**					**Description of Survey Effort**
HT13		190	11/11/09	19/11/09	22/11/09			Stagwatch observation + cherrypicker 22/11/2009
HT29		35	6/11/09					Stagwatch observation
HT46		190	13/11/09	17/11/09	22/11/09			Stagwatch observation + cherrypicker 22/11/2009
HT70		270	20/02/10	1/03/10	7/03/10			Stagwatch observation + spotlight search
HT94		155	22/02/10	5/03/10				Stagwatch observation + spotlight search
HT112 + HT126		95	26/02/10					Stagwatch observation + spotlight search
TOTAL STAGWATCH / SPOTLIGHT		**15.6 hours**						

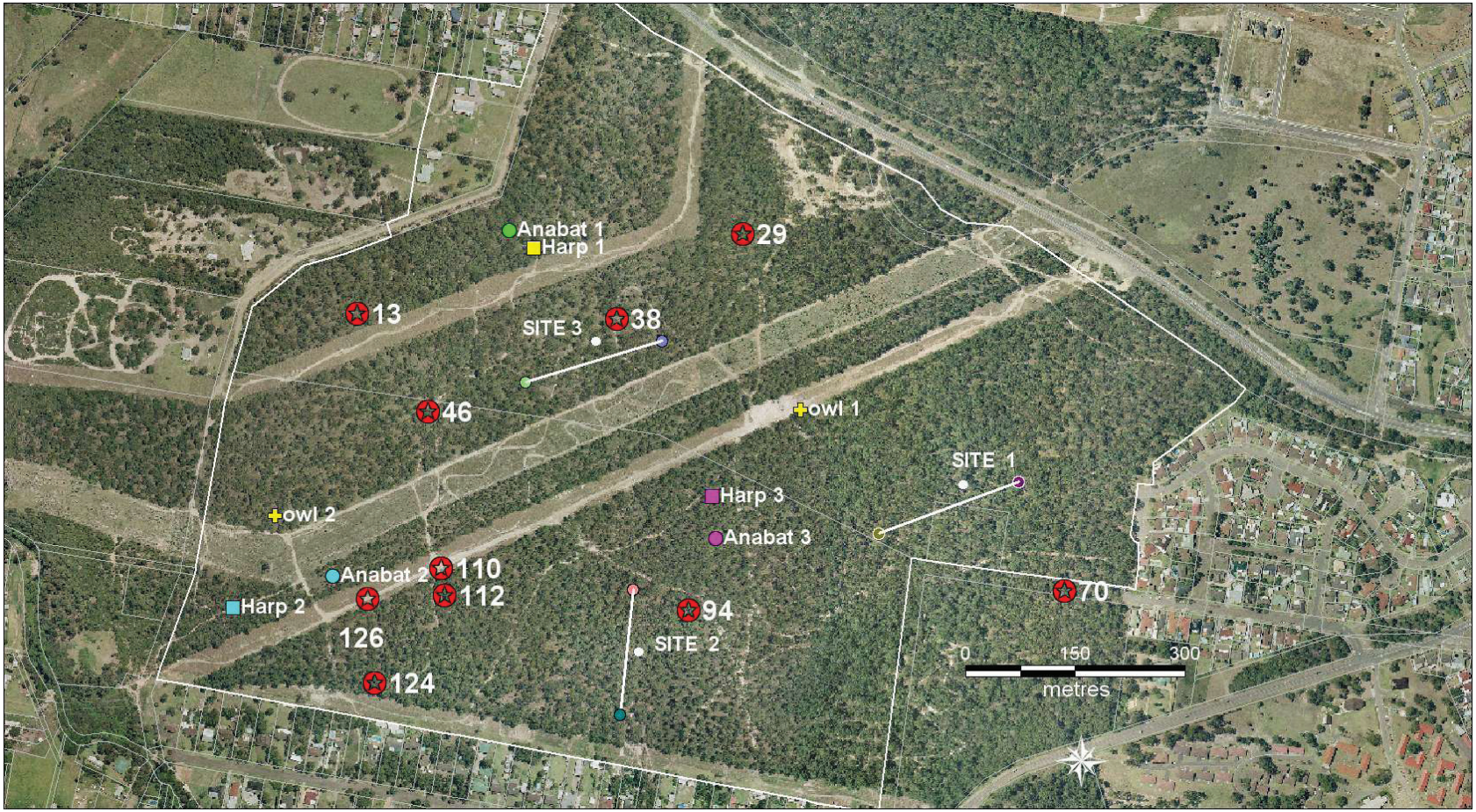

Figure 2. Location of Fauna Survey Sites and Large Forest Owl habitat trees, George Booth Drive.

2.3.1 Birds

Survey techniques for birds include:

- Diurnal census within one hectare plot recording all bird species observed and heard within 20 minute period.
- Opportunistic sampling whilst undertaking other activities, and
- Nocturnal census involving quiet listening for calls of nocturnal birds followed by playback of pre-recorded calls of threatened owls. Nocturnal spotlight searches also comprised listening for characteristic calls of Large Forest Owls.

2.3.1.1 Diurnal Census

This technique involves recording all bird species observed, or heard calling within a one hectare quadrat at each survey site in the study area. This survey is undertaken for a minimum of 20 minutes each morning or evening. Each site was sampled in May, July, August, September and October 2008, typically between the hours 0600 to 0900, or 1600 to 1700 hours. Diurnal investigations also include searches for whitewash or regurgitation pellets of owls, particularly in close proximity to mature trees with large hollows. Total survey effort for diurnal bird census is 6.0 hrs.

2.3.1.2 Opportunistic Sampling

Opportunistic sampling of birds was conducted whilst undertaking other field activities and consisted of identification of calls heard in the study area, or observed directly.

2.3.1.3 Nocturnal Bird Census

Due to the smaller size of the study area, only two nocturnal survey site were sampled. The nocturnal census involved stag-watching* at dusk and a 40 minute nocturnal bird census. *Stag-watching involves sitting beneath mature trees with large hollows at dusk to observe any owls departing a hollow.

Nocturnal census follows the standardised survey methodology. This involves quiet listening for calls of owls and other nocturnal bird species following dusk for a period of approximately 15 minutes to determine the presence of nest or roost sites on, or in close proximity to each 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 was broadcasted through a 20 watt portable amplifier into adjacent bushland.

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

Nocturnal bird investigations were conducted within the first two hours following dusk. No surveys for nocturnal birds were conducted on evenings with strong winds and rainfall as these conditions adversely affect the detectability of all nocturnal bird species.

2.3.1.4 Large Forest Owl Investigations – 2009-2010

Ecological investigations conducted on the site in 2008 identified a number of significant habitat trees occurring on the land. Several of the habitat trees were identified as potential threatened large forest owl roost and or nest trees, particularly the Masked Owl *Tyto novaehollandiae* and Powerful Owl *Ninox strenua*, which has been recorded in the locality (<5km radius). Ten habitat trees were initially identified as potential roost or nest sites for threatened large forest owls (refer to **Figure 2** above). The large forest owl additional investigations were conducted over the period November 2009 to April 2010.

The survey comprised two methodologies which are described below;

Dusk "stagwatch" observations of potential owl trees for emergence of individual owls. These observations were conducted for a period of 40 – 50 minutes immediately following dusk. A short spotlight search of the immediate vicinity of the potential owl tree was conducted for a period of 10 – 15 minutes. Quiet listening was also undertaken within this period for vocalisations of the Masked or Powerful Owl. Physical inspection of several of the potential owl trees by use of a mobile elevated work platform (trailer mounted cherry-picker).

The dusk observations were conducted of the potential large forest owl habitat trees, unless they were deemed unsuitable following more detailed assessment of each tree. For instance, tree 110 was initially identified as potential large forest owl tree during the initial habitat tree survey in 2008. However, during the investigations for this report, it became evident that the tree is no longer suitable due to collapse of the dead hollow trunk section. Additionally, tree HT124 was initially identified as a suitable owl tree, but this assessment is based on smaller owl species such as Southern Boobook, rather than the larger threatened forest owls such as the Masked Owl and Powerful Owl.

The survey was conducted over two periods, with stag-watch observations of habitat trees 13 and 46 inspected during November 2009. Habitat trees 29 and 38 were not watched as 29 was identified as unsuitable for large forest owls, whilst tree 38 had fallen over and burnt (presumably by either strong winds and subsequent fire, or was burnt and fell over as a consequence of the fire). Stag-watch of potential owl habitat trees 13 and 46 was conducted over the following period, Friday 6th to Thursday 19th November 2009 (5 nights of approximately 2 hours per night – 10 hours) and a physical inspection on Monday 22 November 2009.

Habitat trees 70, 94, 112, and 126 were observed by stag-watch surveys during the period Saturday 20 February to Sunday 4 April 2010, a total of 6 nights of approximately 1.5 – 2.0 hours per night. Habitat trees 110 and 124 excluded from stag-watch surveys as these two trees were deemed unsuitable for large forest owls. However, due to their close proximity to habitat trees 112 and 126, they were indirectly surveyed for by quiet listening for any large forest owl activity, such as dusk calls. The date and time of each inspection is presented above in **Table 1**.

2.3.2 Mammals

Surveys for the presence of mammals include:

- trapping for small terrestrial and arboreal mammals,
- spot-lighting for terrestrial, arboreal mammals and megachiropteran bats,
- harp trapping and Anabat detector recording for microchiropteran bats,
- searches for characteristic diggings, burrows and other indirect evidence.

2.3.2.1 Small to Medium Terrestrial Mammals

Trapping was undertaken at three survey sites (FA1, FA2, FA3) with Elliott Type A traps (8 x 10 x 33 centimetre) baited with a mixture of peanut butter, rolled oats and honey. At each survey site, 25 traps were set for three consecutive nights along a linear transect approximately 200-250 metres in length. Two cage trap were set at both end of each trapping transect for 3 consecutive nights to target bandicoots and quolls. Trapping for small terrestrial mammals was conducted in May 2008.

2.3.2.2 Arboreal Mammals

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. Three trapping grids were established in the subject site. The configuration of each trapping grid was 2 parallel lines of 5 traps each, with each trap spaced 50 – 75 metres apart. 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. Traps were set for 3 consecutive nights in May 2008.

Spotlight searches undertaken on foot 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 8 separate nights. Each spotlight search encompassed tracks throughout the entire subject site.

SEPP 44 (Koala Habitat) Assessment

Potential Koala habitat as defined in the Act is a vegetation community with a minimum of 15 per cent of trees in the upper and lower strata which are species listed in Schedule 2 of SEPP 44. The upper strata are those trees in the forest canopy and the lower strata is those trees in mid-understorey or sub-canopy trees. The estimation of percentage tree species was undertaken by counting all tree species in the upper and lower strata within a series of 20x20 metre quadrants. Trees are counted to score a percentage cover, identified to species and allocated to a size class. If the subject land is not considered potential Koala habitat based on the absence of Schedule 2 tree species, the consent authority may grant development consent. If potential Koala habitat is identified, further investigations are required to determine if the subject land supports core Koala habitat.

Core Koala Habitat is defined as an area of land with a resident population of Koalas, evidenced by attributes such as breeding females and recent sightings of, and historical records of a koala population.

2.3.2.3 Bats

Surveys for megachiropteran (flying foxes) and microchiropteran (insectivorous) bat species consisted of:

- Harp trapping undertaken at four sites to determine the presence of subcanopy species;
- Detection of echolocation calls via Anabat II detector onto digital Zcaim storage discs for subsequent computer analysis.
- Spotlighting for flying foxes and large microchiropteran bats.

Captures
Harp traps are designed to capture low flying bats in the study area. Three microbat survey sites in the study area were sampled by harp traps set for two consecutive nights. Traps were checked each morning for captured bats that were identified and measured prior to being released.

Echolocation Calls
Echolocation calls of microchiropteran bats were recorded at three Anabat survey sites. Calls were recorded onto a digital storage cards processed by Titley Zcaim recording units. This technique enables sampling of bat activity for the duration of the night. This provides a more comprehensive recording of bat species and activity utilising a site.

All recorded calls were down loaded to a computer for subsequent analysis. Several species of insectivorous bats have distinctive echolocation calls that are unlikely to be confused with another species. However, some bat species overlap in call frequency and structure, making identification difficult in some cases. The degree of confidence attached to call identifications will depend on the duration of the recorded call and quality of the recording. For example, echolocation calls of the Lesser Long-eared Bat (*Nyctophilus geoffroyi*) and Gould's Long-eared Bat (*Nyctophilus gouldi*) cannot be reliably differentiated, and are therefore grouped as *Nyctophilus sp*. Similarly, calls of Greater Broad-nosed Bat (*Scoteanax rueppellii*), Eastern Broad-nosed Bat (*Scotorepens orion*) and Eastern Falsistrelle (*Falsistrellus tasmaniensis*) sometimes cannot be reliably differentiated and were therefore grouped together.

Spotlight Searches
Flying-foxes were surveyed by spotlighting of potential food trees and by identification of their characteristic social calls. The presence of flying bats was also monitored by dusk activity by visually watching the skyline for bats.

2.3.3 Reptiles

Diurnal investigations for reptiles involved searching beneath ground litter, such as sheets or iron, fallen timber, leaf litter, decorticated bark on tree trunks and on the ground, tuft of vegetation and stones. Searches incorporated both opportunistic searches as well as intensive searches within an area for approximately 30 to 60 minutes. Nocturnal spotlight searches for reptiles were undertaken on foot in conjunction with arboreal mammals and nocturnal birds.

2.3.4 Amphibians

Surveys were undertaken of water bodies (i.e. dams) and drainage lines of the subject site to identify frog species. Nocturnal searches involved spotlight searches along drainage lines, identification of individuals present by audible call and searches in likely microhabitats. Diurnal searches include turning of logs and ground litter in forest searching for sheltering individuals. Several frog species also call during diurnal hours, particularly in response to rising humidity. These calls are recorded opportunistically whilst undertaking other duties.

2.3.5 Limitations of the Fauna Survey

The initial fauna survey was conducted over the period May to November 2008 to account for the occurrence, or potential occurrence of seasonal fauna species. However, despite conducting a number of surveys over this period, this survey will fail to comprehensively account for all fauna species that may frequent the subject site on a regular or irregular basis. For example, several eucalypt tree species on the subject site flower during specific periods of the year (i.e. winter). However, during the winter / spring of 2008, eucalypts that often flower during this period produced very poor nectar and pollen loads. As a possible consequence, fauna species that forage widely for nectar and pollen may not have frequented the subject site due to the low abundance of foraging resource.

The selection of fauna survey sites, particularly bat traps, was severely constrained by the degree of disturbance to the remnant vegetation and fauna habitat. The high fire frequency has created an open forest with very sparse understorey vegetation, which limited the number of sites suitable for catching microchiropteran bat species. Additionally, the site has a very high number of tracks for vehicle and pedestrian usage which are regularly used. This prevented selection of survey sites which were out of sight to the general public, and created concern about the theft of expensive survey equipment. For example, the trapping for microchiropteran bats with Harp traps was cancelled after the theft of a Harp Trap in October 2008 and the remainder of the bat survey relied on Anabat recordings.

In addition, the large forest owl habitat tree inspection conducted in November 2009 and February 2010 was restricted to 7 of the 10 potential large forest owl trees. Three remaining three potential trees were unable to be inspected by cherry-picker due to slope, access or height constraints. This prevented a comprehensive inspection and assessment of the potential of these trees to provide habitat for threatened large forest owls.

2.4 Weather Conditions

Weather conditions for the following survey period is summarised below in **Table 2**.

Table 2. Weather Conditions, George Booth Drive, Edgeworth.

Date	Min. Temp °C	Max. Temp °C	Wind Speed (km/h) and Direction		Cloud Cover	Rainfall 24 hrs
			9 am	3 pm		
6 May 2008	7.8	23.6	NW 4	N 4	4/8	0.0
7 May 2008	9.4	23.6	NW 4	SW 6	4/8	0.0
8 May 2008	9.8	21.6	Calm	S 4	1/8	0.0
9 May 2008	8.0	22.0	Calm	SE 6	1/8	0.0
22 July 2008	4.6	15.0	NW 2	SW 4	1/8	0.0
15 August 2008	6.6	20.2	NW 28	NW 9	2/8	0.0
8 September 2008	8.8	18.0	Calm	S 9	3/8	0.0
9 September 2008	8.8	16.4	W 4	SE 9	1/8	0.0
27 October 2008	15.8	32.3	NE 4	NW 7	1/8	0.0
28 October 2008	18.2	23.4	SW 4	SE 19	5/8	0.0
29 October 2008	17.0	21.0	SE 9	SE 19	8/8	8.0
30 October 2008	17.2	27.8	NE 19	N 4	2/8	0.6
6 November 2009	18.4	22.0	SE 4	SE 4	7/8	5.4 mm
11 November 2009	13.8	26.0	Calm	SE 4	1/8	0.0
13 November 2009	18.2	23.8	SE 6	SE 19	6/8	1.8 mm
17 November 2009	19.8	22.6	SE 7	SE 9	8/8	2.4 mm
19 November 2009	16.8	33.0	NW 4	SE 2	0/8	0.0
22 November 2009	18.8	41.7	NW 2	NW 15	6/8	0.0
20 February 2010	17.5	30.8	calm	Calm	1/8	0.4 mm
22 February 2010	19.3	37.2	NW 6	NW 7	4/8	0.0
26 February 2010	17.2	27.9	Calm	SE 6	2/8	0.4 mm
1 March 2010	No record	21.4	SE 19	SE 6	8/8	14.2 mm
5 March 2010	20.0	28.5	NE 11	N 6	8/8	0.0
7 March 2010	21.0	29.4	NE 2	NE 22	6/8	0.0

Data collected from University of Newcastle Weather Station (10kms to the NE of study area)

3.0 RESULTS

3.1 Fauna Habitats

3.1.1 Open Forest

The majority of the subject site is dominated by relatively juvenile Open Forest dominated by eucalypt and angophora trees to approximately 20 metres in height. Although there is variation in tree species composition in parts of the site, essentially one forest type dominates the fauna habitats present. Tree species recorded in the subject site include Spotted Gum *Corymbia gummifera,* Ironbark *Eucalyptus crebra,* Brown Stringybark *E. capitellata,* Red Bloodwood *C. gummifera* and Sydney Red Gum *Angophora costata.* In the more sheltered locations off the main ridgeline in the centre of the subject site small stands of Large-fruited Grey Gum *Eucalyptus punctata* occur. The understorey is very open with scattered small pockets of taller understorey species to 6 metres in height. The open understorey is attributed to the frequency of fire on the site and dominance of taller grasses and sedges across the site. Very few *Allocasuarina sp.* or *Casuarina sp.* understorey trees were present, limiting the value of the site for species such as the Glossy Black Cockatoo.

Groundlayer vegetation was dominated by low grasses and regrowth shrubs to approximately 0.5 metre in height. Only a small part of the subject site supported dense stands of low understorey vegetation such as Hairpin Banksia *Banksia spinulosa* and Bracken Fern *Pterdium esculentum.*

The density of habitat trees is considered low with a total of 125 habitat trees located within the 95 hectare site. This equates to an average of 1.3 habitat trees per hectare. Whilst the density of habitat trees within the subject site is considered low, there is a number of habitat trees with significant hollows that could be utilised by large hollow dependent fauna such as large forest owls.

Ground litter (logs, stumps and fallen tree limbs / hollows) is sparse throughout the subject site, possibly due to the frequency of fires. Disturbance to vegetation and fauna habitats is high due to the matrix of vehicle and pedestrian tracks throughout the site. Two wide powerline easements occur across the site which fragment the forest canopy. Significant areas of disturbance are located along George Booth Drive where there is extensive dumping of domestic and construction waste, and off-road motorcycle circuits.

The subject site and study area supports minimal habitat for pond dependent frog species. Small ephemeral drainage lines flow through the subject site. During the period of the fauna survey in 2008, these small drainage lines contained small pools with standing water.

3.1.2 Open Grassland

Three powerline easements are maintained within the subject site. Regular slashing of the easements has created an open grassland habitat which provides some habitat for fauna species. However, microhabitat features such as ground litter and logs which provide sheltering sites for small vertebrate fauna is restricted to small areas where dumping has occurred. Small depressions created by off-road vehicles has resulted in development of small ephemeral pools of standing water. However, these small pools have limited value for

amphibians due to the very high turbidity and lack of fringing aquatic vegetation due to the intensity of use by off-road vehicles.

3.2 Habitat Tree Mapping

3.2.1 Abundance and Size Classes of Habitat Trees.

A total of 125 habitat trees were identified within the study area. The location of habitat trees within the study area is presented below in **Figure 3**. Analysis of the distribution of tree species as habitat trees is presented below in **Table 3**. The most numerous tree species as habitat trees is the Spotted Gum *Corymbia maculata,* Dead Stag and Sydney Red Gum *Angophora costata*. Together, the Spotted Gum, Dead Stag and Sydney Red Gum constitute approximately 80.8% of all habitat trees within the study area.

Table 3. Abundance of Tree Species and Size Class of Habitat Trees.

	Size Class (dbh in cms)					
Tree Species	**0-30**	**31-60**	**61-90**	**91-120**	**Total**	**% of total**
Corymbia maculata		17	35	2	54	43.2%
Dead Stag		12	12	4	28	22.4%
Angophora costata		2	14	3	19	15.2%
Eucalyptus crebra		0	7		7	5.6%
Eucalyptus acmenoides		2	2	1	5	4.0%
Eucalyptus punctata		2	3		5	4.0%
Corymbia gummifera		1	2		3	2.4%
Melaleuca decora		1	1		2	1.6%
Eucalyptus capitellata		1	1		2	1.6%
Total		**38**	**77**	**10**	**125**	**100.0%**

Note: **dbh in cms** refers to the measurement of the diameter at breast height of each tree.

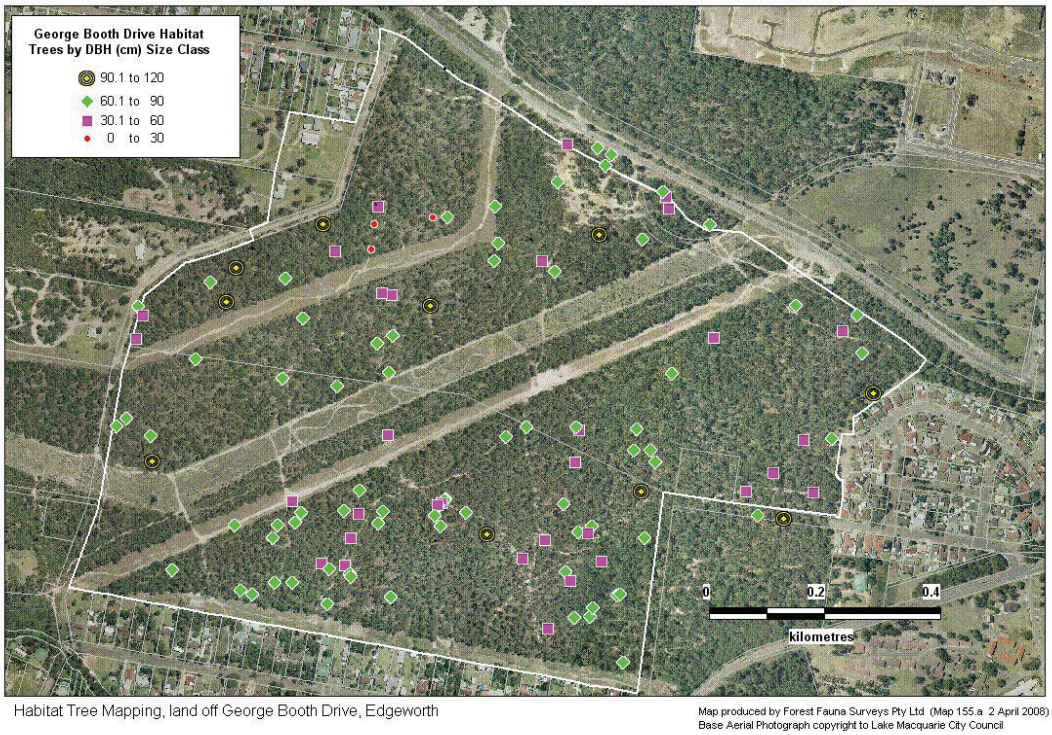

Figure 3. Location of Fauna Habitat Trees, George Booth Drive.

3.2.2 Assessment of Health of Habitat Trees.

The health of the habitat trees was assessed by the % dead recorded for each habitat tree. This assessment of health should not been considered qualitative, and is not subjected to a detailed inspection that would normally be undertaken by a qualified arborist. The assessment is based on the % of a live tree exhibiting dead material (branches, fissures in trunk and branches). For example, a tree exhibiting 20% dead material is considered to survive longer in its natural state than a tree exhibiting 60-80% dead material. Following in **Figure 4** is a summary of the % dead of each species of habitat tree recorded in the study area.

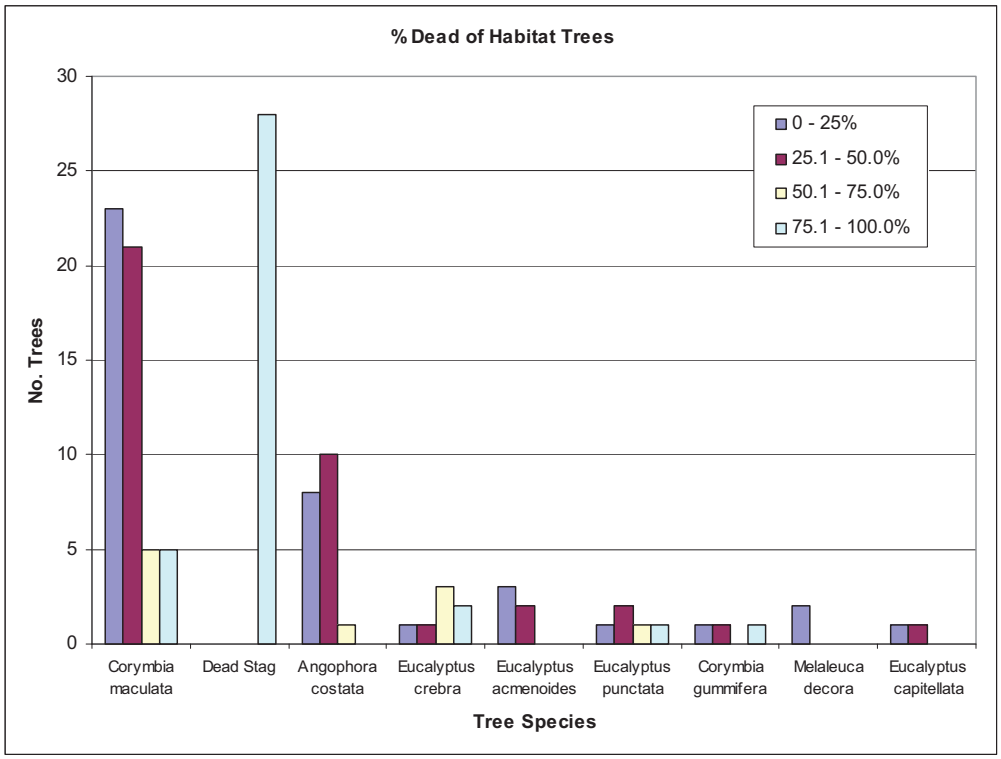

Figure 4. Health of Habitat Trees, land off George Booth Drive, Edgeworth.

The assessment of tree health indicates the majority of habitat trees (apart from the dead stags) have relatively high proportions of healthy trees (as measured by the % dead of each tree). This would suggest these trees have a relatively long life expectancy unless impacted by stochastic events such as fire, disease and wind. Induced factors such as modified soil moisture and soil horizons by disturbance related to future development may also impact upon the vigour of these trees.

3.2.3 Distribution of Habitat Trees in Study Area.

The location of the habitat trees within the study area is presented above in **Figure 4**. The vegetation mapping of the study area (Bell, 2008) has identified a number of vegetation communities of ecological significance (endangered ecological communities). The EEC vegetation mapping boundaries of Bell (draft 2008) capture 86 (or 68.8%) of the 125 habitat trees on site. The distribution of habitat trees in endangered ecological communities on the study site is presented below in **Figure 5**.

Figure 5. Location of Fauna Habitat Trees in EEC's, George Booth Drive.

3.3 Fauna Survey

3.3.1 Birds

The total number of diurnal and nocturnal birds recorded on site is 59 species. This compares to total of 190 species in the locality (<10km radius of the study site) recorded on the LMCC fauna database (LMCC, 2000) or 207 species on the DECCW Wildlife Atlas database (DECCW, August 2010). However, it must be recognised that comparison of species lists between those recorded on the subject site and locality can be mis-leading. For example, locality records include many species occur in habitats that do not exist on the subject site. No aquatic (estuarine) or wetland habitat occurs on the subject site, yet many aquatic and wetland bird species exist in the locality databases. Many additional bird species occur in restricted habitat types that do not occur within the subject site. The list of bird species recorded in the study area and locality is presented in **Appendix 1**.

One threatened bird species was recorded on the subject site during investigations in 2009, the Masked Owl *Tyto novaehollandiae*. An individual owl was observed roosting in a habitat tree during inspections conducted in November 2009. No evidence of the nationally threatened Swift Parrot *Lathamus discolour* was recorded on the subject site despite surveys conducted over periods when the species is present in the region. It must be noted that winter flowering eucalypts was considered very poor for the subject site, with minimal flowering by Spotted Gum *Corymbia maculata* over the winter period in 2008. No evidence of the Powerful Owl *Ninox*

strenua was recorded during the initial surveys and targeted large forest owl surveys, despite a number of records of the species in the locality.

3.3.2 Large Forest Owl Surveys 2009-2010

3.3.2.1 Stagwatch Observations November 2009

A diurnal inspection of the potential large forest owl habitat trees was initially undertaken to locate the habitat trees present. This was conducted on Friday 6th November prior to the first stag-watch observation. Of the four habitat trees, tree number 38 was destroyed by either fire or wind, or a combination of both. This tree was found laying on the ground, possibly a result of a recent fire in the previous couple of months.

Figure 6. Habitat tree 38 found on ground, 6 November 2009

As a consequence of the reduced number of trees to stag-watch, observations were restricted to trees 13, 29 and 46 over the 5 nights. Tree 29 was observed on only one evening as it was deemed unsuitable for a large forest owl, but could be suitable for a smaller forest owl such as a Southern Boobook, which is not listed as threatened. The remaining 4 evenings were allocated to trees HT13 and HT46 (2 evenings each). A summary of stag-watch observations in November 2009 is presented below in **Table 4**.

Table 4. Results of Stag-watch Observations, November 2009

Date	Habitat Tree	Stag-watch Results
6 November 2009	HT29	No evidence of owls
11 November 2009	HT13	No evidence of owls
13 November 2009	HT46	No evidence of owls
17 November 2009	HT46	No evidence of owls
19 November 2009	HT13	No evidence of owls

No threatened large forest owl was recorded present in the study area during the 4 evenings of stag-watch surveys at trees HT13 and HT46, and no audible calls were heard. No evidence of threatened large forest

owls were recorded on the subject site during previous investigations undertaken earlier in the year. No whitewash or regurgitation pellets were located in proximity to the potential owl trees during the stag-watch investigations.

3.3.2.2 Inspection by Cherry-picker, November 2009

An inspection of the internal hollow of HT13 and HT46 was conducted on Monday 22 November 2009. The remaining habitat trees could not be inspected by cherry-picker due to several constraints. Vehicular access to several habitat trees was difficult with a trailer mounted cherry-picker. Two of the habitat trees could not be accessed due to growth of juvenile trees around the base of the habitat tree (HT70). To enable vehicle access would have required felling of several smaller trees to access HT70. Additionally, HT94 is located within a small drainage line with some erosion around the base of the tree. No stable and relatively level ground could be accessed in proximity to this habitat tree. For several of the trees, the height of the hollow was too high for the trailer mounted cherry-picker, which is limited to 11 metres vertically. For instance, the large hollow in HT70 is almost 16 metres above ground level, beyond the reach of the cherry-picker. To compensate for inability to inspect the habitat tree hollows by cherry-picker, additional stag-watch observations and nocturnal listening was conducted. A summary of each inspection is presented below in **Table 5** and **6**.

Table 5. Cherrypicker Inspections HT13, 22 November 2009

Tree ID	**HT13**
Tree Species:	**Description**
Dead Stag **Height**: 10 m **Diameter:** 100 cm **Coordinates**: [GDA94] Easting: 368292.233 Northing: 6356582.095	Dead Stag with a large opening at the top. Upon inspection of the hollow, a large vertical pipe extends approximately 3.0 meters down from the top of the tree to the hollow floor. The internal dimension of the hollow pipe is approximately 40 centimetres. A large adult Masked Owl *Tyto novaehollandiae* was present on the hollow floor but rose to the top and flew away before a photograph could be taken. The floor of the hollow was covered in copious whitewash and regurgitation pellets, indicative of prolonged use (see photo below).

Table 6. Cherrypicker Inspections HT46, 22 November 2009

Tree ID

Tree Species: Spotted Gum

Corymbia maculata

Height: 9.0 metres

Diameter: 69 centimetres

Location Coordinates: [GDA94]

Easting: 368388.58

Northing: 6356448.374

Description

Live Spotted Gum with a large opening on the main trunk approximately 6.0 meters from the ground. An additional vertical spout opening is evident above the trunk opening, and a smaller branch opening is evident to one side of the vertical pipe.

Upon inspection, a large vertical pipe extends down from the top of the tree approximately 3.0 meters to the hollow floor, which is just above the large opening in the main trunk. The entrance to the hollow on the trunk was extensively worn from scratch marks. The internal dimension of the pipe is approximately 35-40 centimetres. A recent nest of a large forest owl, most likely a Masked Owl *Tyto novaehollandiae* was present on the hollow floor. Extensive down and egg shell fragments were evident on the floor of the hollow, together with copious whitewash and regurgitation pellets.

Internal cavity with extensive down present and broken egg shells – evidence of recent nesting

Tree HT46 – Hollow Entrance

Entrance to hollow pipe with extensive scratching of the entrance. Evidence of extended use of this hollow.

3.3.2.3 Stag-watch Observations February – March 2010

Stag-watch observations were conducted over 6 evenings during the period February 20 to 7 March 2010. Observations were restricted to three trees, HT70, HT94 and HT112, which were each observed on two separate evenings. Habitat tree HT126 was indirectly monitored due to its close proximity to HT112 (150 metres), by quiet listening for owl activity in the general area. No evidence of owls emerging from hollows was observed, and no calling activity was heard in proximity to these trees during the monitoring period. Whitewash was found around the perimeter of HT94 but no evidence of regurgitation pellets was found. A summary of the stag-watch surveys is summarised below in **Table 7**.

Table 7. Stag-watch Observation Results, February – March 2010, land off George Booth Drive

Date	Habitat Tree	Stag-watch Results
20 February 2010	HT70	No evidence of owls
22 February 2010	HT94	No evidence of owls, whitewash (but no regurgitation pellets) found around base and perimeter of tree).
26 February 2010	HT112 + 126	No evidence of owls, HT 126 inspected by ladder due to low height to opening
1 March 2010	HT70	No evidence of owls
5 March 2010	HT94	No evidence of owls
7 March 2010	HT112	No evidence of owls

Following is a summary of each habitat tree inspection conducted in February 2010.

Table 8. Stagwatch Results HT70, February - March 2010, land off George Booth Drive

Tree ID **HT70**

Tree Species: Spotted Gum *Corymbia maculata*

Height: 22.0 metres

Diameter: 103 centimetres

Location Coordinates: [GDA94]

Easting: 369255.189

Northing: 6356204.896

Description

Large Spotted Gum *Corymbia maculata* with 1 very large vertical pipe at approximately 15 metres height (too high for cherry picker). No inspection of the internal cavity of the large hollow was conducted. Vehicle and cherry-picker access to tree difficult due to density of smaller trees around the base of the tree. Would require felling of smaller trees to access the base of the tree.

Stag-watch Results

No evidence of large forest owls utilising the large hollow in this tree. A ground based assessment on the suitability of this tree for large forest owls considers HT70 to be highly suitable as a nest and or roost site for either the Masked Owl or Powerful Owl.

Table 9. Stagwatch Results HT94, February - March 2010, land off George Booth Drive

Tree ID **HT94**

Tree Species: Sydney Red Gum *Angophora costata*

Height: 16 metres

Diameter: 98 centimetres

Location Coordinates: [GDA94]

Easting: 368743.186

Northing: 6356178.719

Description

Sydney Red Gum *A. costata*. Large tree with 2 large vertical spouts at 12m height. Unable to access base of tree due to sloping terrain and washouts along small drainage line at immediate base of tree.

Stag-watch Results

No evidence of large forest owls utilising the large hollow in this tree. However, whitewash evident (but no regurgitation pellets) around perimeter of tree. A ground based assessment on the suitability of this tree for large forest owls considers HT94 to be highly suitable as a nest and or roost site for either the Masked Owl, or possibly the Powerful Owl.

Table 10. Stagwatch Results HT110, February - March 2010, land off George Booth Drive

Tree ID **HT110**

Tree Species: Spotted Gum *Corymbia maculata*

Height: 12 metres

Diameter: 56 centimetres

Location Coordinates: [GDA94]

Easting: 368405.636

Northing: 6356235.228

Description

Small Spotted Gum *C. maculata* with open exposed vertical pipe at approximately 6 metres height. Top of the vertical pipe has fallen off exposing the floor of the hollow to the elements.

Stag-watch Results

No stag-watching of this tree was undertaken as it was deemed no longer suitable for threatened large forest owls.

Table 11. Stagwatch Results HT112, February - March 2010, land off George Booth Drive

Tree ID **HT112**

Tree Species: Spotted Gum *Corymbia maculata*

Height: 18 metres

Diameter: 71 centimetres

Location Coordinates: [GDA94]

Easting: 368410.995

Northing: 6356199.031

Description

Large tall Spotted Gum *C. maculata* with large vertical pipe located at approximately 14m height. Access is good to base of tree but height of hollow too high for cherry picker.

Stag-watch Results

No evidence of large forest owls utilising the large hollow in this tree. A ground based assessment on the suitability of this tree for large forest owls considers HT112 to be suitable as a nest and or roost site for the Masked Owl.

Table 12. Stagwatch Results HT124, February - March 2010, land off George Booth Drive

Tree ID **HT124**

Tree Species: Spotted Gum *Corymbia maculata*

Height: 16 metres

Diameter: 83 centimetres

Location Coordinates: [GDA94]

Easting: 368315.734

Northing: 6356079.992

Description

Smaller Spotted Gum *C. maculata* located along southern boundary of site. Tree has a small vertical pipe suitable for a forest owl, but potentially too small for Masked Owl. Height of hollow is 10 metres with good access.

Stag-watch Results

No stag-watching of this tree was conducted as it was deemed unsuitable for large forest owls. However, due to its close proximity to HT112 it was indirectly monitored for owl activity during the stag-watch / quiet listening component of the monitoring of HT112.

Table 13. Stagwatch Results HT126, February - March 2010, land off George Booth Drive

Tree ID **HT126**

Tree Species: Spotted Gum *Corymbia maculata*

Height: 12 metres

Diameter: 80 centimetres

Location Coordinates: [GDA94]

Easting: 368305.558

Northing: 6356193.858

Description

Low Spotted Gum *C. maculata* located on edge of powerline easement. Has large vertical trunk hollow at 5m height suitable for large forest owl.

Stag-watch Results

No stag-watching of this tree was conducted but was physically inspected by ladder for hollow use by large forest owls. No activity by large forest owls was noted. However, due to its close proximity to HT112 it was indirectly monitored for owl activity during the stag-watch / quiet listening component of the monitoring of HT112. An inspection camera revealed no evidence of owl usage.

3.3.3 Mammals

3.3.3.1 Small to Medium Terrestrial Mammals

Trapping results for small to medium sized terrestrial mammals recorded two species, the Brown Antechinus *Antechinus stuartii* and Common Dunnart *Sminthopsis murina*. No evidence of medium sized terrestrial mammals such as Northern Brown Bandicoot *Isoodon macrourus* was observed on the subject site. The number and location of each capture is presented below in **Table 14**.

3.3.3.2 Arboreal Mammals

Four species of arboreal mammal were recorded on the subject site, the Sugar Glider *Petaurus breviceps,* Squirrel Glider *Petaurus norfolcensis,* Common Ringtail Possum *Pseudocheirus peregrinus* and Common Brushtail Possum *Trichosurus vulpecula.* Both the Sugar Glider and Squirrel Glider were detected by spotlight searches and arboreal trapping, whilst the Common Ringtail Possum and Common Brushtail Possum were recorded by spotlight searches.

Table 14 Captures of Small Mammals

Common Name	Scientific Name	Trapping Site	No. Captures
Brown Antechinus	*Antechinus stuartii*	2	4
Common Dunnart	*Sminthopsis murina*	1	2
Sugar Glider	*Petaurus breviceps*	2, 3	2
Squirrel Glider	*Petaurus norfolcensis*	1, 3	2
		TOTAL CAPTURES	**10**

SEPP 44 (Koala Habitat) Assessment

The list of tree species in Schedule 2 of SEPP 44 that were recorded on the subject site is listed below in **Table 15**.

Table 15 Schedule 2 Tree Species, SEPP 44 (Koala Habitat Protection)

Common Name	Scientific Name	Occurrence in Study Area	>15% Schedule 2 Tree Species
White Box	*Eucalyptus albens*	No	
River Red Gum	*Eucalyptus camaldulensis*	No	
Broad-leaved Scribbly Gum	*Eucalyptus haemastoma*	No	No
Tallowwood	*Eucalyptus microcorys*	No	
Bimble Box	*Eucalyptus populnea*	No	
Large-fruited Grey Gum	*Eucalyptus punctata*	Yes	No
Swamp Mahogany	*Eucalyptus robusta*	No	
Scribbly Gum	*Eucalyptus signata*	No	
Forest Red Gum	*Eucalyptus tereticornis*	No	
Ribbon Gum	*Eucalyptus viminalis*	No	

Based on the SEPP44 habitat assessment, no Schedule 2 tree species occur on the subject site with greater than 15% projective cover. Hence, *no potential habitat* as defined in SEPP44 occurs on the subject site. There was no evidence of Koala utilising the subject site based on scat and spotlight searches of the subject site. No Core Koala Habitat as defined by SEPP44 occurs on the subject site, as there was no evidence of a resident Koala population. There is one record of Koala near Cameron Park (DECC, 2008) in 1994 with no recent sightings of the species. Based on the results of the habitat assessment and spotlight / scat searches of the subject site, no Core Koala habitat occurs on the site.

3.3.3.3 Bats

Bat species recorded on the subject site include both mega-chiropteran and micro-chiropteran species. The list of bat species recorded on the subject site is presented below in **Table 16**.

Table 16. Bat Species recorded on Subject Site, land off George Booth Drive.

Site	Common Name	Scientific Name	Status		No. Recorded	No. Calls Recorded
			EPBC	TSC		
	Grey-headed Flying-fox	***Pteropus poliocephalus***	**V**	**V**	~20 observed	
Harp1	**Large-eared Pied Bat**	***Chalinolobus dwyeri***	**V**	**V**		1
	Gould's Wattled Bat	*Chalinolobus gouldii*		P		4
	Chocolate Wattled Bat	*Chalinolobus morio*		P		14
	Little Bent-wing Bat	***Miniopterus australis***		**V**	1 capture	8
	White-striped Freetail-Bat	*Nyctinomus australis*		P		1
	Long-eared Bat	*Nyctophilus sp.*		P		1
	Little Forest Bat	*Vespadelus vulturnus*		P		6
Harp2	**Little Bent-wing Bat**	***Miniopterus australis***		**V**		41
	Long-eared Bat	*Nyctophilus sp.*		P		1
	Gould's Long-eared Bat	*Nyctophilus gouldii*		P	2 captures	
	Lesser Long-eared Bat	*Nyctophilus geoffroyi*		P		
	Little Forest Bat	*Vespadelus vulturnus*		P	1 capture	1
Harp3	Gould's Wattled Bat	*Chalinolobus gouldii*		P		14
	Chocolate Wattled Bat	*Chalinolobus morio*		P		3
	Little Bent-wing Bat	***Miniopterus australis***		**V**		23
	Eastern Bent-wing Bat	***Miniopterus schreibersii oceanensis***		**V**		1
	White-striped Freetail-Bat	*Nyctinomus australis*		P		1
	Greater Broad-nosed Bat / Eastern Broad-nosed Bat / **Eastern Falsistrelle**	***Scoteanax rueppellii*** / *Scotorepens. Orion* / ***Falsistrellus tasmaniensis***		**V** / **V**		3
	Little Forest Bat	*Vespadelus vulturnus*		P		12
				TOTAL	**5**	**135**

Note: Species listed in **Bold Text** are listed as Threatened on either the EPBC Act 1999 or TSC Act 1995.

Below in **Table 17** is a summary of all mammals recorded on the subject site during investigations in 2008.

Table 17. Summary of Mammal Species recorded on Subject Site, land off George Booth Drive.

Common Name	Scientific Name	Site Number		
		Site 1	Site 2	Site 3
Brown Antechinus	*Antechinus stuartii*		T(4)	
Common Dunnart	*Sminthopsis murina*	2		
Sugar Glider	*Petaurus breviceps*		T(1)	T(1)
Squirrel Glider	*Petaurus norfolcensis*	T(1)	S(4)	T(1) S(1)
Common Ringtail Possum	*Pseudocheirus peregrinus*			S(1)
Common Brushtail Possum	*Trichosurus vulpecular*	S(2)		
Eastern Grey Kangaroo	*Macropus giganteus*		2	
Grey-headed Flying-fox	*Pteropus poliocephalus*		S(20)	
White-striped Freetail-bat	*Ncytinomus australis*	A		A
Little Bent-wing Bat	*Miniopterus australis*	A	A, H(1)	A
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*			A
Gould's Long-eared Bat	*Nyctophilus gouldii*		H(2)	
Large-eared Pied Bat	*Chalinolobus dwyeri*	A		
Gould's Wattled Bat	*Chalinolobus gouldii*	A		A
Chocolate Wattled Bat	*Chalinolobus morio*	A		A
Eastern Falsistrelle /	*Falsistrellus tasmaniensis*			?A
Eastern Broad-nosed Bat /	*Scotorepens orion*			?A
Greater Broad-nosed Bat	*Scoteanax rueppellii*			?A
Little Forest Bat	*Vespadelus vulturnus*	A	A	A

Number in parentheses ( ) indicate no. of individuals captured / observed

Key to Table 6. **A – recorded by Anabat detector** **?A – tentative Anabat Identification**
H – captured in Harp trap **T – captured in trap** **S – detected by spotlight**

3.3.4 Reptiles

Three reptile species were recorded on the subject site during investigations in 2008. A total of 18 reptile species have been recorded in the locality on the LMCC fauna database (LMCC, 2000) and 13 species on the DECC wildlife atlas (DECC, Nov. 2008). The subject site provides very depauperate habitat for reptile species, with very limited micro-habitats for shelter dependent species. The only areas supporting higher quality habitat (in the form of sheltering sites) are:

- habitat trees for arboreal reptiles and
- areas of domestic rubbish dumping for terrestrial reptiles.

The site appears to experience a very high frequency of disturbance from clearing for vehicle tracks and fire. These events have resulted in removal of ground litter (ground logs, leaf litter) essential for many smaller reptile species. The list of reptile species recorded on the subject site and locality is presented in **Appendix 1**.

3.3.5 Amphibians

Seven frog species were recorded on the subject site or immediately adjoining areas. A total of 10 frog species have been recorded in the locality on the LMCC fauna database (LMCC, 2000) and 22 species on the DECC wildlife atlas (DECC, Nov. 2008). The subject site provides limited habitat for many of the frog species recorded in the locality, particularly for pond dwelling frog species. No dams with areas of open water and fringing emergent aquatic vegetation is present on the site. Frog habitat is limited to small ephemeral drainage lines and also human created depressions which contained standing water during investigations in 2008. Many small and larger depressions have been created on the subject site by off-road motor vehicles and trial bikes, which frequent the site on a very regular basis.

3.3.6 Threatened Species

Six threatened species were recorded on the subject site during fauna investigations in 2008 - 2010. A further two species, the Greater Broad-nosed Bat or Eastern Falsistrelle, could possibly occur on the subject site as calls resembling both species were tentatively identified from Anabat call recordings. However, the recorded call was not of sufficient quality or duration to enable a more definitive identification. The list of threatened species recorded on the subject site and locality is presented below in **Table 18**.

Table 18. Summary of Threatened Species recorded on Subject Site and Locality.

Common Name	Scientific Name	Status		Record in Study Area			Locality Record	
		EPBC	TSC	Site1	Site2	Site3	LMCC 2000	DECCW 2009
Subject Site Records								
Masked Owl	*Tyto novaehollandiae*		V			+	+	+
Squirrel Glider	*Petaurus norfolcensis*		V	+	+	+	+	+
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V		+		+	+
Little Bent-wing Bat	*Miniopterus australis*		V	+	+	+	+	+
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*		V			+	+	+
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	+			+	+
? Eastern Falsistrelle	*Falsistrellus tasmaniensis*		V			+?		+
? Greater Broad-nosed Bat	*Scoteanax rueppellii*		V			+?	+	+
Locality Records								
Swift Parrot	*Lathamus discolor*	E	E					+
Regent Honeyeater	*Anthochaera phrygia*	E M	E					+
Black Bittern	*Ixobrychus flavicollis*		V					+
Australasian Bittern	*Botaurus poiciloptilus*		V					+
Black-necked Stork (Jabiru)	*Ephippiorhynchus asiaticus*		E				+	+
Eastern Osprey	*Pandion cristatus*	M	V				+	+
Little Eagle	*Hieraaetus morphnoides*		V					+
Comb-crested Jacana	*Irediparra gallinacea*		V				+	+
Black-winged Stilt	*Himantopus himantopus*	M	V				+	+
Wompoo Fruit-Dove	*Ptilinopus magnificus*		V					+
Superb Fruit-dove	*Ptilinopus superbus*		V					+
Rose-crowned Fruit-dove	*Ptilinopus regina*		V					+
Glossy Black-Cockatoo	*Calyptorhynchus lathami*		V				+	+
Little Lorikeet	*Glossopsitta pusilla*		V					+
Powerful Owl	*Ninox strenua*		V				+	+

Common Name	Scientific Name	Status		Record in Study Area			Locality Record	
		EPBC	TSC	Site1	Site2	Site3	LMCC 2000	DECCW 2009
Sooty Owl	*Tyto tenebricosa*		V					+
Brown Treecreeper	*Climacteris picumnus*		V				+	+
Black-chinned Honeyeater	*Melithreptus gularis*		V				+	+
White-fronted Chat	*Ephthianura albifrons*		V					+
Scarlet Robin	*Petroica multicolor*		V					+
Varied Sitella	*Daphoenositta chrysoptera*		V					+
Spotted-tailed Quoll	*Dasyurus maculatus*	V	V					+
Koala	*Phascolarctos cinereus*		V				+	+
Yellow-bellied Glider	*Petaurus australis*		V					+
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*		V					+
East-coast Freetail-bat	*Micronomus norfolkensis*		V				+	+
Large-footed Myotis	*Myotis adversus*		V					+
Eastern Cave Bat	*Vespadelus troughtoni*		V					+

Table Key:

Subject Site Records	refers to fauna species recorded on the subject site by this survey
Locality records	refers to fauna species recorded within 10km radius of the subject site.
Status	
EPBC	Refers to the national *Environment Protection & Biodiversity Conservation Act 1999*
TSC	Refers to the NSW *Threatened Species Conservation Act 1995* (and its subsequent amendments)
E	refers to species listed as **Endangered** under the *EPBC Act 1999* and *TSC Act 1995*
V	refers to species listed as **Vulnerable** under the *EPBC Act 1999* and *TSC Act 1995*
M	refers to species listed as **Migratory** under the *EPBC Act 1999*
Locality Record	
LMCC 2000	refers to fauna records listed in the Lake Macquarie Fauna Database (LMCC, 2000).
DECC 2009	Refers to fauna records listed on the Department of Environment, Climate Change and Water (DECCW) Atlas of Wildlife Database current to August 2010.

The location of threatened species recorded on the subject site is presented below in **Figure 7**.

3.3.5.1 Masked Owl

An adult Masked Owl was observed roosting in Habitat Tree 13 (dead ironbark) during inspection with a cherry-picker on 22 November 2009. An additional nest tree of the species was located nearby at Habitat Tree 46. The Masked Owl was not detected on the subject site during the initial investigations in 2008, nor stagwatch and spotlight searches earlier in November 2009. The species was not detected at any of the additional potential large forest owl habitat trees whilst surveys were conducted in February and March 2010. However, sufficient evidence in the form of scratch marks on the hollow entrance on HT46, plus amount of white-wash and regurgitation pellets on the hollow floor in HT13 indicate the species regularly utilises the subject site for roosting and breeding. The absence of calling behaviour by this Masked Owl is in contrast to the Apollo Drive Charlestown Masked Owls, which were heard calling at dusk on a significant number of evenings.

Figure 7. Location of Threatened Fauna, George Booth Drive.

3.3.5.2 Squirrel Glider

A total of 5 Squirrel Gliders were observed by spotlight searches of the subject site and 2 individuals were captured by tree trapping. The species appears widespread across the subject site, being detected at each of the three survey sites and nearby areas. Spotlight observation rates for the Squirrel Glider on the subject site is 5 individuals for 13.5 spotlight hours, or 0.37 individuals per spotlight hour. Density estimates are based on trapping results of the subject site and comparison sites. A comparison of detectability of Squirrel Gliders on the subject site to other sites surveyed is summarised below in **Table 19**.

Table 19. Detection Rates of Squirrel Glider on the Subject Site to Comparison Sites.

Location	Spotlight Detection Rate	Estimated Density / ha
George Booth Drive (subject site) – This survey	0.37	0.22
Blackbutt Reserve (Murray, 1997)	0.27	-
Eleebana (Murray, 1996)	0.22	0.56
Wyong (Smith and Murray, 2003)	-	0.49
Lake Macquarie (Smith, 1998)	-	0.47

3.3.5.3 Grey-headed Flying-fox

Approximately 20 individuals of the Grey-headed Flying-fox were observed foraging on flowering Spotted Gum *Corymbia gummifera* during nocturnal owl surveys in July 2008. Flowering of Spotted Gum and Ironbark trees was restricted to a small number of trees on the subject site during winter 2008, which is likely to have limited the extent and duration of foraging by the species. The nearest known camp of the species is located at Blackbutt Reserve approximately 9.0 kilometres to the east of the subject site. No evidence of foraging activity was noted in subsequent nocturnal surveys in September and October 2008.

3.3.5.4 Little Bent-wing Bat and Eastern Bent-wing Bat

One individual of the Little Bent-wing Bat was captured at Harp trap 2 in October 2008 and numerous calls of the species were recorded by Anabat detection. In contrast, the Eastern Bent-wing Bat was not captured by harp trapping, but detected by one echolocation call recording. Both the Little Bent-wing Bat and Eastern Bent-wing Bat roost in caves or similar structures (mine shafts, tunnels), of which none exist on the subject site. The subject site would therefore comprise part of the foraging habitat of each species.

3.3.5.5 Large-eared Pied Bat

One echolocation call recording which closely resembles the Large-eared Pied Bat was recorded on the subject site at Site Anabat 1. The Large-eared Pied Bat is also a cave roosting bat and is more commonly associated with the drier sandstone escarpment country such as the nearby Mt Sugarloaf and the Watagan Ranges. The occurrence of the species on the subject site is likely to be for foraging purposes and is not considered to roost on the subject site.

3.3.5.6 Eastern Falsistelle or Greater Broad-nosed Bat

Three calls resembling either the Eastern Falsistrelle or Greater Broad-nosed Bat were recorded on the subject site. Both the Eastern Falsistrelle and Greater Broad-nosed Bat have been recorded in the locality and both species could occur. Additionally, both species roost in tree cavities and could utilise the subject site for foraging and roosting.

Below in **Table 20** is a summary of the occurrence of threatened fauna species recorded on the subject site or in the locality. This summary considers each threatened species listed above in **Table 18** based on the occurrence of suitable habitat on the subject site.

Table 20. Assessment of Threatened Species Occurrence on Subject Site.

Common Name	Scientific Name	Habitat Present	Occurrence
Masked Owl	*Tyto novaehollandiae*	Yes	Recorded on Site
Squirrel Glider	*Petaurus norfolcensis*	Yes	Recorded on Site
Grey-headed Flying-fox	*Pteropus poliocephalus*	Yes	Recorded on Site
Little Bent-wing Bat	*Miniopterus australis*	Yes	Recorded on Site
Eastern Bent-wing Bat	*Miniopterus schriebersii oceanensis*	Yes	Recorded on Site
Large-eared Pied Bat	*Chalinolobus dwyeri*	Yes	Recorded on Site
Eastern Falsistrelle	*Falsistrellus tasmaniensis*	Yes	Potentially recorded on Site
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Yes	Potentially recorded on Site
LOCALITY RECORDS			
Common Name	**Scientific Name**	**Habitat Present**	**Potential Occurrence**
Swift Parrot	*Lathamus discolor*	Yes	Moderate
Regent Honeyeater	*Anthochaera phrygia*	No	Moderate
Black Bittern	*Ixobrychus flavicollis*	No	No
Australasian Bittern	*Botaurus poiciloptilus*	No	No
Black-necked Stork (Jabiru)	*Ephippiorhynchus asiaticus*	No	No
Eastern Osprey	*Pandion cristatus*	No	No
Little Eagle	*Hieraaetus morphnoides*	Yes	Moderate
Comb-crested Jacana	*Irediparra gallinacea*	No	No
Black-winged Stilt	*Himantopus himantopus*	No	No
Wompoo Fruit-Dove	*Ptilinopus magnificus*	No	No
Superb Fruit-dove	*Ptilinopus superbus*	No	No
Rose-crowned Fruit-dove	*Ptilinopus regina*	No	No
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	Yes	Low
Little Lorikeet	*Glossopsitta pusilla*	Yes	High
Powerful Owl	*Ninox strenua*	Yes	High
Sooty Owl	*Tyto tenebricosa*	No	Low
Brown Treecreeper	*Climacteris picumnus*	Yes	Low
Black-chinned Honeyeater	*Melithreptus gularis*	Yes	Low
White-fronted Chat	*Ephthianura albifrons*	No	No
Scarlet Robin	*Petroica multicolour*	Yes	Low
Varied Sitella	*Daphoenositta chrysoptera*	Yes	High
Spotted-tailed Quoll	*Dasyurus maculatus*	Yes	Low
Koala	*Phascolarctos cinereus*	No	No
Yellow-bellied Glider	*Petaurus australis*	No	No

Common Name	Scientific Name	Habitat Present	Occurrence
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	Yes	Low
East-coast Free-tail Bat	*Micronomus norfolkensis*	Yes	High
Large-footed Myotis	*Myotis adversus*	Yes	Moderate
Eastern Cave Bat	*Vespadelus troughtoni*	No	Low

Following in the discussion section of this report is a summary of the occurrence of threatened species recorded on the subject site and locality and potential impacts of development of the subject site on threatened species and their habitat. Based on the development potential of the subject site, a detailed assessment of the likely impact of future development on threatened fauna species is presented in **Appendix 3**.

4.0 DISCUSSION

Fauna investigations were conducted on land off George Booth Drive, Edgeworth between the period May 2008 to March 2010 to assist in assessment of the ecological significance of the subject site. In total, 59 bird species, 16 mammal species, 3 reptiles and 7 frog species were recorded within, or immediately adjacent to the subject site. A total of 6 threatened species were recorded by the surveys, including:

- Masked Owl *Tyto novaehollandiae*
- Squirrel Glider *Petaurus norfolcensis,*
- Little Bent-wing Bat *Miniopterus australis,*
- Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis,*
- Large-eared Pied Bat *Chalinolobus dwyeri,* and
- Grey-headed Flying-fox *Pteropus poliocephalus.*

An additional threatened species was possibly recorded on site, either the Greater Broad-nosed Bat *Scoteanax rueppellii* or Eastern Falsistrelle *Falsistrellus tasmaniensis.* However, either species was detected by echolocation call recording, which was of insufficient quality to confirm the identification to a high degree of accuracy.

Analysis of threatened fauna species recorded in the locality (<10km radius) reveal an additional 29 threatened species. However, for many of the additional 29 species, no suitable habitat exists in the subject site to suggest their likely occurrence. A review of the vegetation communities and habitat type recorded on the subject site suggests:

- 9 of the 29 threatened fauna species recorded in the locality (Glossy Black Cockatoo, Sooty Owl, Brown Treecreeper, Scarlet Robin, Spotted-tail Quoll, Koala, Yellow-bellied Glider, Yellow-bellied Sheathtail-bat, Eastern Cave Bat) have a low likelihood of occurrence on the subject site (due to lack of suitable habitat),
- 5 of the 29 threatened fauna species recorded in the locality (Swift Parrot Regent Honeyeater, Little Eagle, Black-chinned Honeyeater, Large-footed Myotis) have a moderate likelihood of occurrence on the subject site, and
- 4 of the 27 threatened fauna species recorded in the locality (Little Lorikeet, Powerful Owl, Varied Sitella, East-coast Freetail-bat) have a high likelihood of occurrence on the subject site.

The remaining 11 threatened fauna species recorded in the locality would not occur within the subject site due to absence of suitable habitat. Two habitat types were defined for the subject site, Open Forest and Open Grassland, although there is variation in dominant tree species within the Open Forest distributed across the site. The subject site has experienced a high degree of disturbance to the native vegetation by impacts of logging (past and present), vehicle and pedestrian tracks, dumping of domestic and commercial waste, weeds, clearing of easements for infrastructure utilities (powerlines) and fire. Parts of the subject site experience a high to very high fire frequency. The general age of the forest structure is juvenile aged trees with an average of 1.3 habitat trees per hectare (very low). Overall, the condition of the fauna habitat within the subject site is rated as very poor for many fauna species, particularly smaller terrestrial vertebrates.

4.1 Connectivity and LMCC Corridor Mapping

Vegetation within the subject site is fragmented due to wide cleared easements for three powerline easements, and is also fragmented from adjoining bushland areas by both major and minor roadways surrounding the perimeter. One major arterial road, George Booth Drive occurs along the northern boundary of the subject site. The minimum gap width of remnant vegetation across George Booth Drive is 20 metres but this is likely to increase with future upgrades to this main carriageway. Large areas of remnant vegetation and fauna habitat occur on the northern side of George Booth Drive, but this area is subject to future urban development for the Pambulong Estate. Connectivity of remnant vegetation and fauna habitat is likely to be lost once development of this estate proceeds. Land use zones under the LMCC LEP (2004) immediately to the north of the subject site support a mix of developments with limited opportunities for retention of native vegetation, fauna habitat and vegetation corridors.

To the west of the subject site, corridor connectivity to remnant forest is also fragmented due to clearings for power line easements, minor roads (Appletree Road) and residential allotments. This area is mapped as a **Rehabilitation Corridor** in the LMCC Native Vegetation and Corridors Mapping (2007). To maintain this important corridor linkage between the subject site and Slatey Creek would require some rehabilitation of presently cleared land and enhancement of remnant vegetation and fauna habitat. The remnant vegetation along Slatey Creek provides connectivity to large areas of forest west of the suburb of Holmesville. Further west the F3 Freeway presents a significant gap in forest cover to the extensively forested Sugarloaf Range and Heaton / Awaba forests.

To the south and east of the subject site is residential suburbs with no habitat values for the majority of fauna species that utilise the site. However, a narrow corridor of remnant forest exists which connects the subject site to Cockle Creek. This large creek retains riparian vegetation and provides connectivity to large areas of remnant vegetation and fauna habitat in the creek's upper catchment. The only barrier to dispersal of fauna between the subject site is a power line easement and Northville Road.

Potentially, there are two options for creation of, or maintenance of vegetation and habitat corridors between the subject site and adjoining forested areas. The vegetation mapping of the subject site has identified two endangered ecological communities which may limit future development potential of the subject site. Based on the distribution of EEC's within the subject site, the potential exists for the establishment of a north-south vegetation and fauna habitat corridor along a small drainage line on the eastern boundary of the subject site. However, examination of the LMCC LEP (2004) indicates land the north of George Booth Drive (Pambulong Development),which would link to the potential north-south site corridor, will be developed in time. This will result in removal of native vegetation and the potential for corridor connectivity to remnant forest north of George Booth Drive. Therefore, any north –south corridor that is retained on the subject site will not link to any significant adjoining forested areas.

The second option for establishment of a vegetation and fauna habitat corridor is an east – west corridor located along the southern boundary of the subject site. This corridor would essentially link to riparian habitat along Cockle Creek in the east, and to riparian habitat along Slatey Creek to the west of the subject site. The recommended minimum width of this east-west corridor is 130 metres. However, part of the proposal for development of the subject site is the re-alignment of the two large powerlines to create additional developable land. Any proposal to re-align the existing powerlines and their easements will require

consideration for any Vegetation and Corridor Mapping which has been adopted by Lake Macquarie City Council.

In addition, any proposal to formulate recommend corridors into revisions of the LMCC LEP (2004) will require habitat enhancement and vegetation plantings to restore gaps in canopy cover. Presently, the corridor pathway constricts to narrow vegetation stands at several points due to past clearing of the landscape. The locations of potential Vegetation and Fauna Corridors on the subject site is presented below in **Figure 8**.

Figure 8. Location of Potential Vegetation and Fauna Corridors, George Booth Drive.

4.2 Review of LMCC Local Environmental Plan 2004

The Lake Macquarie City Council Local Environmental Plan (2004) provides guidance for land use within the City. Based on the existing LEP 2004, there is limited opportunity for establishment of a vegetation corridor network north of George Booth Drive. However, an east-west corridor along the southern boundary of the subject site has the potential due to existing land use zones sympathetic to conservation of remnant vegetation and fauna habitat. Land to the immediate south-east of the subject site is Zoned 7(2) – Conservation Secondary, with the riparian zone of Cockle Creek also zoned 7(2) – Conservation Secondary.

In the south-western corner, land adjoining the subject site also includes a mix of conservation zonings to suggest potential for establishment of a corridor network linking to Slatey Creek. The riparian zone of Slatey Creek and parts of the adjoining land support 7(3) – Environmental General. Several of the objectives of the 7(3) zone support the implementation of a formal corridor pathway linking the subject site to Slatey Creek. Objective (a) of the 7(3) zone is to maintain and enhance biodiversity, scenic quality and native riparian vegetation and habitat, and objective (b) is to protect, manage and enhance corridors to facilitate species movement, dispersal and interchange of genetic material.

To achieve an improved corridor pathway linking the subject site to Slatey Creek will require enhancement of native vegetation and fauna habitat to widen the existing corridor pathway. In parts the corridor is restricted to a width of 30 metres. Due to the significance of this corridor, it is recommended the corridor is enhanced to at least 60 - 100 metres in width. The locations where native vegetation / fauna habitat enhancement is required are offsite to the subject site and would therefore require the cooperation of the existing landholders to implement such as strategy. Alternatively, a suggestion is presented whereby the subject site owner could acquire the land holdings in question and undertake vegetation enhancement of the corridor as an offset strategy for the clearing of EEC's on the subject site. This suggested biodiversity offset strategy could be undertaken formally under a Bio-certification Application under s.126G of the *Threatened Species Conservation Act 1995.*

In summary, an application for bio-certification would be considered if its implementation is expected to improve or maintain biodiversity values. This is the primary test for certification. There are a range of mechanisms available to planning authorities to offset the loss of biodiversity values incurred by development. Generally, a proposal impacting development or degradation of viable patches with high biodiversity value will be unable to meet the "improve or maintain threshold" and not meet biodiversity certification. However, development may be able to proceed in areas of biodiversity value that are not deemed high conservation value. However planning authorities will need to balance these losses through positive actions undertaken elsewhere to enhance and conserve biodiversity values.

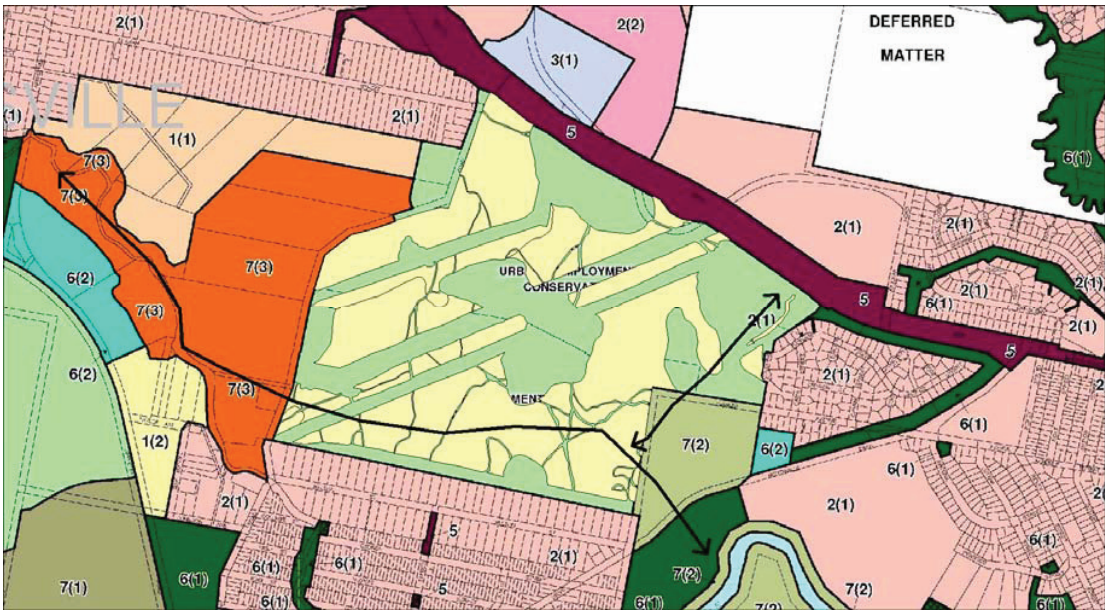

Figure 9. Location of Potential Vegetation and Fauna Corridors overlayed on LMCC LEP (2004).

4.3 Review of Recommended Constraints Mapping

GeoLINK Consulting Pty Ltd is presently preparing the Local Environmental Study for the subject site and has formulated a land use constraints map (ADW Johnson, 2010). A copy of the land use constraints map is reproduced below in **Figure 10**. The area coloured white and light blue represents potential development land, which represent approximately 46.74 hectares, or 48.75% of the subject site. The green areas (49.13 hectares, or 51.25%) represent areas recommended for conservation zonings due to the higher ecological values.

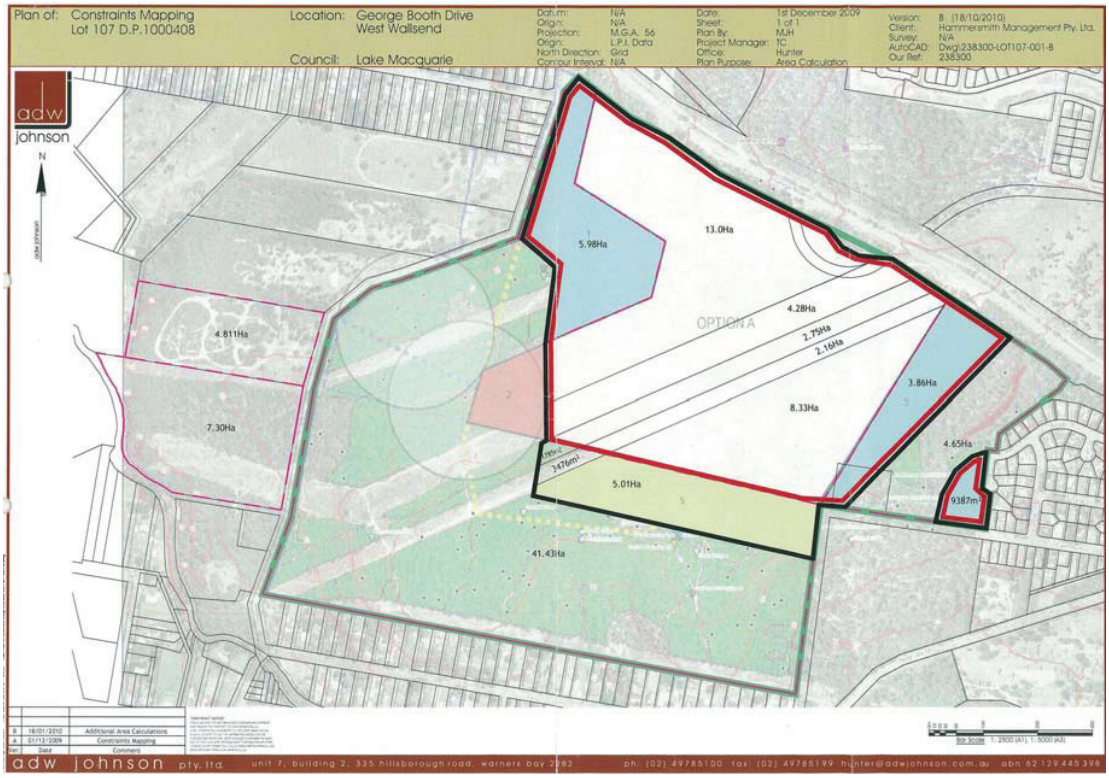

Figure 9. Location of Potential Vegetation and Fauna Corridors overlayed on LMCC LEP (2004).

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The constraints mapping has acknowledged the presence of the Masked Owl nest and roost tree and a conservation buffer of 150 metres has been applied to each habitat tree. This is a considered a good outcome for protection of their key habitat roost and nest sites, and should assist in persistence of the Masked Owl on the subject site once development proceeds. The recommended east to west vegetation corridors in the southern portion of the subject site also is a good ecological outcome due to the width (~240 metres) of retained vegetation, fauna habitat and connectivity between Slatey Creek in the west to Cockle Creek in the east.

4.4 Impact of Constraints Mapping on Threatened Species Habitat

Six threatened species were recorded on the subject site during fauna investigations between the period May 2008 to March 2010. A further two species, the Greater Broad-nosed Bat or Eastern Falsistrelle, could possibly occur on the subject site as calls resembling both species were tentatively identified from Anabat call recordings. A summary discussion on the potential impact of proposed development area (46.74 hectares, or 48.76%) of the subject site, based on the constraints mapping reproduced above, is presented below. A detailed impact assessment under the EPBC Act 1999 and TSC Act 1995 is presented in **Appendix 3**.

Based on the constraints mapping reproduced above, the proposed development footprint would not significantly impact on threatened species, or their habitat, based on assessments conducted under national and state threatened species legislation.

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APPENDIX 1. FAUNA LIST

Species in **bold text** are listed as threatened under the National *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act, 1999) or NSW *Threatened Species Conservation Act 1995* (TSC Act). Status is denoted as **E – Endangered, V – Vulnerable, M – Migratory.**

Bird species listed under the JAMBA and CAMBA Migratory Bird Agreements are denoted in the column Jamba / Camba.

The column **Record on Site** refers to fauna species recorded during ecological investigations in 2008. **Locality Record** refer to published records of fauna species listed on the following databases:

- Department of Environment and Climate Change Wildlife Atlas for the Edgeworth locality (<10km radius of the subject site) (August 2010),
- LMCC Fauna Database (2000),
- personal records of the author.

However, it must be noted that the selection of <10km radius often results in records of fauna species unlikely to utilise habitats on the subject site, for example, aquatic species such as seabirds. The choice of 10km radius is based on directions from DEC Survey Guidelines (draft 2004).

FAMILY		**EPBC**	**TSC**	**Jamba**	**Record in Study Area**			**Locality Record**	
Scientific Name	**Common Name**	**Act 1999**	**Status**	**Camba**	**Site1**	**Site2**	**Site3**	**LMCC 2000**	**DECCW 2010**
BIRDS									
PHASIANIDAE									
Coturnix pectoralis	Stubble Quail								+
Coturnix ypsilophora	Brown Quail							+	+
ANSERANATIDAE									
Anseranas semipalmata	**Magpie Goose**		V						+
ANATIDAE									
Dendrocygna eytoni	Plumed Whistling-Duck	M							+
Dendrocygna arcuata	Wandering Whistling-Duck	M							+
Biziura lobata	Musk Duck	M							+
Cyngus atratus	Black Swan	M						+	+
Chenonetta jubata	Australian Wood Duck	M			+			+	+
** Anas platyrhychos*	* Mallard							+	+
Anas superciliosa	Pacific Black Duck	M						+	+
Anas rhynchotis	Australasian Shoveller	M						+	+
Anas gracilis	Grey Teal	M						+	+
Anas castanea	Chestnut Teal	M						+	+
Malacorhychus membranaceus	Pink-eared Duck	M						+	+
Aythya australis	Hardhead	M						+	+
PODICIPEDIDAE									
Tachybaptus novaehollandiae	Australian Grebe							+	+
ANHINGIDAE									
Anhinga melanogaster	Australian Darter							+	+
PHALACROCORACIDAE									
Phalacrocorax melanoleucos	Little Pied Cormorant							+	+
Phalacrocorax varius	Pied Cormorant							+	+
Phalacrocorax sulcirostris	Little Black Cormorant							+	+

FAMILY Scientific Name	Common Name	EPBC Act 1999	TSC Status	Jamba Camba	Record in Study Area Site1	 Site2	 Site3	Locality Record LMCC 2000	 DECCW 2010
Phalacrocorax carbo	Great Cormorant							+	+
PELECANIDAE									
Pelecanus conspicillatus	Australian Pelican							+	+
ARDEIDAE									
Egretta novaehollandiae	White-faced Heron							+	+
Egretta garzetta	Little Egret							+	
Egretta sacra	Eastern Reef Egret	M		C				+	
Ardea pacifica	White-necked Heron								+
Ardea alba	Great Egret			J				+	+
Ardea intermedia	Intermediate Egret							+	+
Ardea ibis	Cattle Egret	M		J				+	+
Nycticorax caledonicus	Nankeen Night Heron							+	+
Ixobrychus flavicollis	**Black Bittern**		V						+
Botaurus poiciloptilus	**Australasian Bittern**		V						+
PLATALEIDAE									
Plegadis falcinellus	Glossy Ibis	M		C				+	+
Threskiornis molucca	Australian White Ibis							+	+
Threskiornis spinicollis	Straw-necked Ibis							+	+
Platalea regia	Royal Spoonbill							+	+
Platalea flavipes	Yellow-billed Spoonbill								+
CICONIIDAE									
Ephippiorhynchus asiaticus	**Black-necked Stork (Jabiru)**		E					+	+
ACCIPITRIDAE									
Pandion cristatus	**Eastern Osprey**	M	V					+	+
Aviceda subcristata	Pacific Baza	M						+	+
Elanus axillaris	Black-shouldered Kite	M						+	+
Haliastur sphenurus	Whistling Kite	M						+	+
Haliaeetus leucogaster	White-bellied Sea-eagle	M		C		+		+	+
Circus approximans	Swamp Harrier	M						+	+
Accipiter fasciatus	Brown Goshawk	M						+	+
Accipiter novaehollandiae	Grey Goshawk	M					+	+	+
Accipiter cirrhocephalus	Collared Sparrowhawk	M						+	+
Aquila audax	Wedge-tailed Eagle	M						+	+
Hieraaetus morphnoides	**Little Eagle**	M	V					+	+
FALCONIDAE									
Falco berigora	Brown Falcon	M							+
Falco longipennis	Australian Hobby	M						+	+
Falco peregrinus	Peregrine Falcon	M						+	+
Falco cenchroides	Nankeen Kestrel	M			+			+	+
RALLIDAE									
Porzana pusilla	Baillon's Crake								+
Porzana fluminea	Australian Spotted Crake								+
Porzana tabuensis	Spotless Crake								+
Porphyrio porphyrio	Purple Swamphen							+	+
Gallinula tenebrosa	Dusky Moorhen							+	+
Fulica atra	Eurasian Coot							+	+
TURNICIDAE									
Turnix varia	Painted Button Quail							+	+
SCOLOPACIDAE									
Gallinago hardwickii	Latham's Snipe	M		J				+	

FAMILY Scientific Name	Common Name	EPBC Act 1999	TSC Status	Jamba Camba	Record in Study Area Site1	 Site2	 Site3	Locality Record LMCC 2000	 DECCW 2010
Limosa lapponica	Bar-tailed Godwit	M		J				+	
Arenaria interpres	Ruddy Turnstone	M		J					+
Calidris acuminata	Sharp-tailed Sandpiper	M		J				+	+
Calidris ferruginea	Curlew Sandpiper	M		J				+	+
JACANIDAE									
Irediparra gallinacea	**Comb-crested Jacana**		V					+	+
RECURVIROSTRIDAE									
Himantopus himantopus	**Black-winged Stilt**	M	V					+	+
CHARADRIIDAE									
Elseyornis melanops	Black-fronted Dotterel	M						+	
Erythrogonys cinctus	Red-kneed Dotterel	M						+	
Vanellus miles	Masked Lapwing	M						+	+
COLUMBIDAE									
** Columba livia*	* Rock Dove							+	+
Columba leucomela	White-headed Pigeon							+	+
** Streptopelia chinensis*	* Spotted Turtle-dove				+			+	+
Macropygia amboinenses	Brown Cuckoo-dove							+	+
Chalcophaps indica	Emerald Dove							+	+
Phaps chalcoptera	Common Bronzewing							+	+
Phaps elegans	Brush Bronzewing							+	+
Ocyphaps lophotes	Crested Pigeon				+		+	+	+
Geopelia cuneata	Diamond Dove							+	
Geopelia striata	Peaceful Dove							+	+
Geopelia humeralis	Bar-shouldered Dove							+	+
Leucosarcia melanoleuca	Wonga Pigeon							+	+
Ptilinopus magnificus	**Wompoo Fruit-Dove**		V						+
Ptilinopus superbus	**Superb Fruit-dove**		V						+
Ptilinopus regina	**Rose-crowned Fruit-dove**		V						+
Lopholaimus antarcticus	Topknot Pigeon							+	+
CACATUIDAE									
Calyptorhynchus lathami	**Glossy Black-Cockatoo**		V					+	+
Calyptorhynchus funereus	Yellow-tailed Black Cockatoo				+	+	+	+	+
Cacatua roseicapilla	Galah				+	+	+	+	+
Cacatua sanguinea	Little Corella							+	+
Cacatua galerita	Sulphur-crested Cockatoo				+		+	+	+
PSITTACIDAE									
Trichoglossus haematodus	Rainbow Lorikeet				+			+	+
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet							+	+
Glossopsitta concinna	Musk Lorikeet							+	+
Glossopsitta pusilla	**Little Lorikeet**		V					+	+
Alisterus scapularis	Australian King Parrot					+		+	+
Platycerus elegans	Crimson Rosella							+	+
Platycerus eximius	Eastern Rosella				+	+		+	+
Lathamus discolor	**Swift Parrot**	E	E						+
Psephotus haematonotus	Red-rumped Parrot								+
CUCULIDAE									
Cuculus pallidus	Pallid Cuckoo							+	+
Cacomantis variolosus	Brush Cuckoo							+	+
Cacomantis flabelliformis	Fan-tailed Cuckoo					+		+	+
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo							+	+

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Chrysococcyx lucidus	Shining Bronze-Cuckoo							+	+
Eudynamis scolopacea	Common Koel						+	+	+
Scythrops novaehollandiae	Channel-billed Cuckoo				+			+	+
CENTROPODIDAE									
Centropus phasianinus	Pheasant Coucal						+	+	+
STRIGIDAE									
Ninox strenua	**Powerful Owl**		V					+	+
Ninox novaeseelandiae	Southern Boobook				+		+	+	+
TYTONIDAE									
Tyto tenebricosa	**Sooty Owl**		V						+
Tyto novaehollandiae	**Masked Owl**		V				**HT13 HT46**	+	+
Tyto alba	Barn Owl							+	+
PODARGIDAE									
Podargus strigoides	Tawny Frogmouth				+	+	+	+	+
CAPRIMULGIDAE									
Eurostopodus mystacalis	White-throated Nightjar								+
AEGOTHELIDAE									
Aegotheles cristatus	Australian Owlet-Nightjar				+	+	+	+	+
APODIDAE									
Hirundapus caudacutus	White-throated Needletail	M		J		+		+	+
Apus pacificus	Fork-tailed Swift	M		J					+
ALCEDINIDAE									
Alcedo azurea	Azure Kingfisher							+	+
HALCYONIDAE									
Dacelo novaeguineae	Laughing Kookaburra				+	+	+	+	+
Todiramphus sancta	Sacred Kingfisher				+	+		+	+
MEROPIDAE									
Merops ornatus	Rainbow Bee-eater	M		J				+	+
CORACIIDAE									
Eurystomus orientalis	Dollarbird				+	+		+	+
MENURIDAE									
Menura novaehollandiae	Superb Lyrebird							+	+
CLIMACTERIDAE									
Climacteris leucophaea	White-throated Treecreeper				+		+	+	+
Climacteris picumnus	**Brown Treecreeper**		V					+	+
MALURIDAE									
Malurus cyaneus	Superb Fairy-wren				+	+	+	+	+
Malurus lamberti	Variegated Fairy-wren							+	+
Stipiturus malachurus	Southern Emu-wren							+	+
PARDALOTIDAE									
Pardalotus punctatus	Spotted Pardalote				+	+	+	+	+
Pardalotus striatus	Striated Pardalote							+	+
Sericornis frontalis	White-browed Scrubwren				+			+	+
Hylacola pyrrhopygia	Chestnut-rumped Heathwren							+	+
Smicrornis brevirostris	Weebill							+	+
Gerygone mouki	Brown Gerygone							+	
Gerygone laevigaster	Mangrove Gerygone							+	+
Gerygone olivacea	White-throated Gerygone				+	+		+	+
Acanthiza pusilla	Brown Thornbill					+		+	+
Acanthiza reguloides	Buff-rumped Thornbill							+	+

FAMILY Scientific Name	Common Name	EPBC Act 1999	TSC Status	Jamba Camba	Record in Study Area			Locality Record	
					Site1	Site2	Site3	LMCC 2000	DECCW 2010
Acanthiza chrysorrhoa	Yellow-rumped Thornbill							+	
Acanthiza nana	Yellow Thornbill				+			+	+
Acanthiza lineata	Striated Thornbill							+	+
MELIPHAGIDAE									
Anthochaera carunculata	Red Wattlebird							+	+
Anthochaera chrysoptera	Little Wattlebird							+	+
Plectorhyncha lanceolata	Striped Honeyeater							+	+
Philemon corniculatus	Noisy Friarbird				+	+		+	+
Philemon citreogularis	Little Friarbird								+
Anthochaera phrygia	**Regent Honeyeater**	CE M	CE						+
Entomyzon cyanotis	Blue-faced Honeyeater							+	
Manorina melanophrys	Bell Miner							+	+
Manorina melanocephala	Noisy Miner				+	+	+	+	+
Meliphaga lewinii	Lewin's Honeyeater					+		+	+
Lichenostomus chrysops	Yellow-faced Honeyeater				+	+	+	+	+
Lichenostomus leucotis	White-eared Honeyeater							+	+
Lichenostomus melanops	Yellow-tufted Honeyeater							+	+
Lichenostomus fuscus	Fuscous Honeyeater							+	+
Melithreptus gularis	**Black-chinned Honeyeater**		V					+	+
Melithreptus brevirostris	Brown-headed Honeyeater				+	+	+	+	+
Melithreptus lunatus	White-naped Honeyeater								+
Lichmera indistincta	Brown Honeyeater							+	+
Phylidonyris novaehollandiae	New Holland Honeyeater							+	+
Phylidonyris nigra	White-cheeked Honeyeater							+	+
Acanthorhynchus tenuirostris	Eastern Spinebill				+			+	+
Myzomela sanguinolenta	Scarlet Honeyeater				+	+		+	+
Ephthianura albifrons	**White-fronted Chat**		V						+
PETROICIDAE									
Microeca fascinans	Jacky Winter							+	
Petroica multicolor	**Scarlet Robin**		**V**					+	+
Petroica rosea	Rose Robin							+	+
Eopsaltria australis	Eastern Yellow Robin				+			+	+
CINCLOSOMATIDAE									
Psophodes olivaceus	Eastern Whipbird					+		+	+
Cinclosoma punctatum	Spotted Quail Thrush							+	+
NEOSITTIDAE									
Daphoenositta chrysoptera	**Varied Sitella**		**V**					+	+
PACHYCEPHALIDAE									
Falcunculus frontatus	Crested Shrike-tit							+	+
Pachycephala pectoralis	Golden Whistler				+	+		+	+
Pachycephala rufiventris	Rufous Whistler								+
Colluricincla harmonica	Grey Shrike-thrush				+			+	+
DICRURIDAE									
Monarcha melanopsis	Black-faced Monarch							+	+
Monarcha trivirgatus	Spectacled Monarch								+
Myiagra rubecula	Leaden Flycatcher				+			+	+
Grallina cyanoleuca	Magpie-Lark				+		+	+	+
Rhipidura rufifrons	Rufous Fantail							+	+
Rhipidura fuliginosa	Grey Fantail				+	+	+	+	+
Rhipidura leucophrys	Willie Wagtail					+		+	+

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					Site1	Site2	Site3	LMCC 2000	DECCW 2010
Dicrurus bracteatus	Spangled Drongo							+	+
CAMPEPHAGIDAE									
Coracina novaehollandiae	Black-faced Cuckoo-shrike				+			+	+
Coracina papuensis	White-bellied Cuckoo-shrike							+	+
Coracina tenuirostris	Cicadabird							+	+
Lalage sueurii	White-winged Triller								+
ORIOLIDAE									
Oriolus sagittatus	Olive-backed Oriole				+	+		+	+
Sphecotheres viridis	Figbird							+	+
ARTAMIDAE									
Artamus leucorhychus	White-breasted Woodswallow							+	+
Artamus personatus	Masked Woodswallow							+	
Artamus superciliosus	White-browed Woodswallow							+	
Artamus cyanopterus	Dusky Woodswallow							+	+
Cracticus torquatus	Grey Butcherbird							+	+
Cracticus nigrogularis	Pied Butcherbird				+		+	+	+
Gymnorhina tibicen	Australian Magpie				+			+	+
Strepera graculina	Pied Currawong						+	+	+
CORVIDAE									
Corvus coronoides	Australian Raven				+		+	+	+
CORCORACIDAE									
Corcorax melanorhamphos	White-winged Chough							+	+
PTILONORHYNCHIDAE									
Ailuroedus crassirostris	Green Catbird								+
Sericulus chrysocephalus	Regent Bowerbird							+	+
Ptilinorhynchus violaceus	Satin Bowerbird						+	+	+
PASSERIDAE									
* *Passer domesticus*	* House Sparrow							+	+
Taeniophygia bichenovii	Double-barred Finch							+	+
Neochmia modesta	Plum-headed Finch							+	+
Neochmia temporalis	Red-browed Firetail				+		+	+	+
* *Lonchura punctulata*	* Nutmeg Mannikin							+	
Lonchura castaneothorax	Chestnut-breasted Mannikin							+	+
DICAEIDAE									
Dicaeum hirundinaceum	Mistletoebird				+		+	+	+
HIRUNDINIDAE									
Hirundo neoxena	Welcome Swallow							+	+
Hirundo nigricans	Tree Martin							+	
Hirundo ariel	Fairy Martin				+		+	+	+
SYLVIIDAE									
Acrocephalus stentoreus	Clamorous Reed Warbler							+	+
Megalurus timoriensis	Tawny Grassbird								+
Megalurus gramineus	Little Grassbird								+
Cinclorhamphus mathewsi	Rufous Songlark								+
Cisticola exilis	Golden-headed Cisticola							+	+
ZOSTEROPIDAE									
Zosterops lateralis	Silvereye				+			+	+
STURNIDAE									
* *Sturnus vulgaris*	* Common Starling				near 1			+	+
* *Acridotheres tristis*	* Common Myna				+			+	+

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MAMMALS									
TACHYGLOSSIDAE									
Tachyglossus aculeatus	Short-beaked Echidna							+	+
DASYURIDAE									
Antechinus flavipes	Yellow-footed Antechinus								+
Antechinus stuartii	Brown Antechinus					+		+	+
Dasyurus maculatus	**Spotted-tailed Quoll**	V	V						+
Smithopsis murina	Common Dunnart				+			+	+
PERAMELIDAE									
Isoodon macrourus	Northern Brown Bandicoot							+	+
Perameles nasuta	Long-nosed Bandicoot							+	+
PHASCOLARCTIDAE									
Phascolarctos cinereus	**Koala**		V					+	+
PETAURIDAE									
Petaurus breviceps	Sugar Glider					+	+	+	+
Petaurus norfolcensis	**Squirrel Glider**		V		+		+	+	+
PSEUDOCHEIRIDAE									
Petauroides volans	Greater Glider							+	+
Pseudocheirus peregrinus	Common Ringtail Possum						+	+	+
ACROBATIDAE									
Acrobates pygmaeus	Feather-tail Glider							+	+
PHALANGERIDAE									
Trichosurus caninus	Mountain Brushtail Possum								+
Trichosurus vulpecula	Common Brushtail Possum				+			+	+
MACROPODIDAE									
Macropus giganteus	Eastern Grey Kangaroo				+			+	+
Macropus rufogriseus	Red-necked Wallaby							+	+
Wallabia bicolor	Swamp Wallaby							+	+
PTEROPODIDAE									
Pteropus poliocephalus	**Grey-headed Flying-fox**		V		+	+	+	+	+
RHINOLOPHIDAE									
Rhinolophus megaphyllus	Eastern Horseshoe-bat							+	+
EMBALLONURIDAE									
Saccolaimus flaviventris	**Yellow-bellied Sheathtail-bat**		V						+
MOLOSSIDAE									
Mormopterus norfolkensis	**East-coast Free-tail Bat**		V					+	+
Nyctinomus australis	White-striped Freetail-bat				A		A	+	+
VESPERTILIONIDAE									
Miniopterus australis	**Little Bent-wing Bat**		V		A	A, H	A	+	+
Miniopterus schreibersii oceanensis	**Eastern Bent-wing Bat**		V		A	A	A	+	+
Nyctophilus geoffroyi	Lesser Long-eared Bat							+	+
Nyctophilus gouldi	Gould's Long-eared Bat					H			+
Chalinolobus dwyeri	**Large-eared Pied Bat**	V	V		A			+	+
Chalinolobus gouldii	Gould's Wattled Bat				A		A	+	+
Chalinolobus morio	Chocolate Wattled Bat				A		A	+	+
Falsistrellus tasmaniensis	**Eastern Falsistrelle**		V				A?		+
Myotis adversus	**Large-footed Myotis**		V						+
Scoteanax rueppellii	**Greater Broad-nosed Bat**		V				A?	+	+
Scotorepens orion	Eastern Broad-nosed Bat						A?		
Vespadelus darlingtoni	Large Forest Bat							+	+

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Vespadelus pumilus	Eastern Forest Bat								+
Vespadelus regulus	Southern Forest Bat								+
Vespadelus troughtoni	**Eastern Cave Bat**		V						+
Vespadelus vulturnus	Little Forest Bat				A	A	A	+	+
MURIDAE									
Hydromys chrysogaster	Water Rat								+
Melomys cervinipes	Fawn-footed Melomys							+	+
* *Mus musculus*	* House Mouse							+	+
Rattus fuscipes	Bush Rat							+	+
Rattus lutreolus	Swamp Rat							+	+
* *Rattus rattus*	* Black Rat							+	+
CANIDAE									
* *Canis familiaris*	* Dog				+	+	+	+	+
* *Vulpes vulpes*	* Fox					+		+	+
FELIDAE									
* *Felis catus*	* Cat (feral)							+	+
LEPORIDAE									
* *Lepus capensis*	* Brown Hare				+		+	+	+
* *Oryctolagus cuniculus*	* Rabbit				+	+	+	+	+
REPTILES									
CHELIDAE									
Chelodina longicollis	Long-necked Tortoise							+	
AGAMIDAE									
Amphibolurus muricatus	Jacky Lizard							+	+
Physignathus lesueurii	Eastern Water Dragon							+	
Pogona barbata	Bearded Dragon					+		+	
VARANIDAE									
Varanus varius	Lace Monitor							+	+
SCINCIDAE									
Cryptoblepharus virgatus	Fence Skink						+	+	
Ctenotus robustus	Striped Skink								+
Ctenotus taeniolatus	Copper-tailed Skink							+	
Cyclodomorphus casuarinae	Oak Skink								+
Egernia major	Land Mullet							+	
Egernia striolata	Tree Skink							+	+
Eulamprus quoyii	Eastern Water Skink							+	
Lampropholis delicata	Garden Skink					+		+	+
Lampropholis guichenoti	Garden Skink								+
Saproscinus mustelina	Weasel Skink							+	
Saiphos equalis	Three-toed Skink							+	+
Tiliqua scincoides	Eastern Blue-tongued Lizard							+	+
ELAPIDAE									
Cacophis squamulosus	Golden Crowned Snake							+	+
Furina diadema	Red-naped Snake							+	
Hemiaspis signata	Black-bellied Snake							+	+
Pseudechis porphyriacus	Red-bellied Black Snake							+	+
Pseudonaja textilis	Eastern Brown Snake								+

FAMILY Scientific Name	Common Name	EPBC Act 1999	TSC Status	Jamba Camba	Record in Study Area Site1	 Site2	 Site3	Locality Record LMCC 2000	 DECCW 2010
AMPHIBIANS									
MYOBATRACHIDAE									
Adelotus brevis	Tusked Frog								+
Crinia signifera	Common Eastern Froglet				+	+		+	+
Limnodynastes dumerilli	Eastern Banjo Frog				+				
Limnodynastes ornatus	Ornate Burrowing Frog							+	
Limnodynastes peronii	Brown-striped Frog				+	+		+	+
Limnodynastes tasmaniensis	Spotted Grass Frog							+	+
Mixophyes fasciolatus	Great Barred Frog								+
Paracrinia haswelli	Haswell's Frog								+
Pseudophryne bibronii	Brown Toadlet							+	+
Pseudophryne coriacea	Red-backed Toadlet				+			+	+
Uperoleia fusca	Dusky Toadlet								+
Uperoleia laevigata	Smooth Toadlet							+	
Uperoleia rugosa	Wrinkled Toadlet								+
Uperoleia tyleri	Tyler's Toadlet								
HYLIDAE									
Litoria aurea	**Green & Golden Bell Frog**	V	E						+
Litoria caerulea	Green Tree Frog								+
Litoria dentata	Bleating Tree Frog				offsite				+
Litoria fallax	Eastern Dwarf Tree Frog							+	+
Litoria freycineti	Freycinet's Frog								+
Litoria jervisiensis	Jervis Bay Tree Frog								+
Litoria latopalmata	Broad Palmed Frog				+	+		+	+
Litoria lesueuri	Lesueur's Frog								+
Litoria peronii	Peron's Tree Frog				+			+	+
Litoria phyllochroa	Leaf Green Tree Frog								+
Litoria tyleri	Tyler's Tree Frog								+
Litoria verreauxii	Whistling Tree Frog								+

APPENDIX 2. HABITAT TREE DATA


0
0.2
0.4
kilometres

Tree ID	Tree Species	Easting GDA	Northing GDA	% dead	DBH (cm)	Height (m)	Major spout	Minor spout	Trunk hollows	Possum	Bat	Glider	Owl	Bees	Notes
1	Dead Stag	368668.684	6356986.491	100	30	10	0	0	bark fissures	0	+	0	0	0	
2	Angophora costata	368674.05	6356728.463	30	68	18	1	4	2	+	+	+	0	0	nesting Rainbow Lorikeet
3	termite arboretum	368648.454	6356728.484	0	0	0	0	0	0	0	0	0	0	+	feral bees
4	Dead Stag	368553.362	6356747.823	100	48	12	0	0	fissues	0	+	0	0	0	
5	Dead Stag	368548.679	6356750.382	100	60	16	0	0	bark fissures	0	+	0	0	0	
6	termite arboretum	368548.102	6356716.086	0	0	16	0	0	0	0	+	+	0	0	
7	termite arboretum	368541.71	6356672.184	0	0	6	0	0	0	0	+	+	0	0	
8	Dead Stag	368479.572	6356669.496	100	43	10	0	0	bark fissures	0	+	0	0	0	
9	Dead Stag	368459.358	6356717.355	100	91	6	0	0	very large vertical pipe	0	+	0	0	0	
10	Angophora costata	368393.803	6356622.323	10	61	17	0	3	0	0	+	+	0	0	
11	Melaleuca decora	368336.17	6356673.772	20	60	12	0	2	1 medium	+	+	+	0	0	
12	Dead Stag (old ironbark)	368310.22	6356639.917	100	99	20	0	0	1 large fissure	0	+	0	0	0	large bark fissures
13	Dead Stag (old ironbark)	368292.233	6356582.095	100	100	8	0	0	1 very large vertical pipe	+	0	0	+	0	Masked Owl roost tree
14	Eucalytpus crebra	368263.746	6356615.994	70	62	12	0	2	bark fissures	0	+	+	0	0	
15	Melaleuca decora	368199.806	6356626.655	20	90	14	0	0	4 large hollows	+	+	+	0	0	bark fissures present
16	Angophora costata	368138.446	6356573.421	20	84	14	0	0	3	+	+	+	0	0	
17	Dead Stag	368146.806	6356557.936	100	40	14	0	0	2 small	+	+	+	0	0	common ringtail drey present
18	Dead Stag	368136.211	6356517.259	100	45	10	0	0	bark fissures	0	+	0	0	0	
19	Eucalyptus acmenoides	368880.533	6356855.215	30	55	12	0	2	bark fissures	0	+	0	0	0	
20	Eucalyptus acmenoides	368934.211	6356848.66	20	61	12	0	2	bark fissures	0	+	0	0	0	
21	Angophora costata	368957.713	6356835.746	30	89	15	0	2	0	0	+	+	0	0	
22	Angophora costata	368946.746	6356817.485	20	65	15	0	0	2 medium	+	0	0	0	+	bees present in one hollow
23	Angophora costata	369051.096	6356764.534	40	50	15	0	2	2 medium	0	0	0	0	+	bees present in one hollow
24	Angophora costata	369046.899	6356771.784	20	64.5	16	3	0	1	0	0	0	0	+	bees present
25	Eucalyptus acmenoides	369056.281	6356744.201	10	49	12	0	0	1 medium fissure	+	0	+	0	0	

Tree ID	Tree Species	Easting GDA	Northing GDA	% dead	DBH (cm)	Height (m)	Major spout	Minor spout	Trunk hollows	Possum	Bat	Glider	Owl	Bees	Notes
26	Dead Stag	368756.468	6356747.184	100	66	6	0	0	1 medium vertical pipe	+	0	0	+	0	suitable for small owl
27	Angophora costata	368761.841	6356683.344	20	71	16	1	0	0	+	0	0	0	0	
28	Angophora costata	368755.01	6356652.385	20	67	14	0	0	2 medium	+	0	0	0	0	
29	Corymbia maculata	368816.495	6356690.076	20	60	12	1	0	1 large	+	0	0	+	0	suitable for small owl
30	Angophora costata	368864.738	6356789.708	20	62	12	0	3	0	0	+	+	0	0	
31	Angophora costata	368859.826	6356633.313	30	68	14	0	3	0	0	+	0	0	0	
32	Dead Stag	368838.188	6356652.814	100	50	4	0	0	1 small	+	0	0	0	0	
33	Angophora costata	368937.092	6356698.661	30	94	16	0	2	1 medium	+	+	+	0	0	
34	Dead Stag (A. costata)	369127.723	6356715.759	100	75	9	0	0	1 very large vertical pipe	0	+	0	0	0	decayed base
35	Corymbia maculata	369011.149	6356689.932	60	86	20	2	4	0	+	+	+	0	+	bees present
36	Eucalytpus crebra	368903.134	6356613.617	80	90	16	0	4	bark fissures	0	+	+	0	0	
37	Dead Stag (A. costata)	368745.768	6356606.986	100	60	11	2	3	1	+	+	+	0	0	
38	Dead Stag (Ironbark)	368645.162	6356574.35	100	93	8	10	4	1 very large vertical pipe	+	+	+	+	0	
39	Stringybark	368576.929	6356593.099	30	46	10	0	3	0	0	+	+	0	0	
40	Corymbia gummifera	368560.892	6356597.068	20	56	12	0	0	1 medium	+	0	0	0	0	
41	Angophora costata	368579.747	6356522.858	30	87	16	1	1	0	+	+	+	0	0	
42	Corymbia gummifera	368552.088	6356509.477	90	78	10	2	0	0	+	0	0	0	+	bees present
43	Angophora costata	368424.489	6356552.863	50	67	15	0	6	0	0	+	0	0	0	
44	Corymbia maculata	368573.179	6356458.655	20	76	18	0	4	0	0	+	+	0	0	
45	Corymbia maculata	368483.045	6356435.656	30	71	16	1	0	0	+	0	0	0	0	
46	Corymbia maculata	368388.585	6356448.374	80	69	8	0	0	1 very large vertical pipe	+	0	0	+	0	Masked Owl nest tree
47	Dead Stag	368238.48	6356481.68	100	61	10	1	1	1 small	+	+	+	0	0	
48	Dead Stag	368119.334	6356379.506	100	63	10	2	4	0	+	+	+	0	0	
49	Stringybark	368102.817	6356365.463	50	78	10	0	2	0	0	+	+	0	0	
50	Angophora costata	368161.184	6356348.119	50	80	18	0	0	1 small	+	0	0	0	0	
51	Angophora costata	368165.162	6356304.514	40	103	18	0	4	0	+	+	+	0	0	

Tree ID	Tree Species	Easting GDA	Northing GDA	% dead	DBH (cm)	Height (m)	Major spout	Minor spout	Trunk hollows	Possum	Bat	Glider	Owl	Bees	Notes
52	Corymbia maculata	368571.192	6356350.259	20	53	10	1	0	0	0	0	0	0	+	bees present
53	Dead Stag	369276.202	6356575.137	100	64	5	0	0	2 medium	+	0	0	0	0	
54	Dead Stag	369381.502	6356557.805	100	71	7	0	2	1 medium vertical pipe	+	+	+	0	0	
55	Dead Stag	369356.457	6356530.452	100	59	10	0	2	fissures + small hollow	0	+	0	0	0	
56	Dead Stag	369390.967	6356491.872	100	63	10	0	3	fissures	0	+	+	0	+	bees present
57	Eucalyptus acmenoides	369410.663	6356422.365	20	94	20	3	0	0	+	+	+	0	0	
58	Dead Stag	369338.623	6356343.622	100	62	12	0	6	1 small	0	+	+	0	0	
59	Angophora costata	369289.283	6356342.457	10	49	12	0	0	1 large	+	0	0	0	0	
60	Dead Stag	369134.377	6356518.741	100	40	10	0	2 small	0	0	+	0	0	0	
61	Dead Stag	369062.204	6356457.133	100	69	7	0	0	1 vertical hollow	+	0	0	0	0	possibly solid hollow
62	Dead Stag	369189.093	6356252.519	100	50	8	0	3	0	0	+	0	0	0	
63	Eucalyptus punctata	369001.791	6356361.3	30	85	18	2	2	0	+	+	+	0	+	bees in one hollow
64	Corymbia maculata	368995.689	6356324.393	20	61	18	0	1	0	0	+	+	0	0	
65	Corymbia maculata	369025.154	6356323.39	20	87	20	1	4	1 large	+	+	+	0	0	
66	Corymbia maculata	369032.303	6356303.352	80	76	18	1	2	1 large	+	+	+	0	0	
67	Corymbia maculata	369008.864	6356253.183	30	95	20	8	0	0	+	+	+	0	0	
68	Corymbia maculata	368900.985	6356359.067	50	55	20	2	0	1 large	+	0	0	0	0	
69	Eucalyptus acmenoides	368896.747	6356363.565	30	87	20	0	6	0	0	+	+	0	0	
70	Corymbia maculata	369255.189	6356204.896	30	103	20	3	2	1 very large vertical pipe	+	+	+	+	+	
71	Dead Stag	369306.524	6356250.61	100	44	8	0	3	1 small	+	+	+	0	0	
72	Corymbia maculata	369237.142	6356284.211	20	57	18	0	2	0	0	+	+	0	0	
73	Corymbia maculata	369210.263	6356211.429	20	69	16	0	6	0	0	+	+	0	0	
74	Eucalyptus punctata	368977.288	6355955.486	10	74	18	0	4	0	0	+	+	0	0	
75	Corymbia maculata	368846.866	6356014.353	20	44	10	0	4	0	+	+	+	0	0	
76	Angophora costata	368893.44	6356034.139	60	76	15	3	2	0	+	+	+	0	0	
77	Eucalyptus crebra	368919.325	6356035.218	80	78	18	0	6	0	0	+	+	0	0	

Tree ID	Tree Species	Easting GDA	Northing GDA	% dead	DBH (cm)	Height (m)	Major spout	Minor spout	Trunk hollows	Possum	Bat	Glider	Owl	Bees	Notes
78	Corymbia maculata	368925.708	6356050.974	40	80	18	0	6	0	0	+	+	0	0	
79	Corymbia maculata	368967.74	6356072.232	30	74	20	3	3	0	+	+	+	0	+	bees in one major spout
80	Corymbia maculata	368971.599	6356073.873	20	61	20	0	3	0	0	+	+	0	0	
81	Eucalyptus punctata	368932.992	6356122.167	60	60	14	0	3	0	0	+	+	0	0	
82	Eucalyptus punctata	368940.73	6356131.518	90	55	10	0	0	fissures	0	+	+	0	0	
83	Corymbia maculata	368886.262	6356097.035	60	56	15	1	1	0	+	+	+	0	0	
84	Eucalyptus crebra	368877.671	6356112.87	60	80	18	2	4	0	+	+	+	0	0	
85	Corymbia maculata	368900.372	6356182.429	90	83	20	2	4	1 large	+	+	+	0	0	
86	Dead Stag	368924.208	6356192.654	100	76	6	0	0	1 v.large v.pipe	0	+	0	0	0	decayed base,
87	Corymbia maculata	368916.722	6356180.248	40	52	14	1	2	0	+	+	+	0	0	
88	Eucalyptus punctata	369014.089	6356171.495	50	76	16	1	1	1 medium	+	+	+	0	0	
89	Corymbia maculata	368895.356	6356303.139	40	56	15	1	1	0	+	+	+	0	+	bees in one major spout
90	Corymbia gummifera	368810.643	6356364.696	30	81	15	3	6	0	+	+	+	0	0	
91	Dead Stag	368774.618	6356347.914	100	80	12	6	3	0	+	+	+	0	0	
92	Corymbia maculata	368842.466	6356168.822	20	52	14	0	0	1 small	+	0	0	0	0	
93	Corymbia maculata	368804.299	6356136.349	80	51.5	8	0	0	1 small v.pipe	+	0	0	0	0	
94	Angophora costata	368743.186	6356178.719	30	98	14	0	0	1 very large vertical pipe	+	0	0	+	0	Suitable Masked Owl tree
95	Corymbia maculata	368669.998	6356238.997	30	62	16	0	3	0	0	+	+	0	0	
96	Eucalyptus crebra	368668.69	6356237.687	20	62	16	0	2	1 small	0	+	+	0	0	
97	Corymbia maculata	368664.006	6356232.745	30	54	16	0	0	1 small	+	0	0	0	0	
98	Corymbia maculata	368659.138	6356227.429	50	70	16	0	0	1 small	+	0	0	0	0	
99	Corymbia maculata	368656.824	6356229.285	30	53	16	0	2	0	0	+	+	0	0	
100	Eucalyptus crebra	368651.372	6356211.357	70	68	16	0	0	1 medium vertical pipe	+	0	0	0	0	
101	Corymbia maculata	368661.762	6356192.31	20	72	14	0	0	1 medium vertical pipe	+	0	0	0	0	
102	Corymbia maculata	368652.071	6356166.527	10	90	20	0	0	1 small	+	0	0	0	0	
103	Dead Stag	368576.172	6356068.561	100	66	12	1	1	0	+	+	+	0	0	

Tree ID	Tree Species	Easting GDA	Northing GDA	% dead	DBH (cm)	Height (m)	Major spout	Minor spout	Trunk hollows	Possum	Bat	Glider	Owl	Bees	Notes
104	Corymbia maculata	368507.515	6356171.552	70	57	12	4	2	0	+	+	+	0	0	
105	Corymbia maculata	368562.099	6356216.803	50	69	16	4	2	0	+	+	+	0	0	
106	Corymbia maculata	368553.225	6356196.775	20	70	16	0	0	1 medium vertical pipe	+	0	0	+	0	Suitable Masked Owl tree
107	Corymbia maculata	368521.104	6356214.759	30	59	16	0	4	1 large	+	+	+	0	+	bees in one minor spout
108	Corymbia maculata	368521.606	6356255.31	60	78	16	3	5	0	+	+	+	0	0	
109	Corymbia maculata	368494.465	6356219.051	20	66	18	0	0	1 large vertical pipe	+	0	0	0	0	
110	Corymbia maculata	368405.636	6356235.228	20	56	16	2	1	1 large vertical pipe	+	+	+	+	0	Suitable Masked Owl
111	Corymbia maculata	368419.982	6356216.403	50	71	16	4	0	0	+	+	+	0	0	
112	Corymbia maculata	368410.995	6356199.031	50	71	16	3	0	1 large vertical pipe	+	+	+	+	0	Suitable Masked Owl
113	Corymbia maculata	368380.365	6356193.343	80	84	6	0	0	1 large vertical pipe	+	0	0	0	0	decayed, disused
114	Corymbia maculata	368372.403	6356172.072	20	70	18	0	6	0	0	+	+	0	0	
115	Corymbia maculata	368455.756	6356128.003	70	59	10	0	1	1 medium vertical pipe	+	+	+	0	0	
116	Corymbia maculata	368470.38	6356117.1	50	73	14	0	1	1 small	+	+	+	0	0	
117	Corymbia maculata	368496.598	6356124.978	50	48	16	0	2	0	0	+	+	0	0	
118	Corymbia maculata	368504.928	6356109.92	10	61	14	0	3	0	0	+	+	0	0	
119	Corymbia maculata	368506.801	6356103.513	10	65	16	0	1	1 small	0	+	+	0	0	
120	Eucalyptus crebra	368467.052	6356056.341	50	77	14	0	2	0	0	+	+	0	0	
121	Corymbia maculata	368405.874	6356094.135	10	61	16	0	2	0	0	+	+	0	0	
122	Corymbia maculata	368374.722	6356093.515	10	70	16	0	0	1 small	+	0	0	0	0	
123	Corymbia maculata	368335.692	6356074.152	10	62	16	0	2	0	+	0	+	0	0	nesting Rainbow Lorikeet
124	Corymbia maculata	368315.734	6356079.992	10	83	16	0	0	1 very large vertical pipe	+	0	0	+	0	Suitable Masked Owl
125	Corymbia maculata	368198.974	6356116.215	50	89	18	2	2	0	+	+	+	0	0	
126	Corymbia maculata	368305.558	6356193.858	20	80	12	0	0	1 very large vertical pipe	+	0	0	+	0	
127	Corymbia maculata	368705.602	6356214.886	30	78	14	0	6	1 medium	+	+	+	0	0	
128	Corymbia maculata	368874.388	6356231.132	30	82	20	4	0	0	+	+	+	0	0	

APPENDIX 3. THREATENED FAUNA ASSESSMENT

The scope of this study was to conduct fauna investigations of the land off George Booth Drive Edgeworth and identify and assess potential ecological constraints associated with the proposed rezoning. The fauna investigation sought to identify the presence of protected and threatened species. Threatened species are those listed on Schedules One and Two of the national *Environment Protection and Biodiversity Conservation Act 1999*, and also Schedules One and Two of the NSW *Threatened Species Conservation Act 1995*.

This fauna review is also required to assess the potential or actual effect of proposed development on those threatened species or their habitat. The assessment of potential or actual effect of the proposal under the *EPBC Act 1999* requires consideration of several Matters of National Significance. In addition, the proposal also requires consideration of impact under s.5A of the NSW *Environmental Planning and Assessment Act 1979* (as amended by the *Threatened Species Conservation Act 1995*).

Following from the review of studies in the locality, coupled with habitat assessments and fauna surveys for threatened species within the subject site, a number of threatened species were identified and also considered likely to occur. These threatened species were identified for consideration with regard to future development of the subject site.

A3.1 Environment Protection and Biodiversity Conservation Act 1999

This Act requires the Commonwealth Environment Minister's approval for an Action that will have or is likely to have a detrimental / adverse impact(s) on a Matter of National Environmental Significance, or on Commonwealth land unless the action is exempt. Matters of National Environmental Significance currently include World Heritage properties, Ramsar Wetlands of international importance, Listed threatened species and communities, Listed migratory species, Nuclear Actions, Commonwealth marine environment, and other matters prescribed by the Regulations.

Significant Impact Guidelines (DEHWA, 2009) have been prepared in order to decide whether an action is likely to have a significant impact, it is necessary to take into account the nature and magnitude of potential impacts. In determining the nature and magnitude of an action's impact, it is important to consider matters including:

- lead to a long-term decrease in the size of an important population of a species,
- reduce the area of occupancy of an important population,
- fragment an existing important population into two or more populations,
- adversely affect habitat critical to the survival of a species,
- disrupt the breeding cycle of an important population,
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat,
- introduce disease that may cause the species to decline, or
- interfere substantially with the recovery of the species.

Additionally, consideration of all on-site and off-site impacts, all direct and indirect impacts, the frequency and duration of the action, the total impact which can be attributed to that action over the entire geographic area

affected, and over time, the sensitivity of the receiving environment, and the degree of confidence with which the impacts of the action are known and understood.

The Act provides that the Minister must, in deciding whether an action is likely to have a significant impact on a matter of national environmental significance, take account of the precautionary principle. Accordingly, the fact that there is a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on a matter of national environmental significance.

Matters of National Environmental Significance relevant to the subject site off George Booth Drive include **Listed threatened species** and **Listed migratory species**. No World Heritage properties, Ramsar Wetlands, Commonwealth Marine Areas, Nuclear Actions or other matters apply to the subject site.

A3.1.1 Listed Threatened Species

Two listed vulnerable species on Schedule Two of the EPBC Act 1999 were recorded in the subject site by this investigation, the Grey-headed Flying-fox and Large-eared Pied Bat. Additional listed species with potential occurrence on the subject site include Regent Honeyeater and Swift Parrot. The assessment guidelines on impact significance were applied to the species indicated above and is presented below.

Under the significant impact guidelines, the definition of an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

A3.1.1.1 Grey-headed Flying-fox *Pteropus poliocephalus*

Criteria One. *An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will lead to a long-term decrease in the size of an important population of a species.*

Small numbers of the species were observed flying over and foraging within the subject site during investigations in July 2008. The population of Grey-headed Flying-fox that utilise habitat within the subject site cannot be considered as an important population in itself. However, it can be considered to be part of a larger "important population" that comprises genetically similar individuals. The nomadic nature of this species suggests that the population visiting the subject site utilise a much greater area to gain sufficient foraging resources throughout the year. Removal of habitat in areas zoned for development is considered unlikely to result in long-term decrease in population size of an important population.

Criteria Two. *An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will reduce the area of occupancy of an important population.*

No populations of the species occupy the study area on a permanent basis. Future development of the subject site is unlikely to reduce the area of occupancy for the local population of the species.

***Criteria Three**. An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will fragment an existing important population into two or more populations.*

Future development of the subject site will not fragment an important population of the species into two or more sub-populations.

***Criteria Four**. An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will adversely affect habitat critical to the survival of a species.*

The subject site does not support a breeding and roosting camp of the species, and supports only a small component of the overall foraging habitat requirements of the local population of the Grey-headed Flying-fox. The draft national recovery plan for the Grey-headed Flying-fox indicates foraging habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential habitat, for Grey-headed Flying-foxes. Natural foraging habitat that is:

1. productive during winter and spring, when food bottlenecks have been identified;
2. known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult)
3. productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)
4. productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions)
5. known to support a continuously occupied camp.

Points 1 and 3 above from the draft national Recovery Plan would qualify the subject sites as either “critical” or “essential” foraging habitat for the Grey-headed Flying-fox. Within the context of the normal foraging range of an individual Grey-headed Flying-fox (average 20km per night, DECCW, 2009), the reduction in foraging habitat by development of 46 hectares is unlikely to constitute a significant impact.

***Criteria Five**. An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will disrupt the breeding cycle of an important population.*

The Grey-headed Flying-fox breeds in large maternity camps. No breeding camps occur within the subject site, with the nearest known breeding camp located at Blackbutt Reserve approximately 9.0 kilometres due east of the subject site.

***Criteria Six**. An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.*

The likely extent of habitat removal associated with future development of the subject site is approximately 46 hectares. This loss of foraging habitat is unlikely to contribute towards a decline in the local population of the species.

***Criteria Seven**. An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat.*

Much of the subject site is relatively free of invasive species and none that would potentially impact upon the species.

***Criteria Eight**. An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will introduce disease that may cause the species to decline.*

Future development of the subject site is unlikely to introduce disease that may significantly impact on an important population of the Grey-headed Flying-fox.

***Action Nine.** An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to interfere substantially with the recovery of the species.*

Future development of a component of the subject site is unlikely to substantially interfere with the recovery of the species.

Summary

The rezoning of land associated with the subject site off George Booth Drive is unlikely to impact (either directly or indirectly) on an important population of the Grey-headed Flying-fox. No camps of the species were located within, or in immediate vicinity of the subject site. The species forages within the subject site during flowering of *Eucalyptus* and *Angophora* tree species for a period of the year, but requires extensive areas of adjoining habitat to support their requirements on an annual basis.

A3.1.1.2 Large-eared Pied-bat *Chalinolobus dwyeri*

***Criteria 1**. An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to lead to a long-term decrease in the size of an important population of a species.*

Calls resembling the Large-eared Pied-bat were recorded at Site 1 during surveys in 2008. Individuals or a small population of the Large-eared Pied-bat would utilise habitat within the subject site for foraging purposes and roost offsite in caves or similar structures (i.e. disused underground mine shafts). The subject site population cannot itself be considered an important population, but can be considered to be part of a larger “important population” that comprises genetically similar individuals. The local population visiting the subject site would likely utilise a much greater area to gain sufficient foraging resources throughout the year. Removal of approximately 46 hectares of foraging habitat for development is considered unlikely to result in long-term decrease in population size of an important population.

***Criteria 2**. An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to reduce the area of occupancy of an important population.*

The rezoning of land and subsequent development of that land under the recommended constraints map would likely result in the clearing of 46 hectares of habitat for the Large-eared Pied-bat. The individuals or population that forage on the subject site would utilise other significant areas of habitat to fulfil their dietary requirements. The potential loss of 46 hectares of foraging habitat is unlikely to reduce the area of occupancy of an important population such that a significant impact will occur.

***Criteria 3**. An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to fragment an existing important population into two or more populations.*

Future development of the subject site will not fragment an important population of the species into two or more sub-populations. The Large-eared Pied-bat has a relatively large geographic distribution in the Lower to Upper Hunter Valley and loss of ~46 hectares will not fragment or isolate the population into two or more sub-populations.

Criteria 4. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to adversely affect habitat critical to the survival of a species.*

The subject site does not support breeding and roosting sites for the Large-eared Pied-bat, and supports only a small component of the overall foraging habitat requirements of the local population. The area of potential development within the subject site does not constitute habitat critical to the survival of the species. Extensive areas of similar vegetation communities and habitat types are represented in adjoining bushland within the locality and extend from the Lower to Upper Hunter Valley region.

Criteria 5. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to disrupt the breeding cycle of an important population.*

The Large-eared Pied-bat breeds in caves or similar structures. No breeding habitat occurs within the subject site. The proposed action will not have a significant impact on the breeding cycle of the species.

Criteria 6. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.*

The likely extent of habitat removal associated with future development of the subject site is approximately 46 hectares. This loss of foraging habitat is unlikely to contribute towards a decline in the local population of the species.

Criteria 7. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat.*

Much of the subject site is relatively free of invasive species and none that would potentially impact upon the Large-eared Pied-bat.

Criteria Eight. *An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will introduce disease that may cause the species to decline.*

Future development of the subject site is unlikely to introduce disease that may significantly impact on an important population of the Large-eared Pied-bat.

Action Nine. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to interfere substantially with the recovery of the species.*

Future development of a component of the subject site is unlikely to substantially interfere with the recovery of the species.

A3.1.1.3 Regent Honeyeater *Xanthomyza phrygria*

The Regent Honeyeater is listed as “Critically Endangered” under the EPBC Act 1999.

Criteria 1. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to lead to a long-term decrease in the size of an important population of a species.*

The Regent Honeyeater was not recorded during surveys on the site, and there are no historic records of the species occurring on the subject site held on the DECCW and LMCC Fauna databases. However, the Regent Honeyeater may utilise the subject site as foraging habitat as a component of its very extensive foraging range. The Regent Honeyeater population that may frequent the subject site would also utilise a much greater area in the locality to gain sufficient foraging resources during those periods of the year when the species is present in the coastal City of Lake Macquarie. Removal of approximately 46 hectares of foraging habitat for development is considered unlikely to result in long-term decrease in population size of an important population.

Criteria 2. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to reduce the area of occupancy of an important population.*

The rezoning of land and subsequent development of that land under the recommended constraints map would likely result in the clearing of 46 hectares of habitat, which may be used very infrequently by the Regent Honeyeater. The individuals or population that may forage on the subject site would utilise other significant areas of habitat to fulfil their dietary requirements. The potential loss of 46 hectares of foraging habitat is unlikely to significantly reduce the area of occupancy of an important population of the Regent Honeyeater.

Criteria 3. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to fragment an existing important population into two or more populations.*

Future development of the subject site will not fragment an important population of the species into two or more sub-populations. The Regent Honeyeater has a very large geographic distribution, more commonly located in Upper Hunter Valley and Western Slopes and Plains. The loss of ~46 hectares of marginal habitat for the species will not fragment or isolate the population into two or more sub-populations.

Criteria 4. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to adversely affect habitat critical to the survival of a species.*

The subject site does not support breeding habitat for the Regent Honeyeater, and supports only a small component of the overall foraging habitat requirements of the local population. The area of potential development within the subject site does not constitute habitat critical to the survival of the species. Extensive areas of habitat are represented in adjoining bushland within the locality, and extending from the Lower to Upper Hunter Valley region.

Criteria 5. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to disrupt the breeding cycle of an important population.*

The Regent Honeyeater tends to breed along riparian vegetated streams in the Upper Hunter Valley and Western Slopes and Plains region. No breeding habitat occurs within the subject site. The proposed action will not have a significant impact on the breeding cycle of the species.

Criteria 6. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.*

The likely extent of habitat removal associated with future development of the subject site is approximately 46 hectares. This loss of foraging habitat is unlikely to contribute towards a decline in the local population of the species.

Criteria 7. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat.*

Much of the subject site is relatively free of invasive species and none that would potentially impact upon the Regent Honeyeater.

Criteria Eight. *An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will introduce disease that may cause the species to decline.*

Future development of the subject site is unlikely to introduce disease that may significantly impact on an important population of the Regent Honeyeater.

Action Nine. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to interfere substantially with the recovery of the species.*

Future development of a component of the subject site is unlikely to substantially interfere with the recovery of the species.

A3.1.1.4 Swift Parrot *Lathamus discolor*

The Swift Parrot is listed as “Endangered” under the EPBC Act 1999.

Criteria 1. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to lead to a long-term decrease in the size of an important population of a species.*

The Swift Parrot was not recorded during surveys on the site, and there are no historic records of the species occurring on the subject site held on the DECCW and LMCC Fauna databases. However, the Swift Parrot may utilise the subject site for foraging habitat as a component of its very extensive foraging range. The Swift Parrot population that may frequent the subject site would also utilise a much greater area in the locality to gain sufficient foraging resources during those periods of the year when the species is present in the coastal City of Lake Macquarie. Removal of approximately 46 hectares of foraging habitat for development is considered unlikely to result in long-term decrease in population size of an important population.

***Criteria 2**. An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to reduce the area of occupancy of an important population.*

The rezoning of land and subsequent development of that land under the recommended constraints map would likely result in the clearing of 46 hectares of habitat, which may be used very infrequently by the Swift Parrot. The individuals or population that may forage on the subject site would utilise other significant areas of habitat to fulfil their dietary requirements. The potential loss of 46 hectares of foraging habitat is unlikely to significantly reduce the area of occupancy of an important population of the Swift Parrot.

***Criteria 3**. An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to fragment an existing important population into two or more populations.*

Future development of the subject site will not fragment an important population of the species into two or more sub-populations. The Swift Parrot has a very large geographic distribution, breeding in Tasmania and irrupting to the mainland in winter for foraging. The loss of ~46 hectares of marginal habitat for the species will not fragment or isolate the population into two or more sub-populations.

***Criteria 4**. An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to adversely affect habitat critical to the survival of a species.*

The subject site does not support breeding habitat for the Swift Parrot, and supports only a small component of the overall foraging habitat requirements of the local population. The area of potential development within the subject site does not constitute habitat critical to the survival of the species. Extensive areas of habitat are represented in adjoining bushland within the locality and region.

***Criteria 5**. An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to disrupt the breeding cycle of an important population.*

The Swift Parrot breeds in Tasmania. No breeding habitat occurs within the subject site. The proposed action will not have a significant impact on the breeding cycle of the species.

***Criteria 6**. An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.*

The likely extent of habitat removal associated with future development of the subject site is approximately 46 hectares. This loss of foraging habitat is unlikely to contribute towards a decline in the local population of the species.

***Criteria 7**. An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat.*

Much of the subject site is relatively free of invasive species and none that would potentially impact upon the Swift Parrot.

***Criteria Eight**. An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will introduce disease that may cause the species to decline.*

Future development of the subject site is unlikely to introduce disease that may significantly impact on an important population of the Swift Parrot.

Action Nine. *An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to interfere substantially with the recovery of the species.*

Future development of a component of the subject site is unlikely to substantially interfere with the recovery of the species.

A3.1.2 Listed Migratory Species

The List of Migratory Species on the *Environment Protection and Biodiversity Conservation Act 1999* that occur, or that could potentially occur within the subject site is presented below in **Table A3.1.**

Table A3.1 Listed Migratory Species recorded in Locality (10km radius).

FAMILY / *Scientific Name*	**Common Name**	**Suitable Habitat on Subject Site**
ACCIPITRIDAE		
Pandion haliaetus	Eastern Osprey	Yes, potential nest sites in proximity to Cockle Creek
Aviceda subcristata	Pacific Baza	Yes
Elanus axillaris	Black-shouldered Kite	Yes
Haliastur sphenurus	Whistling Kite	Yes
Haliaeetus leucogaster	White-bellied Sea-eagle	Yes
Circus approximans	Swamp Harrier	No
Accipiter fasciatus	Brown Goshawk	Yes
Accipiter novaehollandiae	Grey Goshawk	Yes
Accipiter cirrhocephalus	Collared Sparrowhawk	Yes
ANATIDAE		
Chenonetta jubata	Australian Wood Duck	Yes
Anas superciliosa	Pacific Black Duck	No
Anas gracilis	Grey Teal	No
Anas castanea	Chestnut Teal	No
Aythya australis	Hardhead	No
CHARADRIIDAE		
Elseyornis melanops	Black-fronted Dotterel	No
Vanellus miles	Masked Lapwing	Yes
FALCONIDAE		
Falco berigora	Brown Falcon	Yes
Falco longipennis	Australian Hobby	Yes
Falco peregrinus	Peregrine Falcon	Yes
Falco cenchroides	Nankeen Kestrel	Yes
CAMPEPHAGIDAE		
Coracina tenuirostris melvillensis	Cicadabird	Yes
CUCULIDAE		

FAMILY / *Scientific Name*	Common Name	Suitable Habitat on Subject Site
Cuculus saturatus	Oriental Cuckoo	Yes
APODIDAE		
Hirundapus caudacutus	White-throated Needletail	Yes
MEROPIDAE		
Merops ornatus	Rainbow Bee-eater	Yes
RALLIDAE		
Rallus pectoralis clelandi	Lewin's Rail	No
MALURIDAE		
Stipiturus malachurus intermedius	Southern Emu-wren	Yes
MELIPHAGIDAE		
Xanthomyza phrygia	Regent Honeyeater	Yes

The assessment guidelines on significance for migratory species was applied to each of the species listed above in **Table A3.1** and is presented below. An area of 'important habitat' for a migratory species is:

a. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
b. habitat that is of critical importance to the species at particular life-cycle stages, and/or
c. habitat utilised by a migratory species which is at the limit of the species range, and/or
d. habitat within an area where the species is declining.

***Criteria One**. An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species.*

The recommended development footprint on the subject site would clear approximately 46 hectares of habitat for the listed migratory species. The degree to how important this habitat is for each of the listed migratory species will depend on the individual species. For example, the loss of ~46 hectares is unlikely to have a significant impact on more widely ranging migratory species (members of the Accipitridae, Anatidae, Falconidae, Campephagidae, Cuculidae, Meropidae and Meliphagidae families). Members of these families are widespread in NSW and the subject site does not support an ecologically significant proportion of the populations of each of the species. Nor is the subject site of critical importance at a particular life-cycle stage to members of the above mentioned bird families. None of these species are at the limit of their geographic range in the subject site. Where declines of these species are occurring, this is an issue at the landscape scale (Lower Hunter Region and or NSW) rather than at a local scale of the subject site.

Listed migratory species which could occur on the subject site and impacted by the proposed action are the smaller resident species such as the Southern Emu-wren. The Southern Emu-wren was not recorded on the subject site during the fauna surveys, but could potentially occur due to presence of suitable habitat. The subject site is not considered to comprise an area of "important habitat" for the Southern Emu-wren, such that the subject site supports and ecologically significant proportion of the population of this species. The proposed action would not substantially modify, destroy or isolate an area of important habitat for the Southern Emu-wren.

Criteria Two. *An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species.*

Much of the study area is relatively free of invasive species such as weeds. The proposed action to develop a portion of the subject site will unlikely result in establishment of invasive species that may be harmful to the listed migratory species.

Criteria Three. *An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.*

Disturbance and or clearing of vegetation communities and fauna habitats within the subject site would not result in a significant impact upon the lifecycles of those migratory species listed above in **Table A3.1**. Very few of the species listed would actually breed on the subject site and extensive areas of similar habitat occur in the locality. The loss of habitat likely to be associated with future development of the subject site is not considered to significantly impact upon the feeding and migration / resting behaviour of those species.

A3.2 Environmental Planning & Assessment Act 1979

Any activity likely to have a significant effect on threatened species, populations and ecological communities, or their habitat, will require assessment under section 5A ("the seven part test") of the *Environmental Planning and Assessment Act 1979* (as amended by the *Threatened Species Conservation Act 1995*). As indicated below in **Table A3.2**, six threatened species were recorded on the subject site and a further two species were tentatively identified (based on echolocation call recordings of microchiropteran bats). An additional four species recorded in the locality have a high likelihood of occurrence, and four threatened species have a moderate chance of occurrence on the subject site based on presence of suitable habitat.

Table A3.2. Threatened Species Identified for Impact Assessment.

Common Name	**Scientific Name**	**Habitat Present**	**Occurrence**
Masked Owl	*Tyto novaehollandiae*	Yes	Recorded on Site
Squirrel Glider	*Petaurus norfolcensis*	Yes	Recorded on Site
Grey-headed Flying-fox	*Pteropus poliocephalus*	Yes	Recorded on Site
Little Bent-wing Bat	*Miniopterus australis*	Yes	Recorded on Site
Eastern Bent-wing Bat	*Miniopterus schriebersii oceanensis*	Yes	Recorded on Site
Large-eared Pied Bat	*Chalinolobus dwyeri*	Yes	Recorded on Site
Eastern Falsistrelle	*Falsistrellus tasmaniensis*	Yes	Potentially recorded on Site
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Yes	Potentially recorded on Site
LOCALITY RECORDS			
Common Name	**Scientific Name**	**Habitat Present**	**Potential Occurrence**
Little Lorikeet	*Glossopsitta pusilla*	Yes	High
Powerful Owl	*Ninox strenua*	Yes	High
Varied Sitella	*Daphoenositta chrysoptera*	Yes	High
East-coast Free-tail Bat	*Micronomus norfolkensis*	Yes	High
Swift Parrot	*Lathamus discolor*	Yes	Moderate
Regent Honeyeater	*Anthochaera phrygia*	No	Moderate
Little Eagle	*Hieraaetus morphnoides*	Yes	Moderate
Large-footed Myotis	*Myotis adversus*	Yes	Moderate

Following is an assessment of the potential impact of the proposed rezoning (and subsequent development) of the subject site on the threatened species listed above in **Table A3.2**.

A3.2.1 Masked Owl *Tyto novaehollandiae*

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

Actions likely to adversely effect the life cycle of the Masked Owl are:

(1) loss of foraging habitat (remnant forest) and,
(2) disturbance to roost and breeding sites

The clearing of up to ~46 hectares of foraging habitat is unlikely to significantly effect the abundance of this resource within the home range of the local population. Captures of smaller terrestrial mammals (Brown Antechinus, Common Dunnart) indicate the subject site supports good habitat quality for smaller mammals. The proposed clearing of 46 hectares of remnant forest is not considered to significantly effect the life cycle of a local population of the Masked Owl such that a viable local population is likely to be placed at risk of extinction. The application of a 150 metre radius buffer around the known nest and roost tree will maintain a protection buffer for these significant trees. However, the potential for indirect impacts such as noise and lighting (following development of the subject site) are unknown.

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

The threatened Masked Owl in the City of Lake Macquarie is not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:

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

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

The Masked Owl local population is not an endangered ecological community. No further assessment of part (c) is warranted.

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

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

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

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

(i). The extent of habitat to be removed or modified by the proposed action is 46 hectares.

(ii) The existing habitat in the study area is continuous with other areas of forest within the locality. Clearing of 46 hectares of forest within the subject site (based on the current land use constraints map) will not result in fragmentation of habitat or isolation from adjoining areas.

(iii) Components of the habitat presently existing on the subject site would comprise “important habitat” for the threatened Masked Owl local population. The area identified for potential loss of 46 hectares is foraging habitat for the species. The loss of this foraging habitat is unlikely to effect the long term survival of the local Masked Owl population.

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

At present, no habitat critical to the survival of the Masked Owl is declared under the TSC Act 1995 (or its amendments).

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Conservation protocols for Masked Owl roost sites and nest trees on private land are specified in the Recovery plan for Large Forest Owls in NSW (DEC, 2006). Management of owls and their habitat on privately-owned lands in NSW ranges from non-existent to application of the principles and practices which apply on public forest lands. Few attempts have been made to date to coordinate owl conservation efforts over multiple holdings of private land. Examples of conservation protocols applied on development sites include the protection of nest and roost sites, patches of habitat and prey bases (DEC, 2006). For the subject site, a development exclusion zone of 150m radius has been applied around the nest and roost trees to conserve the species important habitat.

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

Key threatening processes relevant to the proposal include;

(1) Clearing of Native Vegetation.

The proposed clearing of 46 hectares of remnant forest would result in loss of foraging habitat for the species. The proposed Action would constitute a key threatening process to the species.

A3.2.2 Squirrel Glider *Petaurus norfolcensis*

The Squirrel Glider has been recorded within the study area during this investigation, and recorded at a number of locations in the locality during previous fauna surveys. One Squirrel Glider was captured and several were observed by spotlight searches within the subject site during this investigation.

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

Factors likely to disrupt the life cycle of the Squirrel Glider is clearing of foraging resources, fragmentation of habitat, isolation of populations and removal of den trees as roost and breeding sites.

Foraging

Within the Wyong Shire, Smith (2002) rated the foraging habitat of the Squirrel Glider based on the vegetation assemblages. Within the study area, the vegetation is mapped as Narrabeen Doyalson Coastal Woodland, identified as supporting lower densities of gliders per hectare (Smith, 2000). The Narrabeen Dooralong Spotted Gum Ironbark Forest (MU30) and Alluvial Floodplain Shrub Swamp Forest (20a) are rated as optimal in relation to glider density at the landscape level.

Breeding

The Squirrel Glider is dependent upon mature trees with hollows to provide shelter and breeding sites. Within the study area, the average density of habitat trees suitable for the Squirrel Glider within the entire study area is considered low, with only 1.3 habitat trees per hectare.

Fragmentation

The vegetation within the subject site is presently continuous with more extensive areas of remnant vegetation to the east and west. No potential isolating gaps in tree canopy cover exist between the subject site and adjoining bushland, although George Booth Drive supports high traffic volumes and may present a barrier to north – south movements. The cleared gap of George Booth Drive is approximately 42 metres, which exceeds the gap of 35 metres identified by Smith (2002). The proposed action will result in the clearing of foraging habitat and loss of potential den sites for the species. However, this action is unlikely to adversely effect the life cycle of a viable local population of the Squirrel Glider.

(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;

The Squirrel Glider local population in Edgeworth is not listed as an endangered population in NSW under the *TSC Amendment Act 2002*.

(c) in the case of an endangered ecological community, whether the action proposed:

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

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

The Squirrel Glider local population is not an endangered ecological community. No further assessment of part (c) is warranted.

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

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

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

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

(i). The extent of habitat to be removed or modified by the proposed action is 46 hectares.

(ii) The existing habitat in the study area is continuous with other areas of forest within the locality. Clearing of 46 hectares of forest within the subject site (based on the current land use constraints map) will not result in fragmentation of habitat or isolation from adjoining areas.

(iii) Components of the habitat presently existing on the subject site would comprise “important habitat” for the threatened Squirrel Glider local population. The area identified for potential loss of 46 hectares is foraging and roosting habitat for the species. Due to the extent of habitat to be conserved on the subject site, combined with good connectivity to adjoining forested remnants, the loss of habitat is unlikely to effect the long term survival of the local Squirrel Glider population.

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

No critical habitat for the Squirrel Glider is currently listed on the TSC Act 1999.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

No recovery plan has been prepared for the Squirrel Glider. However, the Department of Environment, Climate Change and Water has prepared Priority Action Statements (PAS) to promote the recovery of the Squirrel Glider, and the abatement of key threatening processes in New South Wales. The Priorities Action Statement identifies a number of broad strategies to help the Squirrel Glider recover in New South Wales. Two priority actions applicable to the proposed Action are presented below:

(1) Ensure the largest hollow bearing trees (including dead trees) are given highest priority for retention in PVP assessments and other environmental planning instruments, or other land assessment tools.
(2) Delineate boundaries of population to identify the extent to which populations are interconnected (to determine propensity to move across cleared land).

A total of 29 potential habitat trees were identified within the proposed development area. These habitat trees would most likely be removed once development proceeds.

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

Key threatening processes relevant to the proposal include;

(1) Loss of hollow-bearing trees.
(2) Clearing of Native Vegetation.

The proposed clearing of 46 hectares would result in the loss of **29 habitat trees** identified as potential den sites for the Squirrel Glider. The proposed clearing of 46 hectares of remnant forest would result in loss of potential foraging habitat for the species. Both of the above actions would constitute a key threatening process to the species.

A3.2.3 Grey-headed Flying-fox *Pteropus poliocephalus*

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

Actions likely to adversely effect the life cycle of the Grey-headed Flying-fox are:

(1) loss of foraging habitat (remnant forest) and,
(2) disturbance to roost and breeding sites

The clearing of up to ~46 hectares of foraging habitat is unlikely to significantly effect the abundance of this resource within the home range of the local population (<50km radius). The proposed clearing of 46 hectares of remnant forest is not considered to significantly effect the life cycle of a local population of the Grey-headed Flying-fox such that a viable local population is likely to be placed at risk of extinction. There would be no disturbance to roost and or breeding sites by the proposed activity.

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

The threatened Grey-headed Flying-fox in the City of Lake Macquarie and the lower Hunter Region is not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:

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

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

The Grey-headed Flying-fox local population is not an endangered ecological community. No further assessment of part (c) is warranted.

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

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

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

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

(i). The extent of habitat to be removed by the proposed action is 46 hectares.

(ii) The existing habitat in the study area is continuous with other areas of forest within the locality. Clearing of 46 hectares of forest within the subject site (based on the current land use constraints map) will not result in fragmentation of habitat or isolation from adjoining areas.

(iii) The habitat presently existing on the subject site would comprise “important habitat” for the threatened Grey-headed Flying-fox local population, but the loss of 46 hectares is unlikely to be considered significant in comparison to the extent of similar forging resources in the locality or City. The loss of this habitat is unlikely to effect the long term survival of the local Grey-headed Flying-fox population.

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

At present, no habitat critical to the survival of the Grey-headed Flying-fox is declared under the TSC Act 1995 (or its amendments).

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The Department of Environment, Climate Change and Water has prepared Recovery Plan for the Grey-headed Flying-fox and the abatement of key threatening processes in New South Wales. The Recovery Plan identifies a number of broad strategies to help threatened bats recover in New South Wales. However, the

proposed Action of clearing of foraging habitat will conflict with the objectives or actions of recovery plans for the Grey-headed Flying-fox.

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

Key threatening processes relevant to the proposal include;

(1) Clearing of Native Vegetation.

The proposed clearing of 46 hectares of remnant forest would result in loss of foraging habitat for the species. The proposed Action would constitute a key threatening process to the species.

A3.2.4 Little Bent-wing Bat *Miniopterus australis* and Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis*

The Little and Eastern Bent-wing Bat have both been recorded on the subject site and also in the locality based on records held on the DECCW fauna atlas and LMCC Fauna database (current to August 2010). The Little and Eastern Bent-wing Bat both roost in caves or similar structures and forage over aerial spaces for flying insects.

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

Actions likely to adversely effect the life cycle of the Little and Eastern Bent-wing Bat include:

(1) Clearing of native vegetation which provides foraging resources for both species,
(2) disturbance to roost sites (caves)
(3) impact of urban lighting which can draw flying insects away from areas of remnant vegetation into urban areas.

The proposed action (development of 46 hectares on the subject site) would result in the clearing of native vegetation which provides foraging resources for both species of bent-wing bats. Both the Little and Eastern Bent-wing Bat forage widely for their dietary requirements and the loss of 46 hectares of remnant native vegetation is unlikely to have an adverse effect on a component of the life-cycle of each species.

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

The threatened Little Bent-wing Bat and Eastern Bent-wing Bat are not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

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

The Little Bent-wing Bat and Eastern Bent-wing Bat are not an endangered ecological community. No further assessment of part (c) is warranted.

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

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

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

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

(i). The extent of potential habitat to be removed by the proposed action is up to 46 hectares of foraging habitat.

(ii) The habitat within the subject site is presently continuous with adjoining areas of similar forest within the locality. Both species can readily traverse open areas of limited habitat value (i.e. aerial space above residential areas). Development of the subject site will not result in fragmentation of habitat.

(iii) The extent of habitat identified for development is unlikely to be considered significant for the Little Bent-wing Bat and Eastern Bent-wing Bat due to the extent of similar habitat in the locality. The loss of habitat for the proposed development is unlikely to effect the long term survival of the local population of the Little Bent-wing Bat and Eastern Bent-wing Bat.

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

At present, no habitat critical to the survival of the Little Bent-wing Bat and Eastern Bent-wing Bat is declared under the TSC Act 1995, or its subsequent amendments.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The Department of Environment, Climate Change and Water has prepared Priority Action Statements (PAS) to promote the recovery of threatened bats and the abatement of key threatening processes in New South Wales. The Priorities Action Statement identifies a number of broad strategies to help threatened bats recover in New South Wales. With regard to the Little Bent-wing Bat and Eastern Bent-wing Bat, a summary of priority actions applicable to the proposed Action is presented below:

(1) Identify important foraging range and key habitat components for this species.

(2) Identify the effects of fragmentation in a range of fragmented landscapes e.g. cleared landscapes. For example genetic isolation, movement and persistence across a range of fragment sizes.

(3) Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and biobanking, acquisition for reserve establishment or other means.

Response

(1) With regard to the George Booth Drive subject site, the retention of approximately 50% of the subject site under conservation zoning would retain foraging habitat for both bent-wing bat species.

(2) The forested areas within the study area and locality are fragmented by a number of cleared gaps, including major and minor roads, power line easements and urban areas. However, for highly mobile species such as microchiropteran bats, this is unlikely to impact upon their movements in the study area and locality.
(3) The subject site is not high conservation value (HCV) at the landscape scale, and hence, is not recommended for offsetting or acquisition in a conservation reserve system.

In summary, the proposed Action will not conflict with the objectives or actions of recovery plans for threatened Little Bent-wing Bat and Eastern Bent-wing Bat.

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

Key threatening processes relevant to the proposal rezoning and subsequent development include;

(1) Clearing of Native Vegetation.

The proposed clearing of 46 hectares of remnant forest would result in loss of potential foraging habitat for the species. The above action would constitute a key threatening process to either species.

A3.2.5 Large-eared Pied-bat *Chalinolobus dwyeri*

The Large-eared Pied-bat has been recorded on the subject site and also in the locality based on records held on the DECCW fauna atlas and LMCC Fauna database (current to August 2010). The Large-eared Pied-bat roosts in caves or similar structures and forage over aerial spaces for flying insects.

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

Actions likely to adversely effect the life cycle of the Large-eared Pied-bat include:

(1) Clearing of native vegetation which provides foraging resources for both species,
(2) disturbance to roost sites (caves)
(3) impact of urban lighting which can draw flying insects away from areas of remnant vegetation into urban areas.

The proposed action (development of 46 hectares on the subject site) would result in the clearing of native vegetation which provides foraging resources for the Large-eared Pied-bat. The species forages widely for dietary requirements and the loss of 46 hectares of remnant native vegetation is unlikely to have an adverse effect on a component of the life-cycle of the species.

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

The threatened Large-eared Pied-bat is not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:

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

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

The Large-eared Pied-bat is not an endangered ecological community. No further assessment of part (c) is warranted.

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

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

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

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

(i). The extent of potential habitat to be removed by the proposed action is up to 46 hectares of foraging habitat.

(ii) The habitat within the subject site is presently continuous with adjoining areas of similar forest within the locality. The Large-eared Pied-bat can readily traverse open areas of limited habitat value (i.e. aerial space above residential areas). Development of the subject site will not result in fragmentation of habitat.

(iii) The extent of habitat identified for development is unlikely to be considered significant for the Large-eared Pied-bat due to the extent of similar habitat in the locality. The loss of habitat for the proposed development is unlikely to effect the long term survival of the local population of the Large-eared Pied-bat.

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

At present, no habitat critical to the survival of the Large-eared Pied-bat is declared under the TSC Act 1995, or its subsequent amendments.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The Department of Environment, Climate Change and Water has prepared Priority Action Statements (PAS) to promote the recovery of threatened bats and the abatement of key threatening processes in New South Wales. The Priorities Action Statement identifies a number of broad strategies to help threatened bats recover in New South Wales. With regard to the Large-eared Pied-bat, a summary of priority actions applicable to the proposed Action is presented below:

(1) Identify important foraging range and key habitat components for this species.

(2) Identify the effects of fragmentation in a range of fragmented landscapes e.g. cleared landscapes. For example genetic isolation, movement and persistence across a range of fragment sizes.

(3) Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and bio-banking, acquisition for reserve establishment or other means.

Response

(1) With regard to the George Booth Drive subject site, the retention of approximately 50% of the subject site under conservation zoning would retain foraging habitat for the Large-eared Pied-bat.

(2) The forested areas within the study area and locality are fragmented by a number of cleared gaps, including major and minor roads, power line easements and urban areas. However, for highly mobile species such as microchiropteran bats, this is unlikely to impact upon their movements in the study area and locality.

(3) The subject site is not high conservation value (HCV) at the landscape scale, and hence, is not recommended for offsetting or acquisition in a conservation reserve system.

In summary, the proposed Action will not conflict with the objectives or actions of recovery plans for threatened Large-eared Pied-bat.

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

Key threatening processes relevant to the proposal rezoning and subsequent development include;

(1) Clearing of Native Vegetation.

The proposed clearing of 46 hectares of remnant forest would result in loss of potential foraging habitat for the species. The above action would constitute a key threatening process to the Large-eared Pied-bat.

A3.2.6 Eastern Falsistrelle *Falsistrellus tasmaniensis* and Greater Broad-nosed Bat *Scoteanax rueppellii*

Two species of microchiropteran bats with similar habitat requirements and closely resembling echolocation calls were tentatively recorded within the subject site. Additionally, there are several records of both species in the locality to suggest their potential occurrence. Each of these species would utilise the aerial space above the subject site for foraging purposes, but also may utilise tree hollows for roost and nest sites.

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

Actions likely to adversely effect the life cycle of the Eastern Falsistrelle and Greater Broad-nosed Bat include:

- loss of foraging habitat (remnant forests and woodlands),
- clearing of habitat trees utilised as roost and breeding sites

The clearing of foraging habitat for the proposed development area (~46 hectares in area) will reduce the abundance of foraging resources (insects). The potential clearing of 35 habitat trees, which may support roost

sites for tree hollow dependent bats, is unlikely to have an adverse effect on the viability of a local population of threatened microchiropteran bat species. Within the wider locality, this resource is relatively abundant in stands of remnant forest and woodland.

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

The threatened Eastern Falsistrelle and Greater Broad-nosed Bat are not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:
- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

The Eastern Falsistrelle and Greater Broad-nosed Bat are not an endangered ecological community. No further assessment of part (c) is warranted.

(d) in relation to the habitat of a threatened species, population or ecological community:
- *(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- *(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- *(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

(i). The extent of habitat to be removed by the proposed action is up to 46 hectares in area and loss of 35 habitat trees as potential roost sites.

(ii) The existing habitats in the study area are continuous with extensive areas of similar forest within the locality. Clearing of habitat for the proposal will not result in fragmentation of habitat or isolation from adjoining areas.

(iii) The habitats existing within the subject site identified for potential development would comprise important habitat for the threatened Eastern Falsistrelle and Greater Broad-nosed Bat local population. However, whilst it may constitute foraging habitat and potential roost sites for the local population, this is unlikely to be considered significant in comparison to the extent of similar habitats in the locality. The loss of this habitat is unlikely to effect the long term survival of Eastern Falsistrelle and Greater Broad-nosed Bat in the locality.

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

At present, no habitat critical to the survival of Eastern Falsistrelle and Greater Broad-nosed Bat is declared under the TSC Amendment Act 2002.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The Department of Environment, Climate Change and Water has prepared Priority Action Statements (PAS) to promote the recovery of threatened bats and the abatement of key threatening processes in New South Wales. The Priorities Action Statement identifies a number of broad strategies to help threatened bats recover in New South Wales. With regard to each of the threatened bat species, a summary of priority actions applicable to the proposed Action is presented below:

(1) Ensure the largest hollow bearing trees (including dead trees) are given highest priority for retention in PVP assessments or other land assessment tools.
(2) Identify areas of private land that contain high densities of large hollow-bearing trees as areas of high conservation value (HCV) planning instruments and land management negotiations e.g. LEP, CAPs, PVPs.
(3) Identify important foraging range and key habitat components for this species.
(4) Identify the effects of fragmentation in a range of fragmented landscapes e.g. cleared landscapes. For example genetic isolation, movement and persistence across a range of fragment sizes.
(5) Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and biobanking, acquisition for reserve establishment or other means.

Response

(1) With regard to the study area, whilst there would be a loss of 35 hollow bearing trees in the area identified for development, a comparable number of hollows would be conserved in the area identified for conservation.
(2) The land identified for the proposed development supports low density of large hollow bearing trees, approximately 1.0 per hectare (low abundance).
(3) The subject site supports foraging habitat and key habitat components for each of the species, but this is not considered significant in relation to the extent of similar habitat in the locality.
(4) The forested areas within the study area and locality are fragmented by a number of cleared gaps, including major and minor roads, powerline easements and urban areas. However, for highly mobile species such as microchiropteran bats, this is unlikely to impact upon their movements in the study area and locality.
(5) The area of land on the subject site identified for potential development is not considered of high conservation value (HCV) and hence, is not recommended for offsetting or acquisition in a conservation reserve system.

In summary, the proposed Action will not conflict with the objectives or actions of recovery plans for threatened microchiropteran bats.

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

Key threatening processes relevant to the proposal include;

Loss of hollow-bearing trees.

The proposed development may result in the clearing of up to 35 habitat trees suitable for microchiropteran bats. However, it is not known if the 35 habitat trees provide roost or breeding sites for the 2 threatened microchiropteran bat species. The proposed Action would constitute a key threatening process and contribute towards the increase in impact of this key threatening process.

A3.2.7 Little Lorikeet *Glossopsitta pusilla*

The Little Lorikeet was not recorded on the subject site during these investigations, but is known from the locality and may frequent the site as part of its extensive foraging range. There are breeding records of the species in the Hunter Valley (HBOC, 2008), with the nearest known record at Quorrobolong and Kurri Kurri (HBOC, 2006, 2007), but none known from the City of Lake Macquarie to suggest the subject site supports breeding habitat. There are numerous records of the Little Lorikeet on the LMCC fauna database (2000), with many records along the Newcastle Link Road and George Booth Drive in proximity to Mt. Sugarloaf. The subject site contains suitable areas of foraging habitat for the species.

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

Actions likely to adversely effect the life cycle of the Little Lorikeet are:

(1) loss of foraging habitat (remnant forest) and,
(2) loss of breeding sites (mature trees with hollows)

The clearing of up to ~46 hectares of foraging habitat is unlikely to significantly effect the abundance of this resource within the extensive range of the species, although will contribute to incremental loss of habitat for the species. It is unknown if the clearing of habitat trees for the proposed development will result in the loss of breeding sites for the species. The proposed clearing of 46 hectares of remnant forest is not considered to significantly effect the life cycle of a local population of the Little Lorikeet such that a viable local population is likely to be placed at risk of extinction.

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

The Little Lorikeet local population is not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:
- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

The Little Lorikeet local population is not an endangered ecological community. No further assessment of part (c) is warranted.

(d) in relation to the habitat of a threatened species, population or ecological community:
- *(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- *(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

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

(i). The extent of foraging habitat to be removed or modified by the proposed action is 46 hectares.

(ii) The existing habitat in the study area is continuous with other areas of forest within the locality. Clearing of 46 hectares of forest within the subject site (based on the current land use constraints map) will not result in fragmentation of habitat or isolation from adjoining areas.

(iii) Components of the habitat presently existing on the subject site would comprise "important habitat" for the threatened Little Lorikeet local population. The area identified for potential loss of 46 hectares is foraging habitat for the species. The loss of this foraging habitat is unlikely to effect the long term survival of the local Little Lorikeet population.

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

At present, no habitat critical to the survival of the Little Lorikeet is declared under the TSC Act 1995 (or its amendments).

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

There is no recovery plan or threat abatement plan prepared for the Little Lorikeet. However, recovery actions that can assist in conservation of the species include:

- Retain large old trees, especially those that are hollow-bearing
- Ensure recruitment of trees into the mature age class so that there is not a lag period of decades between the death of old trees and hollow formation in younger trees.
- Protect large flowering Eucalyptus trees throughout the habitats frequented by this species. Manage remnant woodlands and forest for recovery of old-growth characteristics.
- Where natural tree recruitment is inadequate, replant local species to maintain foraging habitat and breeding sites.
- Reduce the abundance of feral Honeybees and limit the exploitation of nectar by domestic bees where resources are spatially or temporally sparse (e.g. in years of drought).

With regard to the proposed action to develop approximately 46 hectares of remnant forest, the proposed action would not be consistent with some of the objectives of the recommended recovery actions.

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

Development of the subject site will constitute a Key Threatening Process which include the following actions;

(1) Clearing of Native Vegetation

(2) Loss of hollow bearing trees (as potential nesting sites)

(3) Competition for tree hollows with feral honeybees

The proposed clearing of 46 hectares of remnant forest would result in loss of foraging habitat for the species, and potentially the loss of nesting sites for the Little Lorikeet. Whilst the proposed action will also result in conservation of 50% of the subject site, there is the potential for competition for tree hollows with feral

honeybess in the tree hollows that are retained. The proposed Action would constitute a key threatening process to the species.

A3.2.8 Powerful Owl *Ninox strenua*

The Powerful Owl was not recorded on the subject site during these investigations, but is known from the locality and may frequent the site as part of its larger home range. A number of habitat trees with large to very large tree hollows occur on the subject site and may be utilised as nesting sites by the species.

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

Actions likely to adversely effect the life cycle of the Powerful Owl are:

(1) loss of foraging habitat (remnant forest) and,
(2) disturbance to roost and breeding sites

The clearing of up to ~46 hectares of foraging habitat is unlikely to significantly effect the abundance of this resource within the home range of the local population. Surveys of arboreal mammals (possums and gliders) indicate the subject site supports good habitat quality for their preferred prey. The location of the proposed development area is situated in habitat dominated by open to very open forest, which is unsuitable as roost habitat for the Powerful Owl. The proposed action is unlikely to impact upon roosting habitat of the Powerful Owl. The proposed clearing of 46 hectares of remnant forest is not considered to significantly effect the life cycle of a local population of the Powerful Owl such that a viable local population is likely to be placed at risk of extinction.

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

The threatened Powerful Owl in the City of Lake Macquarie is not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

The Powerful Owl local population is not an endangered ecological community. No further assessment of part (c) is warranted.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

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

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

(i). The extent of habitat to be removed or modified by the proposed action is 46 hectares.

(ii) The existing habitat in the study area is continuous with other areas of forest within the locality. Clearing of 46 hectares of forest within the subject site (based on the current land use constraints map) will not result in fragmentation of habitat or isolation from adjoining areas.

(iii) Components of the habitat presently existing on the subject site would comprise "important habitat" for the threatened Powerful Owl local population. The area identified for potential loss of 46 hectares is foraging habitat for the species. The loss of this foraging habitat is unlikely to effect the long term survival of the local Powerful Owl population.

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

At present, no habitat critical to the survival of the Powerful Owl is declared under the TSC Act 1995 (or its amendments).

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Conservation protocols for Powerful Owl roost sites and nest trees on private land are specified in the Recovery plan for Large Forest Owls in NSW (DEC, 2006). Management of owls and their habitat on privately-owned lands in NSW ranges from non-existent to application of the principles and practices which apply on public forest lands. Few attempts have been made to date to coordinate owl conservation efforts over multiple holdings of private land. Examples of conservation protocols applied on development sites include the protection of nest and roost sites, patches of habitat and prey bases (DEC, 2006). For the subject site, the area identified for potential development is located in open forest unsuited to roosting habitat for the species, suggesting no disturbance to important roosting habitat. The loss of foraging habitat for development of 46 hectares of the subject site is not consistent with recommended actions specified in the recovery plan.

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

Key threatening processes relevant to the proposal include;

(1) Clearing of Native Vegetation.

The proposed clearing of 46 hectares of remnant forest would result in loss of foraging habitat for the species. The proposed Action would constitute a key threatening process to the species.

A3.2.9 Varied Sitella *Daphoenositta chrysoptera*

The Varied Sitella was not recorded on the subject site during these investigations, but is known from the locality and may frequent the site as part of its larger foraging range. There are breeding records of the

species in the Lower Hunter Valley (HBOC, 2008). There are numerous records of the Varied Sitella on the LMCC fauna database (2000), with many records along the Newcastle Link Road and George Booth Drive in proximity to Mt. Sugarloaf (Blue Gum Creek). The subject site contains suitable areas of foraging habitat for the species.

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

Actions likely to adversely effect the life cycle of the Varied Sitella are:

(1) loss of foraging habitat (remnant forest) and
(2) decline in habitat cover and quality.

The clearing of up to ~46 hectares of foraging habitat is unlikely to significantly effect the abundance of this resource within the local range of the species, although will contribute to incremental loss of habitat for the species. The proposed clearing of 46 hectares of remnant forest is not considered to significantly effect the life cycle of a local population of the Varied Sitella such that a viable local population is likely to be placed at risk of extinction.

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

The Varied Sitella local population is not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:
- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

The Varied Sitella local population is not an endangered ecological community. No further assessment of part (c) is warranted.

(d) in relation to the habitat of a threatened species, population or ecological community:
- *(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- *(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- *(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

(i). The extent of foraging habitat to be removed or modified by the proposed action is 46 hectares.

(ii) The existing habitat in the study area is continuous with other areas of forest within the locality. Clearing of 46 hectares of forest within the subject site (based on the current land use constraints map) will not result in fragmentation of habitat or isolation from adjoining areas due to incorporation

of appropriate movement and dispersal vegetated corridors between the subject site and adjoining remnants.

(iii) Components of the habitat presently existing on the subject site would comprise "important habitat" for the threatened Varied Sitella local population. The area identified for potential loss of 46 hectares is foraging habitat for the species. The loss of this foraging habitat is unlikely to effect the long term survival of the local Varied Sitella population.

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

At present, no habitat critical to the survival of the Varied Sitella is declared under the TSC Act 1995 (or its amendments).

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

There is no recovery plan or threat abatement plan prepared for the Varied Sitella. With regard to the proposed action to develop approximately 46 hectares of remnant forest, the proposed action would not be consistent with some of the objectives of the recommended recovery actions.

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

Development of the subject site will constitute a Key Threatening Process which include the following actions;

(1) Clearing of Native Vegetation

The proposed clearing of 46 hectares of remnant forest would result in loss of foraging habitat for the species, and potentially the loss of nesting sites for the Varied Sitella. The species builds a cup shaped nest high in the canopy of living trees which is used repeatedly over several years. Whilst the proposed action will also result in conservation of 50% of the subject site, there is the potential for loss of nesting sites and loss of foraging habitat. The proposed Action would constitute a key threatening process to the species.

A3.2.10 East-coast Freetail-Bat *Micronomus norfolkensis*

The East-coast Freetail Bat has been recorded in the locality based on records held on the DECCW fauna atlas and LMCC Fauna database (current to August 2010).

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

Actions likely to adversely effect the life cycle of the East-coast Freetail-bat is:

(1) loss of foraging habitat (remnant forests and woodlands),
(2) clearing of habitat trees utilised as roost and breeding sites

The clearing of approximately 46 hectares of foraging habitat (tree canopy and associated aerial insects) will result in a net reduction of this resource within the subject site and locality. Additionally, the clearing of 46 hectares of habitat may result in a reduction of roost and breeding sites for the species. It is unknown if this will have an adverse effect on the viability of a local population of species. The proposed clearing may effect the life cycle of a local population of the East-coast Freetail-bat, but the extent of this impact is unknown.

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

The threatened East-coast Freetail-bat is not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:
- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

The East-coast Freetail-bat is not an endangered ecological community. No further assessment of part (c) is warranted.

(d) in relation to the habitat of a threatened species, population or ecological community:
- *(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- *(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- *(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

(i). The extent of potential habitat to be removed by the proposed action is up to 46 hectares of foraging habitat and loss of approximately **35** habitat trees as potential (or actual) roost sites.

(ii) The habitat within the subject site is presently continuous with adjoining areas of similar forest within the locality. Clearing of potential roosting habitat by the proposal will not result in fragmentation of habitat or isolation from adjoining areas.

(iii) The habitats on the subject site may comprise “important habitat” for the two bat species. Whilst it may support roost sites for the local population, the extent of habitat identified for development is unlikely to be considered significant in comparison to the extent of similar habitats in the locality. The loss of this habitat is unlikely to effect the long term survival of the local population of the Eastern Falsistrelle and Greater Broad-nosed Bat.

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

At present, no habitat critical to the survival of each of the Eastern Falsistrelle and Greater Broad-nosed Bat is declared under the TSC Act 1995, or its subsequent amendments.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The Department of Environment, Climate Change and Water has prepared Priority Action Statements (PAS) to promote the recovery of threatened bats and the abatement of key threatening processes in New South Wales. The Priorities Action Statement identifies a number of broad strategies to help threatened bats recover in New South Wales. With regard to the Eastern Falsistrelle and Greater Broad-nosed Bat, a summary of priority actions applicable to the proposed Action is presented below:

(1) Ensure the largest hollow bearing trees (including dead trees) are given highest priority for retention in PVP assessments or other land assessment tools.
(2) Identify areas of private land that contain high densities of large hollow-bearing trees as areas of high conservation value (HCV) planning instruments and land management negotiations e.g. LEP, CAPs, PVPs.
(3) Identify important foraging range and key habitat components for this species.
(4) Identify the effects of fragmentation in a range of fragmented landscapes e.g. cleared landscapes. For example genetic isolation, movement and persistence across a range of fragment sizes.
(5) Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and biobanking, acquisition for reserve establishment or other means.

Response

(1) With regard to the George Booth Drive subject site, the hollow bearing habitat trees would qualify as sufficiently significant to justify retention. The retention of approximately 50% of the subject site under conservation zoning would retain suitable habitat trees and foraging habitat for the species.
(2) The extent of hollow bearing trees in the locality is unknown. However, within the subject site, the areas of higher density of habitat trees is to be retained under conservation zoning to offset loss of habitat associated with the proposed development.
(3) The subject site supports potential foraging habitat and key habitat components for both the Eastern Falsistrelle and Greater Broad-nosed Bat, but this is not considered significant in relation to the extent of similar habitat in the wider locality.
(4) The extent of forest and woodland in the locality is highly fragmented due to intensive urbanisation and associated infrastructure (i.e. power lines, major and minor roads). However, for highly mobile species such as microchiropteran bats, this is unlikely to impact upon their movements within the locality.
(5) The subject site is not high conservation value (HCV) at the landscape scale, and hence, is not recommended for offsetting or acquisition in a conservation reserve system.

In summary, the proposed Action will not conflict with the objectives or actions of recovery plans for threatened East-coast Freetail-bat.

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

Key threatening processes relevant to the proposal rezoning and subsequent development include;

(1) Loss of hollow-bearing trees.
(2) Clearing of Native Vegetation.

The proposed clearing of 46 hectares would result in the loss of **35 habitat trees** identified as potential roost or breeding sites for the Eastern Falsistrelle and Greater Broad-nosed Bat. The proposed clearing of 46 hectares of remnant forest would result in loss of potential foraging habitat for the species. Both of the above actions would constitute a key threatening process to either species.

A3.2.11 Swift Parrot *Lathamus discolour* and Regent Honeyeater *Xanthomyza phrygria*

The Swift Parrot and Regent Honeyeater have been infrequently recorded on the study area and locality. The majority of records of the Regent Honeyeater and also the Swift Parrot occurring to the south near Morisset, Wyee and Swansea. Both species occur irregularly within the City on a seasonal basis and some years there are very limited to no recordings of either species.

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

Important aspects of the lifecycles of the Swift Parrot and Regent Honeyeater include foraging, roosting, breeding and movement/ dispersal. The potential effects/ impacts of the rezoning and development of 46 hectares on the lifecycle aspects are discussed below:

Foraging

The Swift Parrot feed mainly on nectar, pollen and lerp in eucalypt forests and woodlands in Tasmania and the mainland. The Regent Honeyeater is nomadic, searching for rich sources of nectar, although the birds will regularly appear in some districts each year when certain eucalypts and banksia's flower (Blakers et al, 1984). They feed predominantly on the nectar of eucalypts. The use of nectar resource for the Swift Parrot and Regent Honeyeater is limited in duration due to the seasonal abundance of nectar and pollen. The subject site supports stands of Spotted Gum, Grey Gum and Ironbark species which flower during periods of the year (winter) when both species are present in coastal locations.

Roosting / Breeding

The Swift Parrot occurs as a breeding population in Tasmania, and migrates to mainland Australia in autumn each year (Blakers et al. 1984). On the mainland the species inhabits eucalypt forest and woodland, almost invariably in small flocks. They appear in forests and woodlands comprising winter flowering eucalypt species, feeding mainly on nectar, pollen and lerp. Due to the irregular nature of eucalypt flowering, their abundance within an area is highly variable. The birds return to Tasmania in spring to breed (Ferrier *et al.* undated). The highest concentration of breeding records of the Regent Honeyeater occurs west of the Dividing Range.

Movement

The Swift Parrot moves widely across the landscape between foraging areas. Seasonal movements of several thousand kilometres occur extending from Tasmania to south-east Queensland. These movements include across urban areas, grassland or cleared landscapes. The development of the subject site would not disrupt or cause the modification of movement dynamics of this species.

The Regent Honeyeater is highly nomadic searching for rich nectar sources, with most observations of the species west of the dividing range. However, non-breeding individuals will periodically extend their range to the coast in search of nectar, particularly winter flowering eucalypts.

Development of the subject site off George Booth Drive is unlikely to disrupt the lifecycle of the local population of the Swift Parrot or Regent Honeyeater such that either species is at risk of extinction.

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

No endangered populations of the Swift Parrot and Regent Honeyeater are listed for the City of Lake Macquarie under the *TSC Act 1995*.

(c) in the case of an endangered ecological community, whether the action proposed:
- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

The Swift Parrot and Regent Honeyeater are not an endangered ecological community. No further assessment of part (c) is required.

(d) in relation to the habitat of a threatened species, population or ecological community:
- *(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- *(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- *(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

(*i*). Within the subject site, approximately 46 hectares of potential foraging habitat would be cleared by the proposed action.

(*ii*). Development of the subject site will not isolate any habitat for the Swift Parrot or Regent Honeyeater. Additional areas of suitable foraging habitat for the Swift Parrot and Regent Honeyeater occur in the immediate locality.

(*iii*) The potential foraging habitat for the Swift Parrot and Regent Honeyeater to be cleared within the subject site is not considered significant such that it would impact upon the long-term survival of a local population of either species.

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

No assessment under this part is required as no declared critical habitat for the Swift Parrot and Regent Honeyeater has been declared in NSW.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

No recovery plan has been prepared for the Swift Parrot and Regent Honeyeater. However, priority action statements (PAS) has been prepared for both species. For the Swift Parrot, a total 13 priority actions have been identified to assist in recovery of the species. One strategy is applicable to the subject site:

- Retain stands of winter-flowering feed-trees, particularly large mature individuals.

Whilst the proposed development area would result in the loss of 46 hectares of potential foraging habitat, a similar area of land will be conserved which supports stands of winter flowering eucalypt species that support potential foraging habitat for both the Swift Parrot and Regent Honeyeater. There is also the potential for replanting within the lower poorly drained parts of the development area with stands of Swamp Mahogany *Eucalyptus robusta* and Forest Red Gum *Eucalyptus tereticornis* trees to supplement foraging habitat for either species.

No NSW recovery plan has been prepared for the Regent Honeyeater. However, a total 38 priority actions have been identified to assist in recovery of the species. One strategy applies to the subject site:

- No loss of mature key nectar tree species.

The proposed action will result in the loss of potential foraging habitat. These trees would not be considered mature key nectar trees for the Regent Honeyeater, but would provide foraging resources if present during flowering periods. To offset the potential loss of foraging habitat, it is recommended that planting of Swamp Mahogany trees be undertaken following completion of construction.

The proposed action is consistent with the objectives and actions of a recovery plan or threat abatement plan in that no loss of mature key nectar trees species will occur. However, it is recommended that following completion of construction, replacement planting be undertaken where appropriate to offset loss of potential foraging habitat for both species.

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

Key Threatening Processes relevant to the Swift Parrot and Regent Honeyeater include:

- Clearing of native vegetation

The clearing of 46 hectares of potential foraging habitat for the proposed development at George Booth Drive is an activity that is listed as a threatening process under the *Threatened Species Conservation Act 1995*.

A3.2.12 Little Eagle *Hieraaetus morphnoides*

The Little Eagle has been recorded in the locality based on records held on the DECCW fauna atlas and LMCC Fauna database (current to August 2010). Locations in proximity to the subject site include West Wallsend and Cardiff, with other records in the City at Green Point (Belmont), Awabakal Nature Reserve, Swansea and Morissett (LMCC fauna database, 2000).

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

Actions likely to adversely effect the life cycle of the Little Eagle is:

(1) clearing of foraging habitat (remnant forests and woodlands) and reduction in abundance of principal prey,

(2) clearing of habitat supporting breeding sites and displacement of breeding sites in proximity to urban areas

The clearing of approximately 46 hectares of forest habitat (trees and associated native and introduced ground mammals) will result in a net reduction of this resource within the subject site and locality. No known breeding sites are known within the subject site and locality to indicate breeding sites will be disturbed by the proposed action.

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

The threatened Little Eagle is not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:

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

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

The Little Eagle is not an endangered ecological community. No further assessment of part (c) is warranted.

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

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

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

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

(i). The extent of potential habitat to be removed by the proposed action is up to 46 hectares of foraging habitat.

(ii) The potential habitat within the study area is continuous with other areas of similar forest within the locality. Clearing of potential foraging habitat by the proposal will not result in fragmentation of habitat or isolation from adjoining areas.

(iii) The habitats on the subject site is unlikely to comprise “important habitat” for the Little Eagle local population, but may contribute as foraging habitat for the species. The extent of habitat identified for development is unlikely to be considered significant in comparison to the extent of similar habitats in the locality. The loss of this habitat is unlikely to effect the long term survival of the local population of the Little Eagle.

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

At present, no habitat critical to the survival of each of the Little Eagle is declared under the TSC Act 1995, or its subsequent amendments.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The Department of Environment, Climate Change and Water has prepared Priority Action Statements (PAS) to promote the recovery of threatened species and the abatement of key threatening processes in New South Wales. At present, no Priorities Action Statement has been prepared for the Little Eagle.

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

Key threatening processes relevant to the proposal rezoning and subsequent development include;

(1) Clearing of Native Vegetation.

The proposed clearing of 46 hectares may result in the loss of potential foraging habitat for the species. The clearing of native vegetation would constitute a key threatening process to the species.

A3.2.13 Large-footed Myotis *Myotis adversus*

The Large-footed Myotis has been recorded in the locality based on records held on the DECCW fauna atlas and LMCC Fauna database (current to August 2010). The Large-footed Myotis is typically associated with riparian zones and water bodies over which it forages for food. No suitable riparian habitat exists on the subject site, but the species may utilise the tree hollows on the subject site for roost habitat. The subject site is in close proximity to 2 small and larger riparian creeks, namely Cockle Creek to the immediate east and Slatey Creek in the west. The Large-footed Myotis may forage over these riparian areas and retreat to the remnant forest on the subject site for roosting in tree hollows.

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

Actions likely to adversely effect the life cycle of the Large-footed Myotis is:

(1) clearing of habitat trees utilised as roost and breeding sites

The clearing of approximately 46 hectares of roosting habitat (habitat trees) will result in a net reduction of this resource within the subject site and locality.

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

The threatened Large-footed Myotis is not listed as an endangered population. No further assessment of part (b) is warranted.

(c) in the case of an endangered ecological community, whether the action proposed:

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

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

The Large-footed Myotis is not an endangered ecological community. No further assessment of part (c) is warranted.

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

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

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

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

(i). The extent of potential habitat to be removed by the proposed action is up to **35** habitat trees as potential (or actual) roost sites.

(ii) The habitat within the subject site is presently continuous with adjoining areas of similar forest within the locality. Clearing of potential roosting habitat by the proposal will not result in fragmentation of habitat or isolation from adjoining areas.

(iii) The habitats on the subject site may comprise “important habitat” for the Large-footed Myotis. Whilst it may support roost sites for the local population, the extent of habitat identified for development is unlikely to be considered significant in comparison to the extent of similar habitats in the locality. The loss of this habitat is unlikely to effect the long term survival of the local population of the Large-footed Myotis.

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

At present, no habitat critical to the survival of the Large-footed Myotis is declared under the TSC Act 1995, or its subsequent amendments.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The Department of Environment, Climate Change and Water has prepared Priority Action Statements (PAS) to promote the recovery of threatened bats and the abatement of key threatening processes in New South Wales. The Priorities Action Statement identifies a number of broad strategies to help threatened bats recover in New South Wales. With regard to the Large-footed Myotis, a summary of priority actions applicable to the proposed Action is presented below:

(1) Ensure the largest hollow bearing trees (including dead trees) are given highest priority for retention in PVP assessments or other land assessment tools.

(2) Identify areas of private land that contain high densities of large hollow-bearing trees as areas of high conservation value (HCV) planning instruments and land management negotiations e.g. LEP, CAPs, PVPs.
(3) Identify important foraging range and key habitat components for this species.
(4) Identify the effects of fragmentation in a range of fragmented landscapes e.g. cleared landscapes. For example genetic isolation, movement and persistence across a range of fragment sizes.
(5) Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and biobanking, acquisition for reserve establishment or other means.

Response

(1) With regard to the George Booth Drive subject site, the hollow bearing habitat trees would qualify as sufficiently significant to justify retention. The retention of approximately 50% of the subject site under conservation zoning would retain habitat trees as potential roost habitat for the species.
(2) The extent of hollow bearing trees in the locality is unknown. However, within the subject site, the areas of higher density of habitat trees is to be retained under conservation zoning to offset loss of habitat associated with the proposed development.
(3) The subject site is not high conservation value (HCV) at the landscape scale, and hence, is not recommended for offsetting or acquisition in a conservation reserve system.

In summary, the proposed Action will not conflict with the objectives or actions of recovery plans for threatened Large-footed Myotis.

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

Key threatening processes relevant to the proposal rezoning and subsequent development include;

(1) Loss of hollow-bearing trees.

The proposed clearing of 46 hectares would result in the loss of **35 habitat trees** identified as potential roost or breeding sites for the Large-footed Myotis. The action of loss of hollow bearing trees would constitute a key threatening process to either species.

CURRICULUM VITAE: MICHAEL MURRAY

ACADEMIC QUALIFICATIONS:	Bachelor of Science (Hons), University of Newcastle, 1990.
	Pathology Technicians Certificate Tighes Hill Technical College, 1985.
LICENCE	NPWS Scientific Licence S10736 Animal Research Authority 01/1108 DG's Animal Care & Ethics Committee 01/1108
May 1995 - present	Established FOREST FAUNA SURVEYS (Incorporated 1998).

PROFESSIONAL EXPERIENCE

Extensive experience in undertaking detailed fauna surveys. Has undertaken many studies in the range of environments within the Newcastle/Lake Macquarie area, Hunter Valley, Sydney Basin, Western Slops and Plains, NE NSW, and riverine and mallee areas of Western Division of NSW.

MONITORING PROJECTS

October 1995 - present **Mt Owen Complex (including Glendell Mine) –** involved in long term wildlife monitoring project for Mt Owen Complex open cut coal mine in the central Hunter Valley. This work includes the establishment and monitoring of procedures, and formulation of amelioration measures for the maintenance and enhancement of habitat for protected and threatened fauna species. In particular, the threatened Squirrel Glider, woodland birds and microchiropteran bat species.

October 2008 –present **Mangoola Coal Mine -** commenced wildlife monitoring project for Mangoola Coal Open Cut Coal Mine in the upper Hunter Valley. This work follows similar monitoring procedures to the Mt Owen Complex for the maintenance and enhancement of habitat for protected and threatened fauna species.

March 2009 – present **Integra Coal** – commenced monitoring for protected and threatened fauna species following procedures specified in the Threatened Species Management Plan for Integra Coal Open Cut, Singleton. Target threatened species include Grey-crowned Babbler and Brushtailed Phascogale.

June 2008 – present **Bulahdelah Bypass** - commenced specific monitoring for the threatened Squirrel Glider following procedures specified in the Squirrel Glider Management Plan for Bulahdelah Bypass. Monitoring encompasses trapping, spotlight, nestbox and radiotracking monitoring of a population of the Squirrel Glider in proximity to the future bypass.

FAUNA SURVEYS

Michael has undertaken numerous fauna investigations for fauna and species impact statements, environmental impact statements, environmental assessments and strategic planning studies. These surveys have ranged from small individual allotment environmental assessments through to landscape level surveys. Examples of landscape level surveys include:

2008. DECC – Tuggerah Nature Reserve
A fauna inventory was undertaken of the newly acquired Tuggerah Nature Reserve at Wyong. Survey was conducted to document all fauna groups in a 202 hectare area

2005-2007 Wyong Employment Zone (WEZ).
A full fauna inventory, land use strategy and biodiversity certification application was prepared for the Wyong Employment Zone on the Central Coast. Total study area is 750 hectares.

2005-2007 Munmorah State Conservation Area, Lake Macquarie SCA.
A small mammal survey was conducted over three years for native small mammals and the impact of fire on small mammal populations and their responses.

2006 Large Forest Owl Habitat Tree Mapping, Koompahtoo Land Rezoning, Morisset.
Survey undertaken to survey and document nest and roost trees for large forest owls (Powerful Owl, Masked Owl and Sooty Owl) in a large land holding at Morisset (940 hectares) in the City of Lake Macquarie.

2005. Department of Defence:
The Vertebrate Fauna of Singleton Training Area, Hunter Valley (13,752 hectares)
The Vertebrate Fauna of Beecroft Weapons Range, Jervis Bay (4,200 hectares)
The Vertebrate Fauna of HMAS Albatross, HMAS Cresswell and JBRF, Jervis Bay (610 hectares).

September 1998 Specialist Team Member (Large Forest Owls Survey)
NPWS CRA Sydney Region (Comprehensive Regional Assessments) undertook targeted threatened large forest owl surveys in the Central Coast (Gosford City Council reserves), Strickland, Ourimbah, MacPherson, Wyong, Olney, Watagan, Heaton, Awaba, Corrabare, Cessnock and Yango State Forests, Singleton Army Base, Manobolai Nature Reserve.

February 1997 - March 1998 Specialist Team Member (Mammals and Nocturnal Birds)
for the NSW National Parks and Wildlife Service Sydney Zone CRA (Comprehensive Regional Assessments) undertaking regional fauna surveys. Areas targetted include Wollemi N.P., Yengo N.P., Goulburn River N.P., Blue Mountains N.P., Illawarra Water Catchment, Newnes S.F., Gardens of Stone N.P., Wallaroo and Medowie S.F.

June 1995 to April 1996 CONSULTANT BIOLOGIST - TUNRA (The University of Newcastle Research Associates Ltd)

1994 - June 1995 ENVIRONMENTAL SCIENTIST
ERM Mitchell McCotter

October - November 1994 FBN BAT SURVEYS
Assistant to FBN Bat Surveys in bat survey for fauna impact statement, State Forests of New South Wales, Western Division.

1992 - July 1994 PROJECT OFFICER
SWC CONSULTANCY

1991 - 1992 RESEARCH OFFICER
SHORTLAND WETLANDS CENTRE

COMPETENCY

Michael is very competent in all aspects of fauna surveys including species identification of birds, mammals (including microchiropteran bats), reptiles and amphibians. Michael also has extensive GIS experience. Michael has prepared reports for:

- impact assessments,
- species impact statements,
- ecological management plans,
- threatened species management plans,
- ecological monitoring,
- biodiversity certifications
- local environmental studies,
- flora and fauna survey guidelines and
- fauna inventory studies.

EXAMPLES OF PUBLICATIONS:

Research Projects

Murray, M. (1990) The re-introduction of the Magpie Goose *Anseranas semipalmata* to the Shortland Wetlands. BSc (Hons) thesis, Department of Biological Sciences, University of Newcastle.

Murray, M. and Winning, G. (1992). *Flight behaviour and collision mortality of waterbird species into 330kV electricity transmission lines adjacent to the Shortland Wetlands*. Report to Pacific Power by the Shortland Wetlands Centre.

Winning, G. and Murray, M. (1992). *NSW Important Wetlands - the First Chapter*. Recommended important wetlands in NSW, in support of the Directory of Important Wetlands in Australia. Report to NSW Department of Water Resources.

Murray, M. (1993). *Review of Literature on High Country Wetlands of New South Wales and Victoria.* Report to Australian Nature Conservation Agency by Shortland Wetlands Centre.

Murray, M. (1996) *Eleebana Local Squirrel Glider Study.* Report to Lake Macquarie City Council by SWC Consultancy.

Murray, M. (1999) *Characterisation of Habitats and Distribution of Large Forest Owls in the City of Lake Macquarie*. Report to Lake Macquarie City Council.

Published Papers

Kavanagh, R.P. and Murray, M. (1996). Home range, habitat and behaviour of the Masked Owl (*Tyto novaehollandiae*) near Newcastle, New South Wales. *Emu.* **96,** 157-170

Smith, A.P. and Murray, M. (2003). Habitat requirements of the squirrel glider (*Petaurus norfolcensis*) and associated possums and gliders on the New South Wales central coast. *Wildlife Research* **30**, 291-301.

Major Fauna Surveys

Murray, M., Mahony, M. and Hoye, G. (1995). *Pinney Beach Fauna Study.* Report to Lake Macquarie City Council.

Hoye, G., Murray, M. and Mahony, M. (1996) *Mount Owen Coal Mine Wildlife Management Pilot Study.* Report to HLA-Envirosciences by Fly By Night Bat Surveys Pty Ltd and TUNRA Ltd.

Hoye, G., Murray, M., Mahony, M. and Clulow, J. (1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007) *Mount Owen Coal Mine Wildlife Management - Annual Report(s).* Report by Fly By Night Bat Surveys Pty Ltd, Forest Fauna Surveys P/L and TUNRA Ltd.

Smith, A.P. (2000). *Wyong Sub-regional Squirrel Glider Study*. Report to Wyong Shire Council.

Murray, M. (2001) *Salt Ash Air Weapons Range - Fauna and Habitat Assessment*. Report to URS Pty Ltd and Department of Defence.

Bell, S.A.J. and Murray, M. (2001). *The ecological significance of Bow Wow Creek Gorge, Mulbring, lower Hunter Valley, New South Wales: a nationally significant site.* Report to Cessnock City Council by Eastcoast Flora Survey and Forest Fauna Surveys Pty Ltd.

Thomson, C. and Murray, M. (2005). *The Vertebrate Fauna of Singleton Training Area, Hunter Valley, New South Wales*. Report to Department of Defence by Sinclair Knight Merz and Forest Fauna Surveys Pty Ltd.

Thomson, C. and Murray, M. (2005). *The Vertebrate Fauna of Beecroft Weapons Range, Jervis Bay, New South Wales*. Report to Department of Defence by Sinclair Knight Merz and Forest Fauna Surveys Pty Ltd.

Thomson, C. and Murray, M. (2005). *The Vertebrate Fauna of HMAS Albatross, HMAS Cresswell and JBRF, Jervis Bay, New South Wales*. Report to Department of Defence by Sinclair Knight Merz and Forest Fauna Surveys Pty Ltd.

Species Impact Statement

Murray, M., Maryott-Brown, K. and Hoye, G. (1996) *Species Impact Statement, SRA Land, Glendale*. Report to Lake Macquarie City Council by Forest Fauna Surveys, in association with EcoPro P/L and Fly By Night Bat Surveys P/L.

Murray, M., Hoye, G., Mahony, M. and Clulow, J. (2003). *Mt Owen Operations Species Impact Statement*. Prepared for Umwelt (Australia) Pty Ltd on behalf of Mt Owen Mine by Forest Fauna Surveys Pty Ltd, Fly By Night Bat Surveys P/L and TUNRA Ltd.

Bell, S.A.J. and Murray, M. (2004). *Warnervale Business Park Species Impact Statement. Stage 1.* Prepared for Wyong Shire Council by Eastcoast Flora Survey and Forest Fauna Surveys Pty Ltd.

Murray, M. (2005). *Fern Bay Estate Squirrel Glider Study*. Prepared for ERM Australia Pty Limited.

Planning Documents

Murray, M., Maryott-Brown, K. and Hoye, G. (1997) *Flora and Fauna Survey Guidelines*. Report to Lake Macquarie City Council by Forest Fauna Surveys, Fly By Night Bat Surveys P/L and EcoPro P/L.

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Murray, M. and Bell, S.A.J. (2005). *Wyong Employment Zone Ecological Study*. Report to Wyong Shire Council.

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