CANNES RESERVE, AVALON – GREY-HEADED FLYING-FOX CAMP MANAGEMENT

Species Impact Statement

Prepared for
Pittwater Council

5th June 2012

DOCUMENT TRACKING

ITEM	DETAIL
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Photographs	Clockwise from top left - GHFFs roosting at Cannes Reserve, Powerful in Cheese Tree in Gunyah Place Reserve, central section of Cannes Reserve, hair-tube station in Cannes Reserve. All photos by Rod Armistead – February 2012.

This document should be referenced as: 'ELA 2012. Cannes Reserve – Grey-headed Flying-fox camp management: Species Impact Statement. Prepared for Pittwater Council, by Eco Logical Australia Pty Ltd, Sutherland'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from the Mark Behrarrel, Andrew Jennings, Sonja Elwood, and Kim Macqueen from Pittwater Council, Tim Pearson, Nancy Pallin, Benn Treharne from OEH, local Avalon residents and the project design team.

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Abbreviations

ABBREVIATION	DESCRIPTION
BMO	Bushland Management Officer
DECCW	NSW Department of Environment, Climate Change and Water (now OEH)
DGR's	Director General's Requirements
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
EPA	NSW Environment Protection Authority
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*
GHFF	Grey-headed Flying-fox (*Pteropus poliocephalus*)
KTP	Key Threatening Process
LEP	Local Environmental Plan
LGA	Local Government Area
LR	Littoral Rainforest (EEC)
MRBG	Melbourne Royal Botanical Garden
NW Act	Noxious Weeds Act 1993
OEH	NSW Office of Environment and Heritage
PoM	Plan of Management
PSGF	Pittwater Spotted Gum Forest (EEC)
REF	Review of Environmental Factors
RoTAP	Rare or Threatened Australian Plants
SIS	Species Impact Statement
TEC	Threatened ecological community; refers to vulnerable, endangered and critically endangered ecological communities list under the NSW TSC Act
TSC Act	NSW *Threatened Species Conservation Act 1995*
TSSA	Threatened Species Survey and Assessment Guidelines
VMP	Vegetation Management Plan

Definitions

DEFINITION	DESCRIPTION
Activity	Has the same meaning as in the *Environmental Planning & Assessment Act 1979* (EP&A Act).
Locality	Is the area within a 5 km radius of the subject TSC site.
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions- endangered ecological community listing.	As listed by the NSW Scientific Committee as an Endangered Ecological Community (EEC) under the NSW Act).
Proposal	Is the development, activity or action proposed as described in Section 2.1 of the report.
Pittwater Spotted Gum Forest	As listed by the NSW Scientific Committee as an Endangered Ecological Community (EEC) under the NSW TSC Act.
Study area	Means the ***subject site*** and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The ***subject site*** should extend as far as is necessary to take all potential impacts into account.
Subject site	Means the area directly affected by the proposal. For this SIS, ***subject site*** means the area of vegetation to be modified or removed from the boundary of Cannes Reserve, Avalon.
Subject species	Means those threatened species, populations or communities that are known or considered likely to occur in the study area.
Threatened species, populations and ecological communities	Has the same meaning as in the TSC Act.

Certification

The SIS was prepared by Rodney Armistead, Elizabeth Norris, Lucas McKinnon, Robert Humphries, Joanne Daly, and Bruce Mullins on behalf of the applicant, Pittwater Council, for the proposed removal and/or modification of Littoral Rainforest EEC within Cannes Reserve, Avalon, in the Pittwater Local Government Area, NSW.

Dr Rodney Armistead (PhD), Eco Logical Australia Pty Ltd

I, Mark Behrarrel of Pittwater Council, 1 Boonah Drive, Warriewood, NSW, being the applicant for the Section 91 Licence for the proposed removal and/or modification of vegetation from Cannes Reserve, Avalon (Lot 18 DP236595 and Lot 2 DP 209496), have read and understood this Species Impact Statement (SIS). Pittwater Council understands the implications of the recommendations made in this SIS and accept that they may be placed as conditions of consent or concurrence for the proposal.

Mark Behrarrel, Manager Environment and Education, Pittwater Council

Executive Summary

Conflicts between Flying-foxes, their camps and urban residents have become increasing common throughout south-eastern and eastern Australia. Flying-foxes, possibly due to drought, floods, persecution, and use of historical migration patterns, or, in response to the broad scale planting of high nectar/pollen producing street and park trees have begun to establish camps and occupy urban parks and bushland (Roberts 2006; van der Ree *et al.* 2009).

A population of Grey-headed Flying-foxes (GHFF) (*Pteropus poliocephalus*), which are listed as a vulnerable species under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) presently occupies Cannes Reserve in Avalon, in the Pittwater Local Government Area (LGA), Sydney, NSW. Cannes Reserve is a small reserve that contains two endangered ecological communities (EECs) listed under the TSC Act, Littoral Rainforest (LR) and Pittwater Spotted Gum Forest (PSGF) (Pittwater Council 2011a).

Presently the location of the camp is in the lower sheltered gully section in the north-west of the reserve associated with the drainage line that is bordered by Therry Street, Gunyah Place Reserve and Cannes Drive (Pittwater Council 2011a). Cannes Reserve is a relatively small reserve and due to its shape the location of the GHFF camp is in close proximity to backyards of local residents. In support of data previously collected by Pittwater Council, an ELA survey of local residents who live adjacent to Cannes Reserve found the colony to be impacting these residents due to the noise created by the GHFF, odour, excrement and damage to property. The impacts on the local residents are such that human health and well-being is potentially at harm. It is this threat to the well-being of the local residents that has provided an impetus for the proposed works.

Furthermore, the roosting GHFFs' have significantly damaged and defoliated the canopy of the trees in which they roost, within a listed EEC (Littoral Rainforest). In addition, the combined weight of numerous individuals has also resulted in the snapping of branches and possibly contributed to the collapse of several trees. There is concern that the defoliation and damage caused by the GHFF upon their roosting trees may lead to a reduction in the long term ecological health of the LR EEC.

Cannes Reserve has only recently been colonised by GHFF, with the anecdotal evidence suggests that the species was first recorded approximately ten years ago. Originally the camp appeared to consist of males only, but the recent presence of breeding females and young indicates that Cannes Reserve has become a maternal camp. Fluctuating camp numbers and breeding success recorded within the reserve is possibly a response to seasonally available food resources. Generally, core numbers have averaged 200 individuals, however, this number has ranged from 200-400 individuals, with an occasional winter peaks of up to approximately 1,065 individuals (Pittwater Council 2011b). Since then a permanent maternal camp has been established that is continuously occupied throughout the entire year.

As with other GHFF camps, the Cannes Reserve colony contributes to the survival and conservation of the species throughout NSW/SE Australia (Eby 1991 *et al.* 1999). The core roosting habitat trees in Cannes Reserve include *Syncarpia glomulifera* (Turpentine), *Glochidion ferdinandi* (Cheese Tree) and *Livistona australis* (Cabbage Palm) that are located in the north east corner of the reserve. Cannes

Reserve offers short term refuge, social interactions, protection from predators and climatic extremes as well as providing stepping stones in a largely disturbed and altered landscape between other camps and feeding locations (Roberts 2010). When undisturbed, other camps have generally remained stable for decades (Roberts *et al.* 2006). Of concern, is the continued loss and/or modification of suitable habitat along the coast of south-eastern Australia, pressure from agriculture and the increase in plantings of high nectar producing street trees, which has seen more camps become established in urban areas where they conflict with local residents (van der Ree *et al.* 2009). This trend of camps becoming established in urban areas and the subsequent conflicts are likely to continue as urban development and land-clearing encroach on the habitat of this species.

This Species Impact Statement (SIS) has been prepared by Eco Logical Australia Pty Ltd (ELA) on behalf of Pittwater Council for the proposed removal and/or modification of vegetation from Cannes Reserve, Avalon. The aim of the proposed works are to reduce the impact and conflicts between the GHFF camp and local residents, whilst minimising impacts to this potentially important breeding site. As the GHFF is listed as a vulnerable species on the schedules of both the TSC and EPBC Acts and the proposed actions are considered likely to have a significant impact on the GHFF by NSW Office of Environment and Heritage (OEH), an approval to undertake the works cannot be granted without first preparing this SIS.

The proposed works, which are in accordance with the Council approved Cannes Reserve and Gunyah Place Plan of Management (PoM), and involve the gradual and systematic removal and/or pruning of native and exotic GHFF roost or habitat trees from within a 7m boundary surrounding the outer edge of Cannes Reserve (Pittwater Council 2011a). The majority of the trees targeted for removal include the introduced/exotic *Ligustrum sinense* (Narrow-leafed Privet), *Musa acuminata* (Banana Tree) and *Jacaranda mimosifolia* (Jacaranda). However, several of the tree species targeted for removal and pruning form components of the LR and PSGF EECs that occur in the ***subject site*** and ***study area***.

Under the TSC Act, a licence is required under Section 91 if an action is likely to result in harm to, or picking of, a threatened species, population or ecological community; damage to critical habitat; or damage to a habitat of a threatened species, population or ecological community. Pittwater Council have previously applied for a Section 91 licence to remove or prune endemic and non-endemic trees from the north-west section of Cannes Reserve and on private properties adjacent to the reserve. Previous works were done under Section 95 Certificates No. 1115987 in 2010 and No. 1129225 in July 2011. In 2011 approval was provided for the pruning of two G. *ferdinandi* and the removal of a cluster of *H. forsteriana* trees near the entrance of 29 Therry Street, and one *Grevillea robusta* (Silky Oak) within Cannes Reserve. The actual works commenced on the 5th September, 2011. Since these works were undertaken, no significant change in the roost activities, location and numbers of GHFF present within the reserve has occurred (Pittwater Council 2011).

The Pittwater Council is seeking approval to undertake further tree removal and/or pruning in another attempt to mitigate the conflict between the colony and local residents. A requirement of the previous Section 95(2) certification is that any further Section 91 applications must be accompanied by a Species Impact Statement (SIS), in order to demonstrate that any further works will not cause significant negative impacts upon the threatened species, populations and/or ecological communities that occur or have the potential to occur within Cannes and Gunyah Place Reserves. Accordingly, this SIS has been prepared to accompany future Section 91 Licence applications to the OEH, for the removal or modification of vegetation from the Cannes Reserve boundary and residential properties.

The preparation of the SIS represents Pittwater Councils commitment to delivering an environmentally, politically, social and economically sensitive outcome for GHFF in urban areas, to undertake a robust

analysis of the potential impacts threatened species and ecological communities, as well as develop mitigation measures to minimise any impacts that may result from the proposed works. This SIS outlines an incremental and precautionary approach to the vegetation removal/pruning within Cannes Reserve to meet these commitments.

The purpose of the SIS is to identify potential impacts and provide appropriate avoidance, amelioration and mitigation measures for any adverse impacts on threatened species, populations or ecological communities. The ***subject species*** for the purposes of this SIS includes those threatened species, populations and/or ecological communities that are either 'known', 'likely' or with the 'potential' to utilise the ***study area*** from time to time. The likelihood of these species occurring in the study area was determined following the review of information held within threatened species databases, previous reports and from targeted surveys undertaken in Cannes Reserve, Gunyah Place Reserves and the ***locality*** (i.e. 5km radius from the ***subject site***) by ELA staff.

From this initial assessment one flora species, 11 fauna species, two EECs and two endangered populations were identified as potential ***subject species*** for this SIS (**Table 1**). Those species not recorded within the ***study area*** despite targeted surveys, or those considered unlikely to utilise the study area 'from time to time', were not considered ***subject species*** for the purposes of this SIS. Two further species were added to the ***subject species*** after being recorded during the field assessment component of this SIS (**Table 1**).

Table 1: Subject Species and Endangered Ecological Communities identified in the Director General Requirements as potential *subject species*.

SCIENTIFIC NAME	COMMON NAME	TSC ACT LEGAL STATUS	EPBC ACT LEGAL STATUS	SUBJECT SPECIES DGR'S	CONSIDERED IN SIS
SPECIES					
Syzygium paniculatum	Magenta Lilly Pilly	Endangered	Vulnerable	Yes	No (not recorded on site)
Ninox strenua	Powerful Owl	Vulnerable	-	Yes	Yes (recorded on site)
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Endangered	Yes	No (not recorded on site)
Phascolarctos cinereus	Koala	Vulnerable	-	Yes	No (not recorded on site)
Petaurus norfolcensis	Squirrel Glider	Vulnerable	-	Yes	No (not recorded on site)
Pteropus poliocephalus	Grey-headed Flying Fox.	Vulnerable	Vulnerable	Yes	Yes (recorded on site)
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable		No	Yes (recorded on site)
Mormopterus norfolkensis	East Coast Freetail-bat	Vulnerable		No	Yes (recorded on site)

SCIENTIFIC NAME	COMMON NAME	TSC ACT LEGAL STATUS	EPBC ACT LEGAL STATUS	SUBJECT SPECIES DGR'S	CONSIDERED IN SIS
ENDANGERED ECOLOGICAL COMMUNITIES					
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South West Corner Bioregions		Endangered	Endangered	Yes	Yes (recorded on site)
Pittwater Spotted Gum Forest		Endangered	-	Yes	Yes (recorded on site)
POPULATIONS					
Koala *Phascolarctos cinereus* population in the Pittwater LGA		Endangered	-	Yes	No (not recorded on site)
Squirrel Glider *Petaurus norfolcensis* population on Barrenjoey Peninsula, north of Bushrangers Hill		Endangered	-	Yes	No (not recorded on site)

In an attempt to alleviate these conflicts Pittwater Council aims to (Pittwater Council 2011a):

- Undertake all efforts to retain, manage and conserve the historical colony in situ within Cannes Reserve, which is consistent with the OEH Flying Fox Camp Management Policy (DECC 2007).
- Encourage the GHFF colony away from the reserve boundary 'as the need arises' by incrementally (over a five year period) creating a 7m buffer around the outer perimeter of Cannes Reserve between the GHFF colony and residents who live in close proximity (Pittwater Council 2011).
- Encourage the camp to roost towards the centre of the reserve away from local residents. In the longer term this will require planting of known roosting tree species. While in the shorter term artificial roosting areas may need to be considered.
- Over a five year period restore the LR and PSGF habitat within the 7m buffer of Cannes Reserve, particularly the waterway
- Manage the population to maintain the size of the colony at approximately 200 individuals.
- Manage buffer zone to establish native plant species and discourage weeds.
- Allow for the regeneration of native trees.
- Mitigate impacts and conflicts on residents.

In 2012, two Section 91a licences applications will be submitted for the following proposed works.

- Removal or pruning of two exotic Jacaranda trees, four *G. ferdinandi* trees and three *Livistona australis* palms from Cannes Reserve.
- Removal or pruning of one unhealthy *G. ferdinandi* tree and four L*. australis* from private property at 29 Therry St, Avalon.

Additionally, the works aim to be beneficial to the EECs present on site include.

- Poison through injection all *Ligustrum* species from the present within the 7m buffer zone and along the drainage lines.
- Removal of two exotic *Jacaranda mimosifolia* (Jacaranda) trees from the eastern boundary.
- Establishing buffer plantings of LR and PSGF EEC using specific species that will create a canopy no taller than 3 - 5m in height, to discourage the GHFF from roosting in this region. non-roosting flora species.
- Reduce weed densities through bush regeneration and rehabilitation strategies to encourage the health of the LR and PSGF EECs.

This SIS concludes that the proposed tree removal and pruning works in Cannes Reserve are unlikely to have significant impacts on any of the ***subject species*** identified. The reasons for this conclusion include:

- The vegetation removal or pruning works within the 7m buffer will be done incrementally over a five year through selective clearing or pruning.
- The loss of any vegetation will be compensated through restoration and other management activities that aim to maintain and enhance the quality and integrity of EECs and the reserve in general.
- The planned restoration and rehabilitation will effectively result in no net cumulative reduction, degradation or isolation of either LR or PSGF EEC within the ***locality***, but rather will enhance the ecological integrity and long-term viability of these EECs within the reserve.
- The GHFF camp will be retained and managed in situ within the Cannes Reserve, consistent with the Flying-fox Camp Management Policy (DECC 2007). .
- The rehabilitation programs aim to enhance potential roost opportunities away from the edge of the reserve by planting known roosting trees in the centre of the park away from residential houses, whilst maintaining a viable maternal camp.
- The four threatened fauna species including the Powerful Owl, Eastern Bentwing-bat, East Coast Freetail-bat and GHFF are all highly mobile species and there are able to use or migrate to the considerable areas of alternative roosting and foraging habitat elsewhere within the region, such as Ku-Ring-gai Flying-fox Camp and Warriewood Reserve, that could support additional GHFF individuals if displaced from Cannes Reserve.

Therefore, it is concluded that the planned works, which involve vegetation removal and subsequent restoration works, will not significantly impact upon any threatened species, populations or ecological communities if undertaken consistent with those works outlined in this SIS.

Purpose

PURPOSE OF SIS

This SIS has been prepared by ELA on behalf of Pittwater Council to consider potential impacts to threatened species, populations and ecological communities associated with the removal and modification of Grey-headed Flying Fox (GHFF) roosting habitat, Littoral Rainforest (LR) and Pittwater Spotted Gum Forest (PSGF) endangered ecological communities (EEC). The aim of the works is to retain and manage the GHFF camp in situ within Cannes Reserve while mitigating the impacts and conflicts between exist among the local residents.

The purpose of this Species Impact Statement (SIS) is to:

- allow the applicant or proponent to identify threatened species issues and provide appropriate amelioration of adverse impacts that may result from the proposal
- assist the Director-General in the assessment of Section 91 Licence applications lodged under the TSC Act

DIRECTOR-GENERAL'S REQUIREMENTS

The NSW OEH Director General's Requirements (DGR's) for this SIS were issued on the 26th October 2011 (**Appendix A**).

MATTERS WHICH HAVE BEEN LIMITED

The following Section 110 matters need only be addressed where relevant:

Threat abatement plans

No threat abatement plans have been currently approved in accordance with the TSC Act which hare relevant to this proposal.

Recovery plans

The following Recovery Plans are relevant to this proposal

- GHFF *Pteropus poliocephalus* Draft Recovery Plan
- Koala *Phascolarctos cinereus* Recovery Plan
- Large Forest Owls Recovery Plan

Key threatening processes

- Clearing of native vegetation.
- Infection of native plants by *Phytophthora cinnamomi.*
- Invasion and establishment of exotic vines and scramblers.
- Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata.
- Invasion of native plant communities by exotic perennial grasses.
- Invasion, establishment and spread of *Lantana camara*.
- Loss of hollow-bearing trees

- Predation by the Feral Cat *Felis catus* (Linnaeus, 1758)

Critical habitat

At this time, no areas of declared critical habitat are relevant to this proposal.

The proponent should be aware that recovery plans may be approved, critical habitat may be declared and key threatening processes may be listed between the issue of these requirements and the granting of consent. Such an occurrence may require additional matters to be addressed in the SIS and considered by the consent, determining or concurrence authority.

MATTERS TO BE ADDRESSED

Except where those matters have been limited above, the TSC Act provides that the SIS must meet all the matters specified in Sections 109 and 110 of the Act, as directed by the following sections.

This SIS addresses the requirements identified in the DGRs as indicated in **Table 2**. The format of this SIS follows the structure of the DGR's

Table 2: Director General's Requirements for SIS

DG'S REQUIREMENTS	RESPONSE/SIS SECTION(S)
1. Form of the Species Impact Statement	Section 1 of this SIS
1.1 A species impact statement must be in writing	As required by Section 109(1) of the TSC Act, this SIS is in writing.
1.2 A species impact statement must be signed	As required by Section 109(2) of the TSC Act, the SIS has been signed by the principal author, (a) the applicant of the licence, or (b) if the species impact statement is prepared for the purposes of the Environmental Planning and Assessment Act 1979, the applicant for the development consent or the proponent of the activity proposed to be carried out (as the case requires) section 109 (2) (see 'Certification' at the front of this document)
2. Contextual Information	Section 2 of this SIS
2.1. Description of proposal, ***subject site*** and study area	Section 2.1 of this SIS
2.2. Land Tenure information	Section 2.2 of this SIS
2.3. Vegetation	Section 2.3 of this SIS
2.4. Plans and maps	Section 2.4 of this SIS and includes relevant plans and maps
2.5. Threatened Species	Section 2.5 of this SIS
3. Initial Assessment	Section 3 of this SIS
3.1. Identifying subject threatened species, populations and ecological communities ('***subject species***')	Section 3.1. of this SIS
4.0 Survey	Section 4 of this SIS

DG'S REQUIREMENTS	RESPONSE/SIS SECTION(S)
4.1. Requirement to survey	Section 4.1 of this SIS
4.2. Documentation of survey effort and technique	Section 4.2 of this SIS
4.2.1. Description of survey techniques and survey locations	Section 4.2.1. of this SIS
4.2.2. Documenting survey effort and results	Section 4.2.2. of this SIS
4.2.3. Description and mapping of results of vegetation, flora and fauna surveys	Section 4.2.3. of this SIS
4.3. Specific survey requirements	GHFF Pteropus poliocephalus Section 4.3 of this SIS
5. Assessment of Likely Impacts on Threatened Species and Populations	
5.1. – 5.5. Assessment of species likely to be affected	Section 5.1 – 5.5. of this SIS
5.2.1 – 5.5.1. Discussion of regional and local abundance and distribution.	Section 5.2.1 – 5.5.1 of this SIS
5.2.2. – 5.5.2. Assessment of habitat	Section 5.2.2 – 5.5.2 of this SIS
5.2.3. – 5.5.3. Discussion of conservation status	Section 5.2.3 – 5.5.3 of this SIS
5.3.4 - 5.5.4. Discussion of the likely effect of the proposal at local and regional scales.	Section 5.3.4 – 5.5.4 of this SIS
5.2.5 – 5.5.5. Description of conservation status	Section 5.2.5. – 5.5.5 of this SIS
5.6. Description of feasible alternatives	Section 5.6 of this SIS
6. Assessment of Likely Impacts on Threatened Ecological Communities	
6.1 Assessment of critically endangered or endangered ecological communities likely to be affected	Section 6.1 of this SIS
6.2 Description of habitat	Section 6.2 of this SIS

DG'S REQUIREMENTS	RESPONSE/SIS SECTION(S)
6.2.1. Study area	Section 6.2.1 of this SIS
6.2.2. ***Locality***	Section 6.2.2 of this SIS
6.3 Discussion of conservation status	Section 6.3 of this SIS
6.4. Discussion of the likely effect of the proposal at the local and regional scales.	Section 6.4 of this SIS
6.4.1. Significance within a local context	Section 6.4.1 of this SIS
6.4.2. Extent of habitat removal or modification	Section 6.4.2 of this SIS
6.4.3. Discussion on connectivity	Section 6.4.3 of this SIS
6.4.4. Consideration of threatening processes	Section 6.4.4 of this SIS
6.5. Discussion of feasible alternatives	Section 6.4.5 of this SIS
7. Description of Feasible Alternatives	**Section 7 of this SIS**
7.1. Description of ameliorative measures	Section 7.1 of this SIS
7.1.1. Long term management strategies	Section 7.1.1 of this SIS
7.1.2. Compensatory strategies	Section 7.1.2 of this SIS
7.1.3. Translocation	Section 7.1.3 of this SIS
7.1.4. Ongoing monitoring	Section 7.1.4 of this SIS
8. Assessment of significant of likely effect of proposed action	
9. Additional information	
9.1. Qualifications and experience	Section 9.1 of this SIS includes the qualifications and experience of any person who has prepared this SIS.
9.2. Other approvals required for the development or activity	Section 9.1 of this SIS provides a description of any other approvals required for the proposed new TL.
9.3. Licensing matters relating to this survey	Section 10.3 of this SIS
9.4 Section 110 (5) reports	Section 10.4 of this SIS

1 Form of the Species Impact Statement

1.1 A SPECIES IMPACT STATEMENT MUST BE IN WRITING (SECTION 109{1})

1.2 A SPECIES IMPACT STATEMENT MUST BE SIGNED BY THE PRINCIPLE AUTHOR OF THE STATEMENT AND BY

- The applicant for the licence, or.
- If the species impact statement is prepared for the purpose of the Environmental Planning and Assessment Act 1979, the applicant for the development consent or the proponent of the activity proposed to be carried out as the case requires) Section 109(2).

All of these requirements are met in the appropriate sections of the document.

2 Contextual Information

2.1 DESCRIPTION OF PROPOSAL, SUBJECT SITE AND STUDY AREA

The DGR's state that: *'A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout."*

2.1.1. Description of the proposal

The proposed scope of the works as described in the Cannes Reserve and Gunyah Reserve Plan of Management and Cannes Reserve Flying-fox Colony Plan of Management (PoM) (Pittwater Council 2011a) include:

- 'As the need arises' over a 5 year period, create a 7m buffer around the outer perimeter of Cannes Reserve to from a buffer between the GHFF colony and residents who live in close proximity (Pittwater Council 2011) (**Figure 1**).
- Encourage the GHFF colony to roost away from the boundary and towards the centre of the reserve.
- Limit the number of available roosting substrates/opportunities and as a consequence maintain the size of the colony at the historical average of 200 individuals.
- Continue to seek to mitigate impacts and conflicts on residents.

The creation of the 7m buffer is an attempt to minimise the impacts and resulting ill-health among the local residents potentially caused by GHFF camp.

Community and residential fears and conflicts

The present location of the camp is in the lower sheltered gully section of the reserve that is associated with the drainage line and is bordered by Therry Street, Gunyah Place Reserve and Cannes Drive (Pittwater Council 2011a). Local residents who live adjacent to Cannes Reserve are affected by noise, sleep disturbance, odour, loss of residential amenity, and excrement that results in mess, damage to property and perceived loss of property values. Of particularly concern is the possibility that the GHFF camp in Cannes Reserve is a threat to human health and the well-being of local residents, through sleep disturbance and potentially disease.

Cannes Reserve is a relatively small reserve (approximately 0.5 hectares) and due to its shape the location of the GHFF camp is in close proximity to backyards of local residents. A recent letter drop style survey conducted by ELA provided an insight into the sentiments of the local residents. Generally, the responses to the surveys indicate that the majority of the residents are extremely negatively affected by the GHFF camp. In the surveys, local residents expressed how they were most affected by the camp through the noise produced by the GHFF's as they return from foraging in the early morning (~4am), odour (particularly after rainfall), dead animals (fear of disease) and excrement (mess, damage to property and repair costs), fear of disease, potential loss property values, loss of residential amenity. These issues have subsequently led to medically diagnosed stress and ill health that is associated with lack of sleep, difficulties in acquiring rental tenants, costs associated with repairing or cleaning damaged property, health and disease, concerns (Lyssavirus {Australian Bat Lyssavirus - ABL} and Hendra Virus).

Further, these issues have impacted on the ability of young students to cope with the pressures of completing the required assessments (Higher School Certificate). However, these concerns that have been ongoing for at least two years, with many of the survey responses being previously recorded by Pittwater Council (2011a). However, local residents also expressed their concern for the lack of action that has occurred over the last few years to manage or remove the GHFF.

The 7m buffer

The buffer is located around the outer edge of Cannes Reserve. The planned habitat removal or pruning will occur gradually and incrementally over a five year period. In this time the tree and palm species will be selectively removed or pruned to reduce their GHFF roosting potential. These areas will then be restored and managed in accordance with the measures outlined below and in **Section 7**. The vegetation targeted for removal or pruning from the 7m buffer forms part of two endangered ecological communities (EEC) listed under the NSW TSC Act, Littoral Rainforest (LR) and Pittwater Spotted Gum Forest (PSGF). The works that have been planned for 2012 will only occur within the LR EEC. In 2012, there is no plan to undertake any works within the PSGF. The level of vegetation removal will vary from year to year. The planned restoration and rehabilitation will effectively result in no net reductions, degradation or isolation of either LR or PSGF EEC.

The cumulative area to be affected and subsequently restored from within the 7m buffer is 0.204ha. This includes:

- 0.08ha of Coastal Moist Spotted Gum Forest EEC.
- 0.124ha of Coastal Escarpment Littoral Rainforest EEC.

It is intended that the planned vegetation removal or modification and subsequent restoration will be undertaken over a 5 year period and will include:

- Removal or pruning of selected native roosting and non-roosting trees from the 7m buffer
- The buffer will be managed to encourage (either through direct planting or natural regeneration) the establishment of native plant species and actively remove and discourage weeds
- Undertake restoration and rehabilitation works that will benefit and enhance the quality of the two EECs
- Using plant species with local providence restore the EECs impacted by the proposed vegetation removal
- Remove all non-indigenous weed species and regenerate as appropriate with the correct LR and PSGF EEC plant species using local providence. In 2012, all the Ligustrum species will be removed from the 7m buffer and from along the drainage line.
- Create a canopy that is less than 5m in height, to discourage the GHFF from roosting in close proximity to the local residents within the 7m buffer.

2.1.2. Subject site

The ***subject site*** includes Cannes Reserve (Lot 18 DP236595 and Lot 2 DP 209496) and Net Road Reserve in the Pittwater Council LGA. Cannes Reserves is located at 7a Cannes Drive, Avalon (**Figure 1**). Cannes Reserve is among a number of parks and reserves that are managed by Pittwater Council (Figure 4).

Cannes Reserve

Cannes Reserve comprises of a total area of 0.53ha. This includes of 0.4ha of Littoral Rainforest in the lower slopes in association with the drainage system and 0.11ha of PSGF on the upper slopes. The reserve is also heavily infested with weeds. Sections of the Cannes Reserve have been previously disturbed during works in the drainage line (Pittwater Council 2011a). Presently the site is severely infested by exotics weeds, resident encroachment, litter, disposal of garden and lawn clippings.

2.1.3. Study Area

The ***study area*** includes the ***subject site*** and additional areas which may be directly or indirectly impacted by the proposal (**Figure 2**). For the purposes of this SIS, the ***study area*** includes Cannes Reserve as well as Gunyah Place and Net Road Reserve.

Gunyah Place Reserve

Gunyah Reserve (Lot 4 DP 232257) is a small park compromising of 0.08ha of mostly mown grass, a child's play ground and a patch of *G. ferdinandi* that is continuous with Cannes Reserve.

Net Road Reserve

Net Road Reserve comprises of 0.14ha of heavily weed infested PSGF EEC, mown grass and a pathway.

For the ***subject species*** (including EECs), there will be no indirect impacts outside of the ***subject site***.

2.1.4. Locality

The ***locality***, as defined in the DGRs is the area within a 5 km radius of the ***subject site*** (**Figure** 3). This area includes parts of the Barrenjoey Peninsula suburbs of Avalon, Clareville, Whale Beach, Palm Beach, Bilola and Newport. It also includes Council managed reserves, Whiltshire, Horden, Frog Hollow, McKay, Toongari, Angophora Parks and Stapleton Reserve.

2.2 LAND TENURE INFORMATION

The land within the reserve is owned and managed by Pittwater Council and the reserve is zoned Open Space - Reserves 6(a) Existing Recreation A while the surrounding residential properties are zoned 2(a) Residential A.

2.3 VEGETATION

The DGR's state that: *'Vegetation present within the **locality** must be mapped and described... Vegetation descriptions should match (or at least refer to) those in the Vegetation Types Database. Reference should also be made to the descriptions of endangered and critically endangered ecological communities''*

Cunningham (1994) provides an early European description of the Barrenjoey Peninsula vegetation depicting five basic vegetation types being present. In 1788, the region was described as being '*heavily*

timbered inland hills and ranges, rainforests, swamps, beachfront and estuarine communities and coastal heaths.' The majority of these communities still exist in the area, but they have been significantly cleared and modified since the 1940's. Between 1940 and the mid 1980's considerable urban and related development occurred within the region that effectively resulted in an 80% reduction in the forested areas on the Barrenjoey Peninsula (Smith and Smith 2000).

The vegetation of the ***locality*** has been described by various authors, including Tozer *et al.* (2006) (a.k.a. SCIVI) and from information provided by Pittwater Council (**Figure 6** and **Figure 7**). There are thirty-five vegetation communities identified within the SCIVI and Pittwater Council mapping units that occur within the ***locality***. Many of these communities form no association with the subject and consequently are unlikely to directly or indirectly impacted by the proposed works. Therefore, only the two Endangered Ecological Communities (EECs) that have the greatest likelihood of being impacted will discussed further in this section. Both communities are listed under the TSC Act or the EPBC Act. The vegetation communities present within the ***subject site***, include LR and PSGF. Ground truthing of this mapping was undertaken in Cannes Reserve to validate the extent of the LR and PSGF within the ***subject site*** only.

Littoral Rainforest

Cannes Reserve comprises of 0.4ha of LR, which is located mostly on the lower slopes in association with the drainage system. Sections of Cannes Reserve have been disturbed previously during works on the drainage line (Pittwater Council 2011a). Presently the site is being severely disturbed by weed control, resident encroachment, litter, disposal of garden and lawn clippings (Pittwater Council 2011a). The characteristic species of this community include *L. australis* in the canopy, *Banksia integrifolia*. *Ficus coronata*, *Pittosporum multiflorum P. undulatum* and *Pisonia umbellifera* in the mid-storey as well as *Acmena smithii* and *Ficus coronata* in the understorey (Pittwater Council 2003).

Pittwater Spotted Gum Forest

The Pittwater Spotted Gum Forest occurs on shale-derived soils with high rainfall on lower hill slopes on the Narrabeen group - Newport Formation, on the Barrenjoey Peninsula, Scotland Island and western Pittwater foreshores (NSW Scientific Committee 2004). Tiny remnants also occur within Ku-Ring-Gai Chase National Park. Two forms of PSGF occur within Pittwater LGA, including dry and wet. The wet form exists at Cannes Reserve (Pittwater Council 2011). The characteristic species of this community include *Corymbia maculata* (Spotted Gum) in the canopy, *L. australis*, *S. glomulifera* and *Allocasuarina torulosa* in the mid-storey as well as *Acmena smithii* and *Ficus coronata* in the understorey (Pittwater Council 2003).

The wet form of the Pittwater Spotted Gum Forest (PSGF) occupies 0.11ha (20.8%) of Cannes Reserve. The PSGF community is generally confined to several small patches located on the eastern and south east of the site. Further, two smaller patches are located on the south western arm that is adjacent to Cannes Drive. The characteristic species and structure of the community includes tall *Corymbia maculata* (Spotted Gum), *L. australis* and *S. glomulifera.*

2.4 PLANS AND MAPS

The DGR's state: '*An aerial photograph or reproduction of such photographs (preferably colour), of the **locality**, indicating scale and clearing delineating the **subject site** must be provided*.'

The maps provided in the following section show the location of the ***subject site*** while depicting the position of the locations of previously known threatened species, populations and EECs.

The location of, size, SCIVI vegetation and EECs, extent of cleared and natural habitat associated with Cannes Reserve is provided in **Figures 1, 3, 4, 6, and 7.** The topography of the Cannes Reserve is shown in **Figure 8.**

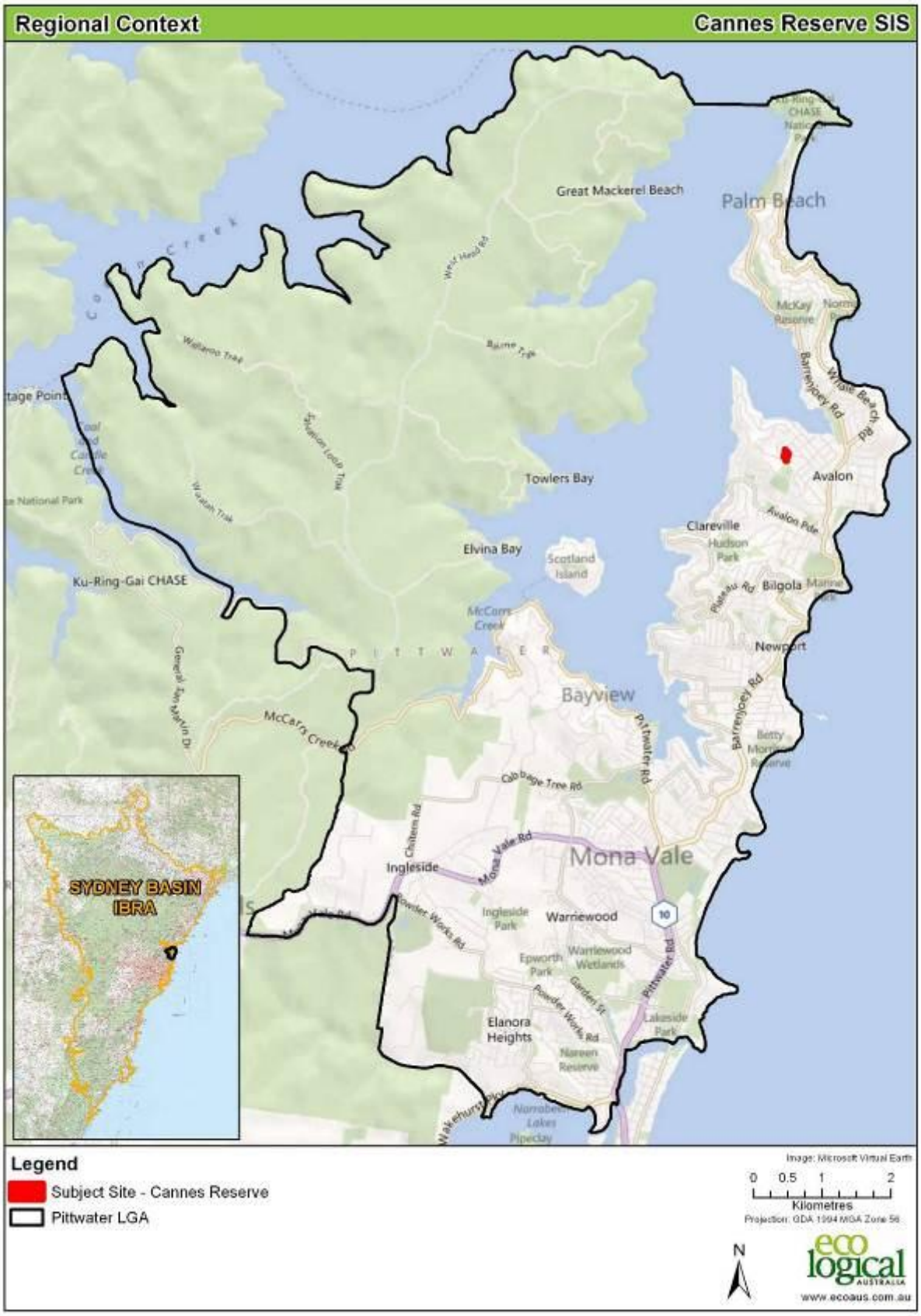

Figure 1: The location of the subject site in the Sydney Basin Bioregion.

Figure 2: Subject site.

Figure 3: The locality.

Figure 4: The Pittwater managed parks and reserves located within the locality.

Figure 5: Subject site and extent of the proposed 7m buffer.

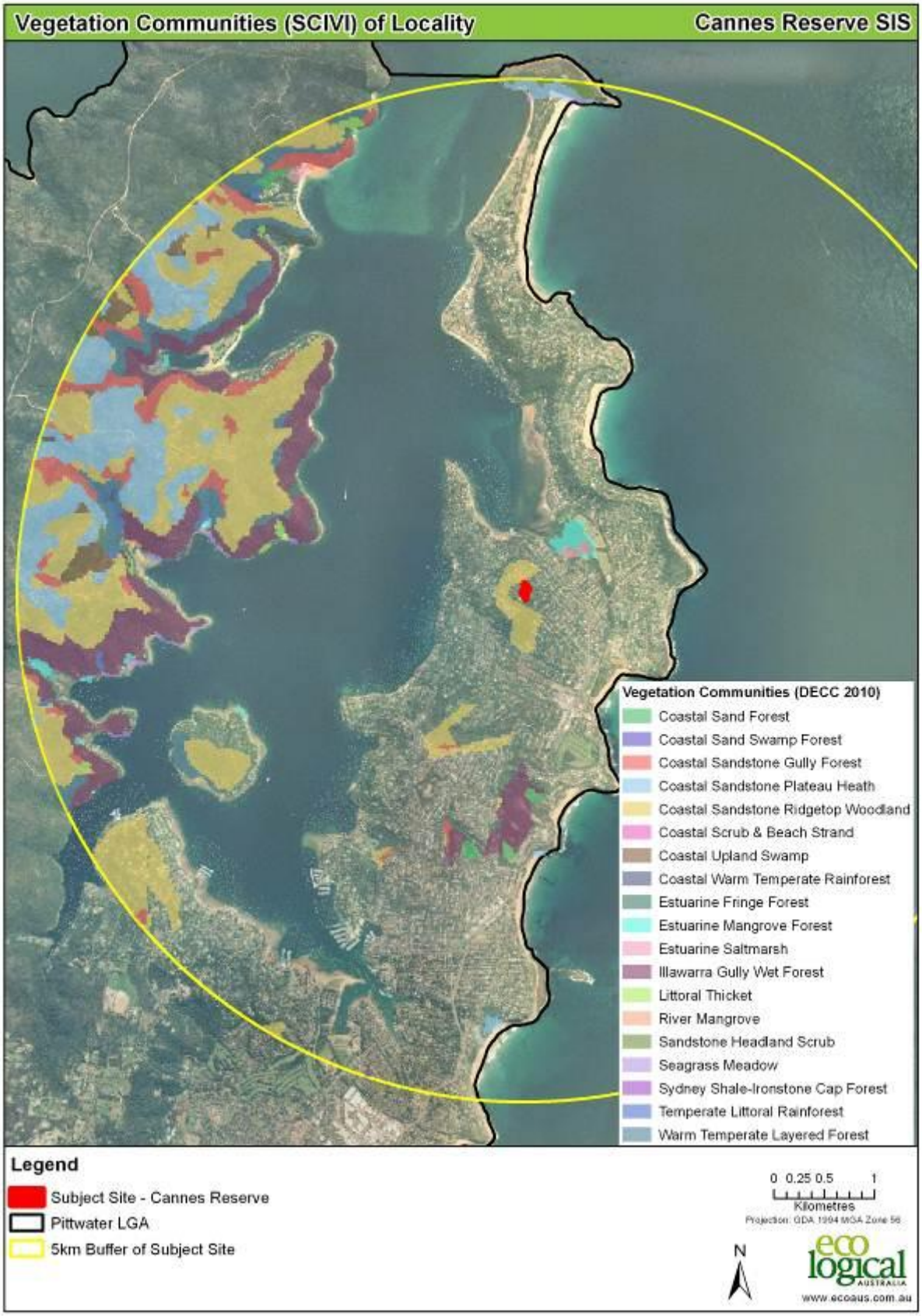

Figure 6: The SCIVI vegetation communities that occur within the locality or 5km radius of the *subject site*.

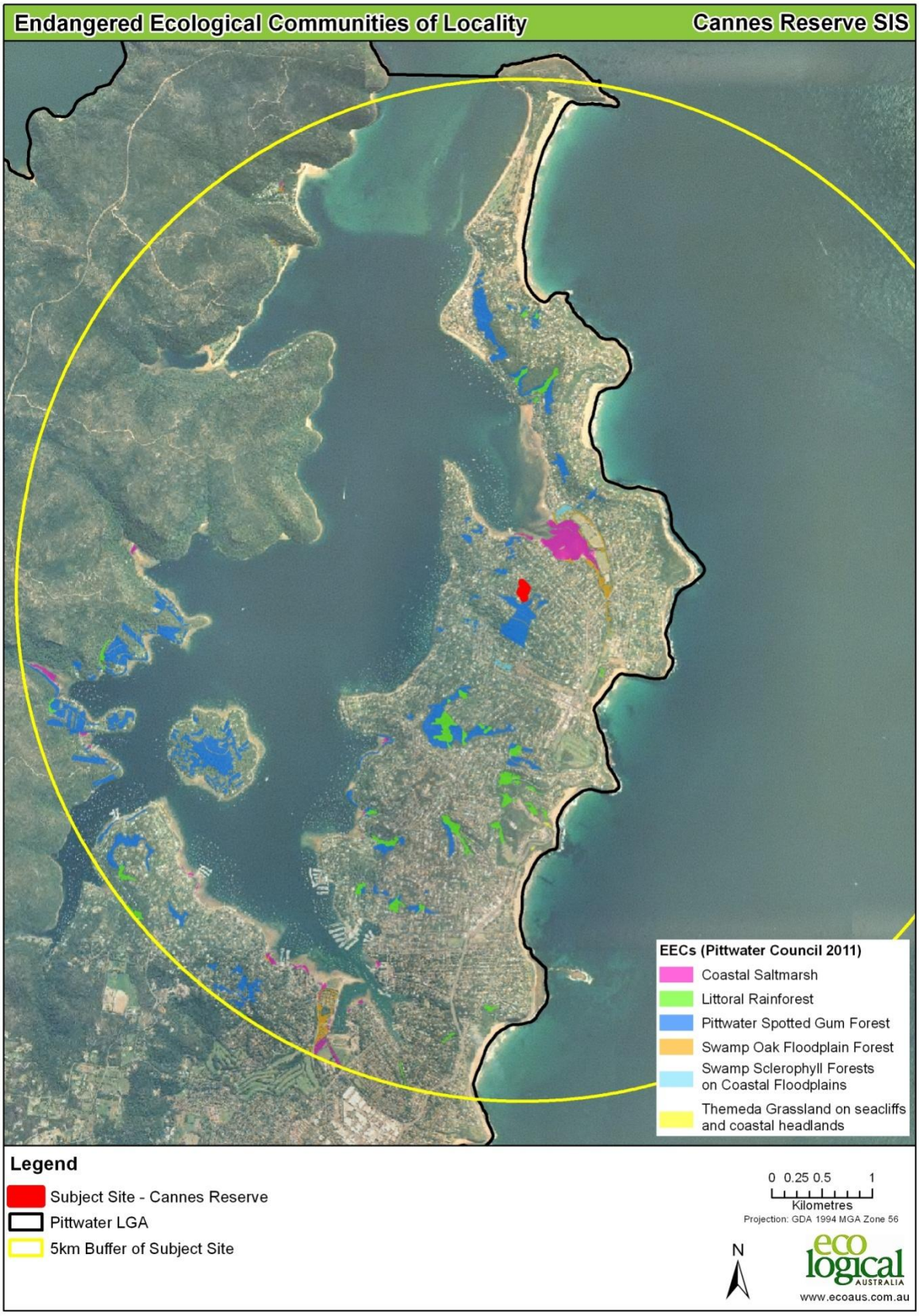

Figure 7: The Endangered Ecological Communities present within *locality* or 5km radius of the *subject site*.

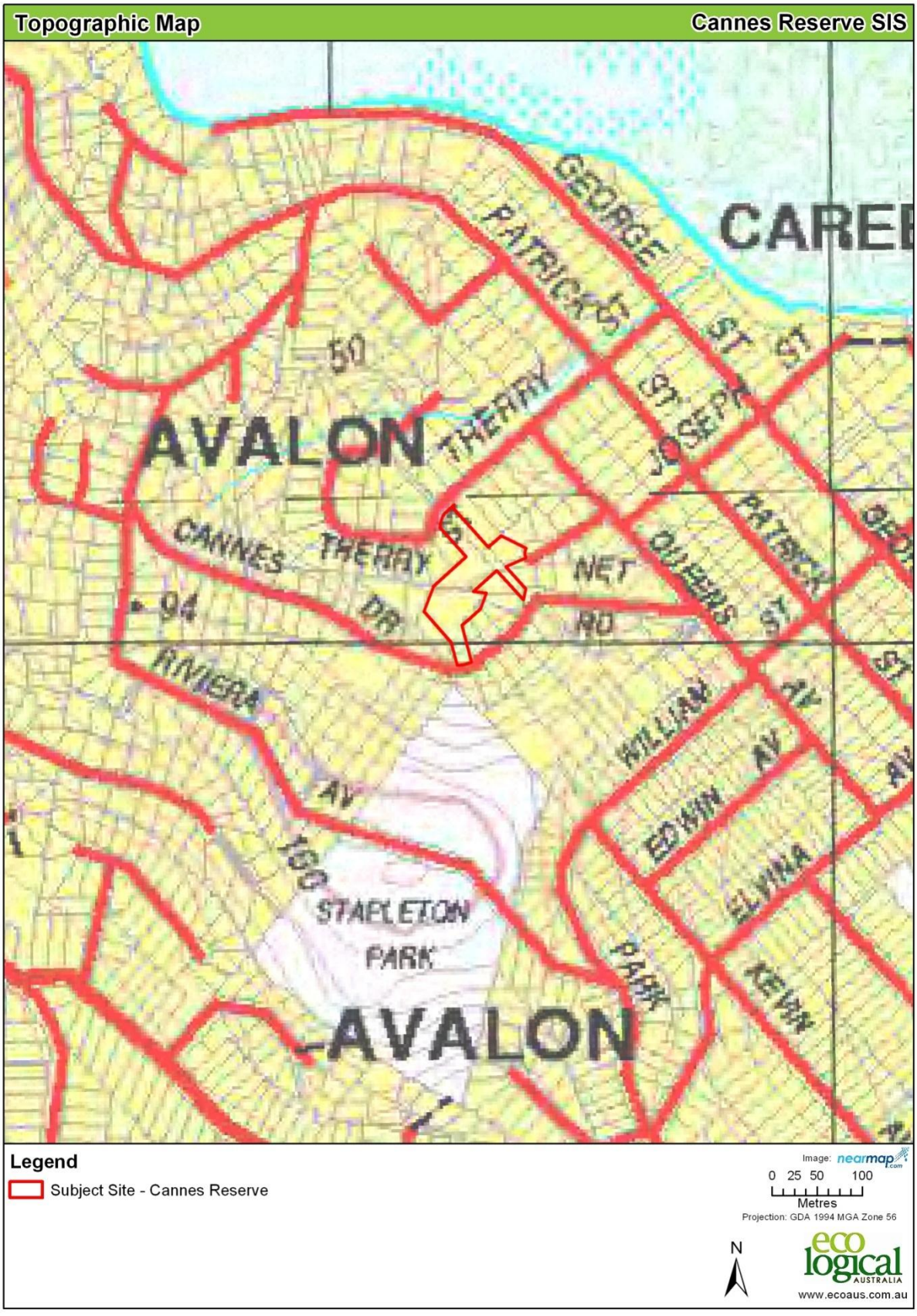

Figure 8: Topographical map of the *locality*

3 Initial Assessment

The DGR's require:

- *A general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action.*
- *A general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action.*

3.1 IDENTIFYING SUBJECT THREATENED SPECIES, POPULATIONS AND ECOLOGICAL COMMUNITIES ('SUBJECT SPECIES')

The DGR's require:

- *To determine the subject threatened species, populations and ecological communities likely to be present (the **subject species**).*

This section provides an explanation of methodology used to select the ***subject species*** that will potentially be impacted upon the proposed works.

3.1.1. Assessment of available information

Subject species for this SIS have been identified from the Atlas of NSW Wildlife, the online EPBC Protected Matters Search Tool and the Biobanking Credit Calculator, and have also been informed by reviews of previous surveys in the ***locality***.

There are a small number of reports and review that were used that have been undertaken prior to 2000. In addition, during the initial stage of preparing for this SIS, the relevant datasets and information were reviewed:

- existing vegetation, soil and landscape mapping, as well as other available GIS data
- Atlas of NSW Wildlife
- EPBC Protected Matters Search Tool
- Previous flora and fauna survey reports, the general reviews are detailed below.

Smith and Smith (2000) – Management Plan for Threatened fauna and flora in Pittwater LGA.
Includes a concise and thorough review of:

- The previously conducted surveys and management recommendation for the conservation of Pittwater LGA's flora and fauna.
- Provides a summary of events and a time line detailing the demise and possible extinction of Koalas in the Pittwater LGA region.
- Provides a summary of events and a time line detailing records of Squirrel Gliders and the endangered Barrenjoey Peninsula population.
- Localities and records of threatened flora and fauna.

Coughlin, R. (2011). Pittwater Bird Survey 2006 – 2007.

This report discusses the results of bird surveys undertaken in a number of Pittwater LGA's parks and reserves. There were no bird surveys undertaken at Cannes reserve during these surveys. Across 12 Parks and Reserves in Pittwater LGA, including Mckay, Bangelley (north and south), Angophora, Attunga, Bilarong, Deep Creek Reserves, Stapleton Park, Crown Of Newport, Ingleside Park, Mclean Street Heath and Careel Bay.

Ecotone Ecological Consultants Pty. Limited (2011) – Native Fauna Management Plan Pittwater LGA.

- This report is a summary of the conservation issues occur within Pittwater LGA and the management directions of Pittwater Councils Strategic Plan

The reminder of the information used to develop a subject species list was through searches of the relevant databases. From these searches a 'Likelihood of Occurrence Table' containing a full list of the threatened species, populations and ecological communities that have been either been recorded or are regarded as being likely to occur within the study area due to the presence of suitable habitat is provided in **Appendix B.**

A general description of the ecological community(ies) present in the area that is the subject of the action and in any area that is likely to be affected by the action is provided in Section 2.3. More detailed information on the EECs in the study area is provided in **Section 4.2.4**.

The general locations of previously recorded threatened flora and fauna species, as recorded in the Wildlife Atlas and Pittwater Council records, are shown in **Figure 9** and Figure 10.

The DGR's state: '*that the following vulnerable, endangered or critically endangered species must be considered as **subject species**'* (see **Table 3**).

Table 3: Subject species identified in the DGR's for consideration in this Species Impact Statement

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT
Syzygium paniculatum	Magenta Lilly Pilly	Endangered	Vulnerable
Ninox strenua	Powerful Owl	Vulnerable	-
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Endangered
Phascolarctos cinereus	Koala	Vulnerable	-
Petaurus norfolcensis	Squirrel Glider	Vulnerable	-
Pteropus poliocephalus	Grey-headed Flying-fox.	Vulnerable	Vulnerable

The DGR's state: '*that the following endangered populations must be as subject species (endangered population)* (see **Table 4**).

Table 4: Subject populations identified in the DGRs for consideration in this Species Impact Statement

POPULATIONS	TSC ACT
Koala *Phascolarctos cinereus* population in the Pittwater Local Government Area	Endangered
Squirrel Glider *Petaurus norfolcensis* population on Barrenjoey Peninsula, north of Bushrangers Hill	Endangered

The DGR's state that the following endangered or critically endangered ecological communities must be considered as a subject species (ecological community) (see **Table 5**).

Table 5: Subject ecological communities identified in the DGRs for consideration in this Species Impact Statement

ECOLOGICAL COMMUNITIES	TSC ACT LEGAL STATUS	EPBC ACT LEGAL STATUS
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South West Corner Bioregions	Endangered	Endangered
Pittwater Spotted Gum Forest	Endangered	-

The DGR's state: *'These lists are not exhaustive. The role of this SIS is to determine which species may be utilizing the study area given the limitations of existing databases.'*

An assessment of the 'likelihood of occurrence' was made for threatened ecological communities, populations and species identified from a search of a 5 km radius from the centre of the ***subject site*** (co-ordinates - S 33.626 ˚ and E 151.324˚). Searches of the NSW Wildlife Atlas and the EPBC Act Protected Matters Tool were performed on the 10 February 2012. This assessment of occurrence was made using the database and other records (as outlined in the literature review), the presence or absence of suitable habitat, features (aspect and topography) of the study area, results of the field survey and professional judgement.

A full summary of the results of this data audit along with a 'likelihood of occurrence' ranking using the following terminology can be found at **Appendix B.**

- "Known" = the species was or has been observed in the Study Area
- "Likely" = a medium to high probability that a species uses habitats within the Study Area
- "Potential" = suitable habitat for a species occurs in the Study Area, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "Unlikely" = a very low to low probability that a species uses the Study Area
- "No" = habitat in the Study Area and in the vicinity is unsuitable for the species

The results of this search identified two threatened ecological communities, 21 flora species and 54 fauna (two fish, six amphibians, two reptiles, 33 diurnal birds, two nocturnal birds, five mammals (non-bats) and four bat species) listed as threatened under either the TSC and/or EPBC Acts have been recorded or are predicted to occur within a 5 kilometre radius of the ***subject site***. (**Appendix B**).

For each community, species and endangered population, their likelihood of occurrence was evaluated by reviewing the ecology, biology, habitat preferences, habitat availability, and location and timing of each local record. Those species, populations and ecological communities considered to be known, likely to occur or with the potential to utilise the site from 'time to time' are considered as initial ***subject species*** for the purposes of this SIS and are provided in **Table 6**.

The data base search also identified 10 migratory bird species that have either been recorded or are predicted to occur within a 5 kilometre radius of the ***subject site***. Migratory species are a consideration under the EPBC Act and as such are considered no further in this SIS.

The final subject species, populations and ecological communities for this SIS as determined by the process outlined in **Section 5** and listed in **Table 6**.

Table 6: Final list of subject species for targeted survey in the study area

COMMON NAME	SCIENTIFIC NAME	TSC ACT	LIKELIHOOD OF OCCURENCE
Powerful Owl	*Ninox strenua*	Vulnerable	Recorded
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Vulnerable	Recorded
Eastern Freetail-bat	*Mormopterus norfolkensis*	Vulnerable	Recorded
GHFF	*Pteropus poliocephalus*	Vulnerable	Recorded
ECOLOGICAL COMMUNITIES			
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South West Corner Bioregions		Endangered	Recorded
Pittwater Spotted Gum Forest		Endangered	Recorded

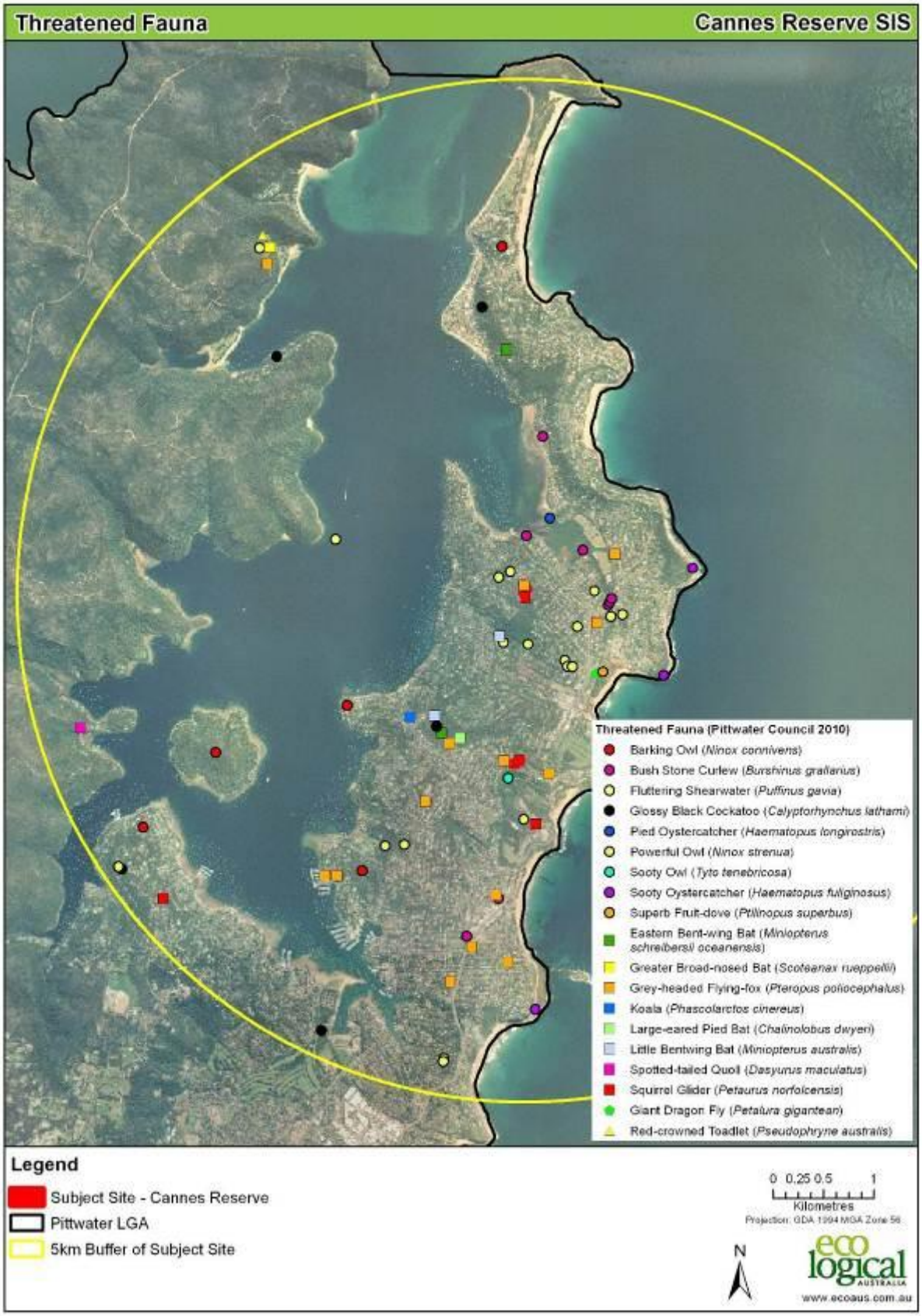

Figure 9: Records of threatened fauna in the 5km radius of Cannes Reserve.

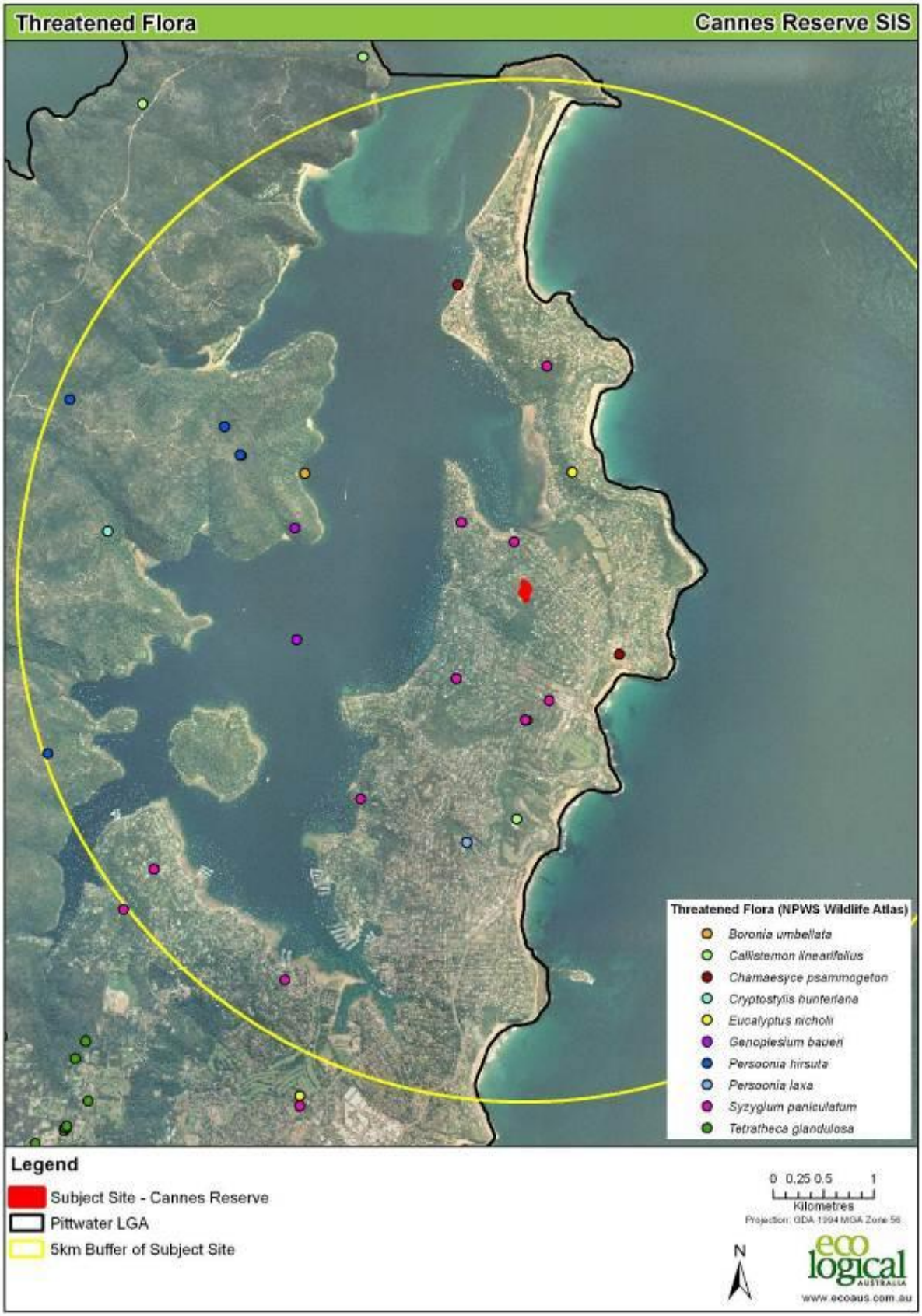

Figure 10: Records of threatened flora in the 5km radius of Cannes Reserve.

4 Survey

4.1 REQUIREMENT TO SURVEY

The DGR's state: '*Flora and fauna surveys are to be conducted in the area. Targeted surveys must be conducted for all subject threatened species, populations and ecological communities determined in accordance with s*ection 3.

'*Surveys are to be commensurate with the biology/ecology of the subject threatened species following appropriate methodologies from OEH's Threatened Species Survey and Assessment (TSSA) Guidelines (DEC 2004) except where specific requirements are outlined within the DGRs). Previous surveys and assessments can contribute to addressing these requirements where they have been conducted and documented in accordance with the specified provisions.'*

Flora and fauna survey undertaken were undertaken in accordance TSSA Guidelines, and are discussed in Section 4.2.1.

4.2 DOCUMENTATION OF SURVEY EFFORT AND TECHNIQUES

4.2.1. Description of survey techniques and survey locations

The DGR's state: '*Survey technique(s) must be described and, where possible, a reference supporting the survey technique employed is to be provided.'*

In this section a brief description of the survey techniques, reasons for the use and survey locations are provided. All of the targeted flora and fauna surveys discussed here were conducted within Cannes and Gunyah Place Reserves. Targeted surveys descriptions are provided for each fauna guild. Surveys were conducted either in conjunction or sequentially during the site visits that were conducted on the 13th, 17th and 20th of February 2012. Survey effort is shown in Figure 11**.**

Climatic conditions leading to and during each survey

The weather conditions and season during the survey period were considered appropriate to undertake the habitat assessment, targeted flora and fauna surveys. In general the weather conditions consisted of mild day and night time temperatures. Several periods of high rainfall were recorded with falls of up to 69 millimetres (mm) occurring on 20 of February. Thus, conditions were adequate to undertake frog survey.

The weather conditions leading up to and during surveys are shown in **Table 7**. Data is from the nearest Bureau of Meteorology (BOM) weather station at Terrey Hills, Sydney which is located approximately 6 km south-west of the study area.

Table 7: Weather conditions recorded during field work record from Terrey Hills, Sydney NSW

DATE*	MINIMUM TEMPERATURE (°C)	MAXIMUM TEMPERATURE (°C)	RAINFALL (mm)
14/02/2012*	16.7	23.6	3.0
17/02/2012*	17.0	26.9	0.0
22/02/2012*	15.9	23.8	0.0

Source: http://www.bom.gov.au/

Amphibians

The DGRs did not specify survey requirements for particular frog species in this SIS, although it was suggested that guidance on methods and survey effort should be taken from the Threatened Species Survey and Assessment (TSSA) Guidelines (DEC 2004) and Threatened Species Assessment Guidelines: Field survey methods for fauna – amphibians (DECC-2009).

Surveys conducted to target subject threatened frog species included two daytime searches for a period of two person hours (one hour effort on each of the 13th and 20th of February) and two nights nocturnal survey with call play back of target species, for a total effort of one person hour (30 minutes over two nights). Frog species recorded on site were identified within the field by call recognition or from captured specimens with the assistance of Robinson (2004) and Griffith (2006). Any unfamiliar frog calls were recorded for identification back at the office.

Targeted surveys for threatened frog species and their known habitats were conducted in conjunction with other surveys undertaken on the 13th and 20th of February 2012. Diurnal and nocturnal searches involved random meanders along the drainage lines and throughout all traversable sections of vegetation (Figure 11). Diurnal searches were conducted by lifting rocks, logs and assorted debris. Call back surveys were conducted from two locations, one near the centre of the Cannes Reserve and the other behind 29 Therry Street (Figure 11). These surveys involved playing the recorded reproductive calls of male frogs through an amplifier for 5 minutes followed by 10 minutes listening for return calls. Call back surveys were conducted for Red-crowned Toadlet (*Pseudophryne australis*) and Giant Burrowing Frog (*Heleioporus australiacus*). Call back for each species was undertaken twice on each survey night.

Reptiles

The DGRs did not specify survey requirements for particular reptile species in this SIS, although it was suggested that guidance on methods and survey effort should be taken from the TSSA Guidelines (OEH 2004).

The survey methods employed during this study to detect subject threatened reptiles species in Cannes Reserve included:

- Daytime habitat searches for 30 minutes on each of two separate days.
- Spotlighting for 30 minutes on each of two separate nights.
- Incidental sightings were recorded while ecologist was present within the study area.

The ***subject site*** was searched for suitable reptile habitat including rocky outcrops and fallen logs and that provide shelter, basking and foraging habitats for the species (DEC 2004).

Surveys were undertaken as a meander through the traversable vegetation within and around the boundary of Cannes and Gunyah Place Reserves. Survey effort totalled approximately2 person hours (1 hour effort on the 13th and 20th of February). Reptile species were identified using Wilson and Swan (2011).

Diurnal avifauna

The DGRs did not outline specific survey requirements for birds for this SIS, although it was suggested that guidance on methods and survey effort should be taken from the TSSA Guidelines (DEC 2004). The survey methods employed during this study included morning and evening bird surveys, conducted on two separate occasions (13th and 20th February 2012). Bird surveys were employed an 'area search method' as defined in the TSSA Guidelines (DEC 2004). This involved traversing site for at least 30 minutes in the morning and evening searching for and identifying all of the birds that were observed or heard calling within the ***subject site*** and adjacent area (Figure 11). A total survey effort of 4 person hours was spent undertaking area search surveys for bird species at Cannes Reserve. Visual surveys were conducted using binoculars. All additional species that were observed or heard opportunistically were also recorded. Birds were identified using Pizzey and Knight (2007) and Morcombe (2011). Slater (1994) suggested that survey effort of at least 100 to 150 minutes are required (depending on the structure of the vegetation, time, mobility of species present and climatic factors) to obtain a complete bird species list while undertaking area search methods. The methods employed and the survey effort that was undertaken in Cannes Reserve was deemed sufficient because of the small size of the site, the generally weedy nature of the site and the mix of sparse and structurally rich vegetation. However, as many bird species are seasonal visitors, it is unlikely that the surveys undertaken for this SIS will comprise the full list of species that would utilise the site.

Nocturnal avifauna

Powerful Owls are known to occur within the Avalon area and were recorded within the reserve on the during the first site visit. Consequently, no further field surveys were undertaken to detect the species. However, searches were still undertaken to determine the presence or absence of suitable breeding and/or roosting sites and foraging habitat within the ***subject site***.

Traverses of the ***subject site*** were made on foot to search for evidence of owls through their distinctive pellets, large hollows (potential nest sites) and roost trees (Figure 11). A 30 minute daytime visual and 30 minute nocturnal spotlight search was also conducted. Nocturnal call back surveys were undertaken for Barking and Masked Owls in conjunction with the other nocturnal surveys. Call back surveys were conducted over a single night and involved playing the territorial calls of each species for 5 minutes followed by ten minutes listening for responses. Each species distinct call was played twice on each occasion.

Mammals (excluding bats)

The DGRs did not specify survey requirements for particular mammal species in this SIS, although it was suggested that guidance on methods and survey effort should be taken from the TSSA Guidelines (DEC 2004). A variety of individual methods were used to be certain that all species present had some likelihood of being recorded. Previous studies have shown a biased towards certain animal groups towards certain survey techniques (Catling *et al.* 1997).

The survey effort for mammals involved a combination of remote sensing and non-invasive techniques. This included the use of hair-tubes, remote movement sensing cameras, call back using territorial calls, stag watching and spotlighting. Each technique and how it was applied during the present survey are outlined below.

Arboreal - Tree mounted hair tubes. Ten survey stations containing three tubes (including 1 large and 2 small hair-tubes with 250mm and 50mm diameter openings respectively) were set on the 7 February 2012 and collected on the 20 of February (2012) (Figure 11).

Arboreal hair tubes (70 x 150mm diameter and 140 x 50mm diameter openings) targeting arboreal Squirrel Gliders were attached to branches and tree trunks using cable ties. Each hair tube station was located in an area that contained suitable fauna habitat in the form of a hollow bearing tree or dense overstorey and midlevel vegetation. Hair tubes were baited with a mixture of honey, peanut butter, rolled oats and vanilla essence. A mixture of one part honey and three parts water was sprayed on the entrance of the hair tube, branches and tree trunk at each station in an attempt to attract the insectivorous mammalian fauna, including the threatened species, Squirrel Glider. Double sided sticky tape was placed around the entrance of each hair tube to collect the hairs of any animals that visit the hair tube. A total hair tube nights (70 x 150mm (large size) diameter and 140 x 50mm (small size) diameter openings) were undertaken across 10 arboreal stations (30 hair tubes per night). Hair-tubes have been successfully applied to assessing mammal species presence and diversity (Harris and Nicol 2010; Macak *et al.* 2010)

Hair samples were sent to Dr. Hans Brunner, an expert in fauna forensics and hair identification for analysis and species identification.

Remote Movement Sensing cameras. Arboreal mounted remote movement sensing cameras were set at three locations. The infra-red beam sensors in each camera were aimed directly at the hair tubes that were also set at the same three locations. When the sensors detect the movement of an animal the camera is triggered resulting in the camera taking a series of three consecutive photos, each 1-3 seconds apart. The time, date and air temperature is recorded each time a photograph was taken. Photographs were stored on a XD memory cards and were download to a laptop on the completion of the survey. A total of 21 Remote Movement Sensing Camera survey nights were undertaken across the three sites.

All photographs were examined for the presence of animal activity. Species were identified using Menkhorst and Knight (2010) and Van Dyck and Strahan (2008).

Remote sensing camera have become widely used in fauna survey and monitoring programs (Wemmer *et al.* 1996). The use of remote sensing cameras has several effort and cost advantages over conducting live capture survey techniques including:

- Non-intrusive to the animals
- Areas can be monitored with minimal human disturbance.
- Animals do not need to be captured and stressed.
- Increased detectability of shy cryptic species that are often difficult to capture using conventional trapping methods.

Spotlighting. Spotlighting surveys was conducted over two nights on the 13th and 20th of February. Additional spotlighting was also undertaken on the 20th of February Stapleton Park along Riverina Road (Figure 11).

Call playback surveys. Vocal call back surveys targeting Squirrel Gliders were undertaken from one location within Cannes Reserve over two separate nights (Figure 11). The territorial calls of male Squirrel Gliders were played continuously for five minutes followed by 10 minutes of listening for reply calls. This was repeated on three separate occasions during on each survey night.

Stag watching. Stag watching was conducted at a large dead stag within the southern section of Cannes Reserve (Figure 11). The stag watching survey involved watching the largest dead tree for 30 mins prior and 60 min following sunset over two separate survey nights.

Active searches. Day time active searches were undertaken to locate evidence of presence in the form of individual animals, skeletal remains, scats, tracks and hair. Searches were also made of potential nesting habitat including hollows or active nests.

The combination of these methods was considered adequate to have some certainty in determining the presence or absence of Squirrel Gliders, Koalas and other threatened mammal species at Cannes Reserve. Previous assessments have revealed that a combination of survey techniques maximises the likelihood of encountering all species that are present within a ***locality*** (Catling *et al.* 1997).

Micro-chiropteran bats

The DGRs did not outlined specific survey requirements for micro-chiropteran bats. But we followed the suggested methods provided in the TSSA Guidelines (DEC 2004).

Survey work as part of this SIS utilised two Anabat detectors across three consecutive nights on the 13th, 14th and 15th of February 2012. Each Anabat detector was placed at separate locations within the study area and left at the identical location for the entire survey (Figure 11). Each Anabat device was programmed to begin recording prior to dusk at 1800hr and turn off the following morning at 06:00hr. The Anabats were left off outside these periods to extend battery life.

Additional Anabat recordings were undertaken in conjunction with stag watching on the 13th and 20th of February 2012. The stag watching was conducted at a large dead stag present within the centre of the site.

A single Anabat recording device was placed 30m from the base of the stag and was programmed to begin and stop recording at 1930 hrs and 2100 hrs respectively. Anabat calls were downloaded in the office and analysed by Peter Knock of ELA, Coffs Harbour.

Bat calls were analysed using the program AnalookW (Version 3.7w 31 December 2009, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay *et al.* 2004); and south-east Queensland and north-east New South Wales (Reinhold *et al.* 2001) and the accompanying reference library of over 200 calls from north-eastern NSW (http://www.forest.nsw.gov.au/research/bats/default.asp).

Bat calls are analysed using species-specific parameters of the call profile such as call shape, characteristic frequency, initial slope and time between calls (Rinehold *et al.* 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd *et al.* 2006) were followed:

- Recordings containing less than three pulses were not analysed (Law *et al.* 1999) and are labelled as short.
- Only search phase calls were analysed (McKenzie *et al.* 2002).
- Four categories of confidence in species identification were used (Mills *et al.* 1996):
  - definite – identity not in doubt
  - probable – low probability of confusion with species of similar calls
  - possible – medium to high probability of confusion with species with similar calls
  - unidentifiable – calls made by bats which cannot be identified to even a species group

- *Nyctophilus* spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay *et al.* 2004).
- Calls not attributed to microbat echolocation calls are labelled as junk or non-Bat calls and don't represent microbat activity at the site. Calls labelled as low are of poor quality and therefore not able to be identified to any microbat species, they can however be used as an indicator of microbat activity at a site.

Vegetation and threatened flora

The vegetation communities at Cannes Reserves was assessed and ground truthed by Elizabeth Norris, a senior botanist at ELA and mapped using a GIS and recent high resolution aerial photos. The classification of these vegetation communities was based on opportunistic observations, quadrats and traverses, with vegetation being assigned to recognised types from Smith and Smith (2000), Pittwater Council.

Surveys targeting threatened flora species were undertaken on 13th and 17th of February 2012. Assessments of the vegetation were carried out by Elizabeth Norris of ELA over approximately 9 person hours (7hrs, 13th Feb and 2hrs, 17th Feb). A further five hours were spent at the Royal Botanical Gardens Herbarium confirming and identify unknown species collected while in the field.

Vegetation quadrats and transect habitat assessments included surveys within a 0.04 ha (20 m x 20 m) area, recording presence of all vascular flora species, along with cover and abundance for each species using a modified Braun-Blanquet scale (measures of cover and abundance were taken to determine species dominating each stratum). Habitat features were determined within a 0.1 ha plot (50 m x 20 m quadrats); measures included number of hollow bearing trees and length of fallen dead timber greater than 10 cm diameter. Within the 0.1 ha quadrats, projected foliage cover of each strata level and exotic flora was assessed along a 50 m transect. One vegetation quadrats was undertaken in each of the two mapped vegetation types (Figure 12).

Survey for the ***subject species***, *Syzygium paniculatum* (Magenta Lily-Pilly), can be undertaken at any time of the year, though it is preferable to confine survey to periods to when the species is fruiting as it can easily be mistaken for the more common *S. australe*. Given the small area of the site, the duration of survey and that no *Syzygium* species have previously been identified at the site in (pers obs. Andrew Jennings pers comm 2012), survey effort is considered sufficient to have identified this species if it occurred on site. The physical characteristics (such as aspect, slope and disturbance) of each location were noted and photos were taken of the quadrats along the 50 m transect line as well at points along the random meander traverses. Species were identified to the lowest taxonomic level possible, following the Flora of NSW (Harden 1992-2002) and NSW Flora online (www.plantnet.rbgsyd.nsw.gov.au).

Random meanders were also conducted throughout Cannes and Gunyah Place Reserve to search for threatened species.

Figure 11: Locations of fauna survey stations and tracks undertaken while conducting visual surveys

Figure 12: Locations of vegetation quadrats and random meanders for the flora surveys.

4.2.2. Documenting survey effort and results

The DGR's state: That each and every survey must be documented (including) name(s) of surveyors, date, time and environmental conditions of survey, time invested in applying each survey technique'

Surveyors, dates, times, environmental conditions and survey effort are documented in **Section 4.2.1**. This section provides the results of the targeted fauna and flora surveys that were undertaken within Cannes Reserve.

Fauna Habitat values

The habitat features and values in Cannes Reserve include an intact canopy, two small ephemeral waterways, fallen logs (at varies stages of decay) and a large dead tree which contained the only hollows present within the study site. Only one of the three dead stags contained sufficiently large enough hollows to support hollow dependant fauna. The location of these features is provided in **Figure 13**. It must be noted that due to the dense mats of weeds covering much of the ground, it is possible that some habitat values were not recorded. These features may only become apparent after the planned weed removal and habitat restoration described in **Section 7.**

Amphibians

One species of frog, the Striped Marsh Frog (*Limnodynastes peronii*) was heard calling from the lower section of the Cannes Reserve drainage line at the rear of 29 Therry Street on the 20th of February (**Figure 14**). Other species recorded in the study area/local ***locality*** include Common Froglet (*Crinia signifera*) and Peron's Frog (*Litoria peronii*) (Atlas of NSW Wildlife 2011; Pittwater Council pers com. 2012).

Red-crowned Toadlet and Giant Burrowing Frog are known to occur in the Pittwater LGA. However, habitat assessments at Cannes Reserve revealed limited available habitat for either species (Smith and Smith 2000; Ecotone Ecological Consultants 2011). Red-crowned Toadlet appear to be restricted to areas on Hawkesbury Sandstone where the species uses a variety of foraging, shelter and breeding habitats. This species prefers mosaics of woodland and heath habitats with ephemeral drainage lines, soaks and pools of water that persist after rainfall events (Robinson 2004). The species shelters among fallen logs, surface rocks and similar microhabitat features. These habitat features were infrequently observed within the study area (Robinson 2004).

The Giant Burrowing Frog is also generally restricted to areas dominated by Hawkesbury Sandstone, where is occupies sandy creek banks with isolated pools that are sufficiently large to retain water for an extended period to support larval growth (Robinson 1994). Although, water was present in the main drainage line at the time of the survey, it does not appear to be sufficient in size to offer potential breeding and foraging habitat to the species.

In summary, although several small pools, logs and a few small rocks were present within the survey site, it is unlikely that these elements, in the absence Hawkesbury Sandstone, would be sufficient to support Red-crowned Toadlet and/or Giant Burrowing Frog.

Reptiles

No threatened reptile species were recorded during these surveys. The only species of reptile recorded at the site was the common Speckled Garden Skink (*Lampropholis delicata*) (**Appendix C**).

The habitat in Cannes Reserve was generally regarded as being of low quality and possibly unsuitable for reptile species. This is mainly due to the dense cover of exotic weeds, including *Tradescantia fluminensis* (Wandering Jew) and *Lantana camara*. In some sections of the reserve the weeds were so dense that any potential habitat, including fallen logs with crevices or rocky crevices are completely

over-grown. In addition, there is a general absence of rocky structures, crevices and other habitat features that would offer nesting, refuge, basking substrates and breeding habitat that would normally support a range of reptile species.

Diurnal avifauna

Fifteen bird species were recorded during the current surveys (**Appendix C)**.

Assessments of the habitat within Cannes Reserve identified potential roosting, nesting and foraging habitat for an array of bird species. This habitat was in the form of a dense intact canopy and understorey vegetation. A small number of high volume nectar producing plant species, including Spotted Gum and a range of potential invertebrate prey species (especially spiders) occur within the ***subject site***. Although, there appeared to be plentiful resources present at the site, the bird diversity and abundance was considered low. Several factors may have contributed to this including.

- The highly disturbed and urbanised nature of the adjacent areas
- The offsite operation of chainsaws and lawns mowers while the surveys were being undertaken
- Cats were recorded within Cannes Reserve (a cat was recorded during the Remote Movement Sensing Camara surveys)
- Presence of large native predatory birds such as the Powerful owl and Brown Falcon (Falco berigora)
- There is quality habitat off-site in Stapleton Park and Angophora Reserves
- Prevalence and dominance of weed species
- Dumping of lawn clippings

Although, native and exotic birds are known to use Lantana as a food and cover resource, this invasive plant species often forms dense mono-specific stands that exclude native plants vital to the survival of a range of native bird species. This is definitely the case within Cannes Reserve, which as previously stated is severely infested with a range of weed species.

Previous assessments identified 233 bird species within the Pittwater LGA (Smith and Smith 2000; Ecotone Ecological Consultants 2011; Coughlin 2007). Of the 233 species, 68 are either marine or aquatic and would not occupy the site.

The endangered winter migrant, the Swift Parrot has been recorded in the Mona Vale, Warriewood, Irrawong, Ingleside, Toongaria and Deep Creek Reserves as well as the Bayview Golf Course in the Pittwater region (Smith and Smith 2000). This species was recorded in high numbers in the late 1930's but since then it has only been recorded infrequently and generally in low numbers (Smith and Smith 2000). Historically this species has been recorded in years when there is unusually high *Eucalyptus robusta* blossom.

According to the Atlas of NSW Wildlife, only one Superb Fruit-dove record exists within a 5 km radius of the ***subject site***. Due to the low records of this species, it is considered that there is low likelihood of this species occurring within Cannes Reserve.

The Gang-gang and Glossy-black Cockatoos are also known to occur within the Pittwater LGA (Smith and Smith 2000). The ***subject site*** may provide short term foraging habitat only. There are few opportunities for nesting and breeding habitat for these species due to an absence of large hollow bearing trees and potential food plant species. Both species have been recorded from Ku-Ring-gai Chase National Park, Avalon, Palm Beach, Newport, Bayview, Church Point and Browns Bay on the

Barrenjoey Peninsula. These species may be locally nomadic and move through the region in response to the availability of food resources (Smith and Smith 2000). Both species have particular dietary and nesting requirements. This includes seeds (especially *Allocasuarina* species for Glossy-black Cockatoos), berries and insect larvae species and requires large deep hollows in old *Eucalyptus* trees for nesting (Pepper *et al.* 2000). However, there has been no evidence that of Glossy-black Cockatoos breeding in the region (Smith and Smith 2000).

Better quality nesting, refuge and foraging habitat occurs offsite in Stapleton Park, Toongari, Warriewood, Irrawong and Angophora Reserves, which are located in relatively close proximity to Cannes Reserve. These reserves contain stands of important food trees including *Banksia spinulosa* (Old Man Banksia), *E. robusta* (Swamp Mahogany), *Melaleuca quinquenervia* and *Allocasuarina littoralis* (Black She-oak) (Smith and Smith 2000; Pittwater Council 2002; Per obs. 2011). Potential nesting and breeding habitat in the form of large hollow bearing *Angophora costata* (Sydney Red Gum) and *C. maculata* were common throughout Stapleton Park and Angophora Reserves. Considering the high levels of mobility and general foraging requirements among these species there is considerable capacity for them to forage and roost in other areas of suitable habitat.

Nocturnal Birds

Neither Barking nor Masked Owls were recorded during the surveys undertaken for this SIS. Both species have been previously been recorded in the Pittwater LGA. Historically, Barking Owls have been recorded in Avalon, Deep Creek, Ingleside, Scotland Islands, Palm Beach, Warriewood and in areas south of Taylors Point (Pittwater Council 2012). More recently and between 2003 and 2008 the species has been recorded from the Church Point/Bayview areas and Elanora Heights. Historically, Masked Owls have been recorded in the Avalon, Newport and Warriewood areas (Pittwater Council 2012).

The Powerful Owl was recorded on two separate occasions in Cannes Reserve (**Figure 15:** Locations of threatened fauna records). The first sighting occurred on the 6th of February during the initial site inspection meeting between ELA, OEH and Pittwater council representative. The owl was observed perching in LR at the eastern corner of Cannes Reserve, near 29 Therry Street, and subsequently amongst the Cheese Trees in Gunyah Place Reserve. Powerful Owls were also heard calling from among residential areas and Stapleton Park during both nocturnal surveys. This suggests that this species is utilising a range of natural and urban habitats within the adjoining areas. In addition, adult pairs and young were recently recorded in several of the adjoining valleys (Andrew Jennings of Pittwater Council pers. comm. 2012).

The ***subject site*** provides potentially roosting and important foraging habitat for these owl species. Both day-time Powerful Owl sightings were made in close proximity to the GHFF colony. Evidence suggesting that the Powerful Owls prey upon the Cannes Reserve GHFF was located at 29 Therry Street in form of large clumps of fur. At Ku-Ring-gai and the Sydney Botanic Gardens, GHFF have been shown to be an important food resource for this species (Kavanagh 1993; Pallin 2000). Other important dietary species including Common Ringtail Possums and Common Brush-tail Possums were recorded and are known to occur in the Cannes Reserve and adjacent areas (Smith and Smith 2000; Ecotone Ecological Consultants 2011). Common-Ring-tail Possum (*Pseudocheirus peregrinus*), Common Brush-tail Possum (*Trichosurus vulpecula*), Greater Glider (*Petauroides volans*) and Sugar Glider (*Petaurus breviceps*) have been shown to contributed to 99% of the Powerful Owl diet (Kavanagh 1993; Cooke *et al.* 2005).

Cannes Reserve may form an important foraging habitat for these owl species, however, Cannes Reserve is unlikely to offer critical nesting and breeding habitat to these owl species, due to a general

absence of large mature hollow bearing trees. Powerful Owls, prefer to nest and breed in hollows that have a diameter greater than 45cm, are 100cm deep and are surrounded by canopy and understorey trees (DECC 2006). In contrast, trees with considerable nesting potential in the form of sufficiently sized hollows were observed among Stapleton Park and Angophora Reserves (Pittwater Council 2002a, 2002b).

Mammals (excluding bats)

Four native and one introduced mammal species were recorded (**Table 8** and **Appendix C**).

A breakdown of the results of each method used to survey for Squirrel Gliders and other threatened mammal species in (**Table 8**)

Table 8: Mammal species recorded by each survey method employed

SURVEY METHOD	SPECIES RECORDED
Hair tubes	Brush-tailed Possum
Remote sensing camera	Brush-tailed Possum, Common Ringtail Possum, Brown Antechinus and Domestic Cat.
Call playback	Nothing recorded
Spotlighting	Brush-tailed Possum, Common Ringtail Possum and Feather-tail Glider
Stag watching	Nothing recorded

None of the subject mammal species identified on the DGR's, including the Squirrel Glider and Koala were recorded during the field surveys. The lack of Koalas and Squirrel Glider observations was not unexpected. Only a small number of recent (last 20 years) and very infrequent Squirrel Glider records exist from near the study area. This includes records from a residential house in Cannes Drive, Sanctuary Cove (unsubstantiated report from a Household Species Survey conducted in 1993), Palgrove Road and Prince Alfred Parade in Avalon, a female with two pouch young from Careel Bay (Smith and Smith 2000; Pittwater Council 2011). In 2001 an injured Squirrel Glider was found in a backyard in the Cannes Drive house that backs onto Stapleton Park. This individual appeared to have been attacked by a cat, was taken to a veterinary hospital and released after treatment (Pittwater Council 2011a). There have been no further Squirrel Gliders recorded in the ***locality*** since this date. In addition, the Atlas of NSW Wildlife database has just two records of Squirrel Glider records within a 10km radius of Cannes Reserve.

Squirrel Gliders prefer woodlands and open forests with an overstorey dominated by *Eucalyptus*, *Angophora* and *Corymbia* with shrubby *Acacia* and *Banksia* dominated understorey (van der Ree and Suckling 2008). They typically live in social groups and occupy tree hollows that have tight fitting entrances (van der Ree and Suckling 2008). Although, the habitat present within Cannes Reserve appears suitable to support short term foraging activities or refuge to dispersing individuals, the site lacks the high nectar producing plant species and sufficient numbers of hollow-bearing trees required to support a viable population of this species. There is one large hollow bearing tree present within the ***subject site*** that has the potential to provide nesting habitat for the species. This tree was the focus of the stag watching surveys. More typical habitat in the form of abundant tree hollows and high nectar producing plants are present within the Stapleton Park, Toongari and Angophora Reserves (Pittwater

Council 2002). Therefore, if the species is present in the area it may rely on these reserves and the connecting habitat among the urban residential dwellings (Pittwater Council 2002a; 2002b).

The absence of Koala observations was expected, due to the apparent extinction of this species from the region (Smith and Smith 2000). There is considerable habitat in the form of potential feed trees present in the region. This is especially the case for the nearby Stapleton Park and Angophora Reserve, which have both been identified as important refuge for Koala's.

Between the 1930's and 1970's Barrenjoey Peninsula's koala population was regarded as one of the largest and best known colonies in Sydney. At this time population estimates had the population containing approximately 120 individuals. Since the 1970's there has been a gradual decline in densities to a low of approximately 6 individuals at the end of the 1990's. Koalas suffered a massive decline from the 1970's most likely due to urban expansion, dog attacks, being hit by cars and disease (Smith and Smith 2000). No Koalas have been reported in the region since 2000 (Ecotone Ecological Consultants 2011).

Micro-chiropteran Bats

Seventy definite and useable micro-chiropteran bat call sequences were recorded across the six survey nights and two stag watch nights (**Appendix C**). There were four species of micro-chipteran bats recorded, including two threatened species, the East-coast Freetail Bat and Eastern Bentwing-bat. Non-threatened species recorded were the Chocolate Wattled Bat (*Chalinolobus morio*) and Gould's Wattled Bat (*C. gouldii*). Of these, the most commonly recorded species was the Gould's Wattled Bat, which is known to forage and roost in open forest, mallee, dense forest, tall shrubland and urban areas (Dixon and Lumsden 2008). The Chocolate Wattled Bat and Gould's Wattled Bat have been known to rest or occupy tree hollows, tree sprouts, ceilings and basements of urban buildings during the day time. The ***subject site*** and the surrounding areas supports suitable habitat for Gould's Wattled Bats. Raw analysis data can be viewed in **Appendix D**.

In contrast, the two threatened species were only recorded on one survey and only four calls for each. The location of where each species was recorded is shown in **Figure 15**. The low numbers of calls suggests that Eastern Free-tail Bat and Eastern Bentwing-bat may only infrequently use the study area or occur in low numbers at the site (Knock pers. comm. 2012). It is unlikely that the ***subject site*** support roosting or breeding habitat for either threatened species due to an absence of caves, culverts, deep rock fissures or cracks.

Mega-chiropteran Bats

The location of the GHFF camp is shown in **Figure 15**. During the current survey it was estimated that 150 - 200 individuals were present within the camp.

Flora

A total of 135 flora species (55 native and 80 introduced species) were recorded at Cannes Reserve during the present survey. Previous surveys undertaken within Cannes Reserve identified a further 5 native and 11 introduced species (Pittwater Council 2011) (**Appendix D**). To date, a cumulative total of 151 species (60 native and 91 introduced) have been recorded within Cannes Reserve. No threatened species or regionally significant species listed under the TSC Act, EPBC Act or Rare or Threatened Australian Plants database, were recorded during this survey.

Survey Limitations

It is possible that some fauna species were not detected due to life history traits, behavioural attributes and/or environmental factors such as site history and disturbance. This limitation is reduced through the collation of previous survey effort including Smith and Smith (2011) and Pittwater (2001).

Obtaining a full flora species list can be limited by seasonality, with best practise for survey generally being within the spring and summer months (except when surveying for specific flora species that may be flowering at other times of year; DEC 2004).

The flora survey recorded as many species as practicable within the seasonal and timeframe constraints of this SIS, and provides a comprehensive but not definitive species list. A more comprehensive species list would be attainable with further survey over several seasonal periods. Limitations of the present survey were reduced through the collation of previous survey data results from Pittwater Council (2011). Given no threatened flora were considered known, likely or with the potential to occur onsite flora survey is considered adequate for the purposes of this SIS.

Description and mapping of results of vegetation, flora and fauna surveys

The DGR's state: *The locations of any newly recorded threatened species or endangered populations resulting from the additional surveys must be mapped and described. The mapping of vegetation required under section 2.3 must reflect any new information resulting from the additional surveys.*

There was no newly recorded threatened amphibian, reptile, diurnal bird or mammals recorded within the ***subject site***. Furthermore, the four threatened fauna species (Powerful Owl, East Coast Freetail Bat, Eastern Bentwing-bat and GHFF) and the two EECs (LR and PSGF) have either been previously recorded within Cannes Reserves or within the adjacent surrounding areas.

Survey effort and results from the flora and fauna surveys are provided within **Figures 12 – 16.**

Description and mapping of results of endangered ecological community surveys

Littoral Rainforest of the NSW North Coast, Sydney Basin and South-east Corner Bioregions

LR is the dominant vegetation community in Cannes Reserve and occupies 0.4ha (75.5%). This is consistent with Pittwater Council PoM (2011) mapping. The core section of the LRF community is associated with the riparian zone that passes through the centre of the survey site. Nomenclature, extant, conservation status are provided.

The dominant canopy species identified in the survey plots included *G. ferdinandi* (Tree) and *J. mimosifolia*. Additional canopy species recorded included *L. australis*, while the mid-stratum was dominated by *Ficus coronata* and *L. sinense*. Groundcovers were dominated by the exotic perennial herb *Tradescantia fluminensis* (**Figure 17** and **Figure 18**).

Characteristic species of LR are provided in **Table 9.** A full flora inventory of the species recorded within the LR plot is available at **Appendix D.**

Table 9: Littoral Rainforest nomenclature, extant, conservation status, vegetation composition and structure within the Subject site/Study Area

NOMENCLATURE	
Other classifications	Littoral Rainforest (Pittwater (2011), Coastal Escarpment Littoral Rainforest (S_WSF11) (DECC 2008) Littoral Rainforest (Littoral Thicket and Temperate Littoral Rainforest) (Tozer *et al.* 2006), Coastal Littoral Rainforest SMCMA (2010) name, Floyd (1990), Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (EPBC Act 1995)
CONSERVATION STATUS	
Extant in ***Locality*** (5km radius)	25.76ha (derived from Pittwater 2011) and 16ha (SCIVI).
Pittwater (2011)	Littoral Rainforest covers 0.005% of the Pittwater LGA. Half has this extent occurs outside the protection of Pittwater's parks and reserves. Pittwater Council aims to protect and enhance the quality of the LR through restoration programs, weed removal and encouraging community stewardship.
VEGETATION COMPOSITION AND STRUCTURE	
Canopy	*Glochidion ferdinandi, Livistona australis, Syncarpia glomulifera* and *Jacaranda mimosifolia* (Projected foliage cover 60%)
Sub-canopy	-
Mid-stratum	*Ficus coronata* and *Ligustrum sinense** (Projected foliage cover 55%)
Vines and climbers	-
Groundcover	*Tradescantia albiflora**

*Exotic species

The structure and composition of this community is typical of LR Sub-alliance 19 that occurs south of South West Rocks and in protected gullies and away from the ocean (Floyd 1990; DECC 2008).

As noted previously, LR vegetation onsite is consistent with the TSC Act listed EEC, though it is does not meet the condition thresholds of the EPBC Act listed Critically Endangered Ecological Community (CEEC) given that, the cover of 'transformer weed species' is >70% (DEWHA 2008) (weed coverage averaged across several survey points was approximately 70%). The majority of this EEC within Cannes Reserve was found to be in a highly degraded state and was densely infested by exotic weeds (**Figure 20**).

Pittwater Spotted Gum Forest

Pittwater Spotted Gum Forest is represented by two forms in the Pittwater LGA, the wet form and the dry form (Pittwater 2011). The wet form is the only form of the (PSGF) is the only form present within ***subject site*** and occupies 0.11ha (20.8%) of Cannes Reserve (). The PSGF community was generally confined to several small patches located on the eastern and south east of the site. Further, two smaller patches are located on the south western arm that is adjacent to Cannes Drive. The characteristic species and structure of this community include tall *C. maculata*, *L. australis* and *S. glomulifera*. Nomenclature, extant, conservation status is provided in **Table 10**.

The dominant species in the canopy included *C. maculata* (**Table 10**). While there is a general absence of sub-canopy, and the mid-stratum and ground covers are over grown with exotic weeds (Figure 19). A full flora species inventory is available at **Appendix D**.

Table 10: Pittwater Spotted Gum Forest nomenclature, extant, conservation status, vegetation composition and structure within the *Subject site*/Study Area

NOMENCLATURE	
Other classifications	Hunter-Macleay Dry Sclerophyll Forests (Kieth 2004) and Hunter-Macleay Dry Sclerophyll Forests (DECC 2008),
CONSERVATION STATUS	
Extant in ***Locality*** (5km radius)	231ha (derived from Pittwater 2011) and 107ha (SCIVI).
Pittwater (2011)	PSGF is well represented within the region both in protected reserves and on private property.
VEGETATION COMPOSITION AND STRUCTURE	
Canopy	*Corymbia maculata* (Projected foliage cover 5%)
Mid-stratum (1)	*Glochidion ferdinandi* (Projected foliage cover 70%)
Mid-stratum (2)	*Ligustrum sinense**, *Lantana camara**, *Ficus inornata* (Projected foliage cover 70%)
Vines and climbers	
Groundcover	*Tradescantia fluminensis* (Projected foliage cover 70%)

Figure 13: Fauna habitat values recorded in Cannes Reserve

Figure 14: Location of the nocturnal fauna records

Figure 15: Locations of threatened fauna records

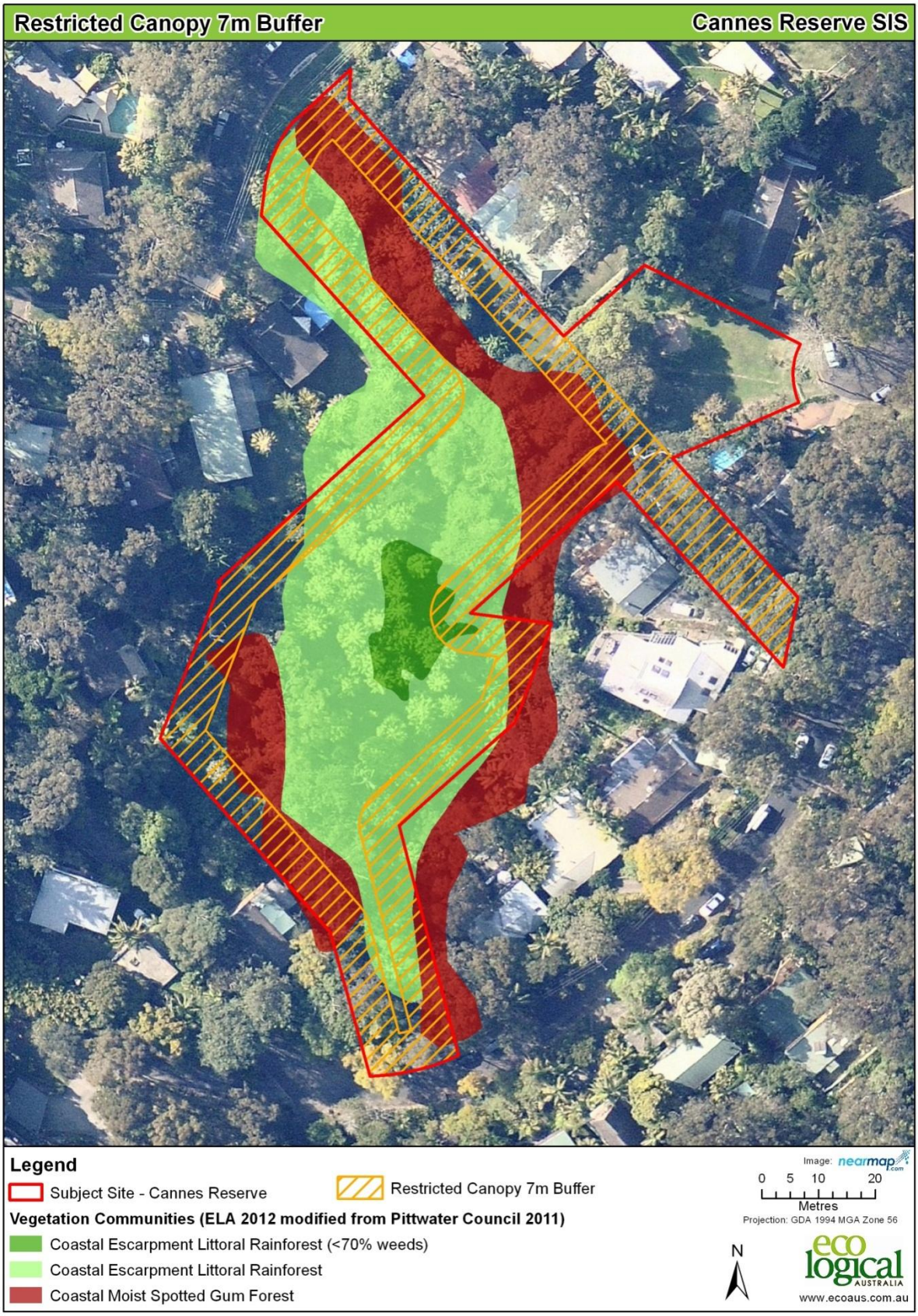

Figure 16: The mapped vegetation communities that occur in Cannes Reserve

Figure 17: Littoral Rainforest at the Subject site

Figure 18: Weed infested Littoral Rainforest

Figure 19: Spotted Gum Forest and stag at the Subject site

4.3 SPECIFIC SURVEY REQUIREMENTS

Grey-headed Flying-fox (Pteropus poliocephalus)

The DGRs state that: *'The SIS must include all available population data for the Cannes Reserve GHFF colony based on past and current monitoring. This must include the results of the population monitoring required by the conditions of the Section 95(2) certificate issued by OEH to Pittwater Council on 8th July 2011.* The applicable conditions are as follows.'

- Camp numbers will be verified by ongoing monitoring by appropriately trained Council Staff or volunteers, as agreed by OEH.
- Camp assessments and local populations counts of Cannes Reserve must be continued on at least a fortnightly basis until immediately prior to the proposed disturbance when a count will be done the day before the works, on the day, on the day after, one week later and then monthly thereafter until at least June 2012.
- The numbers of GHFFs at the Cannes Reserve camp leading up to and after the works and the gender ratio within the camp. If additional information can be sought as to whether there are juveniles in the roost, this information should be included.

GHFF camp numbers were verified and monitored by Andrew Jennings, Bushland Management Officer and Sonja Elwood, Environmental Projects Officer from Pittwater Council. Counts were conducted at the Cannes and Warriewood Reserve colonies. Only those staff considered to have been appropriately trained as agreed by OEH was to conduct the counts of the GHFF at Cannes Reserve.

Counts are ongoing and have been undertaken in accordance with the Section 95(2) license, as outlined above.

The results to April 2012 show that the GHFF camp has been permanently occupied at the Cannes Reserve since the counts began in February 2009. This differs from the Warriewood camp which is only used occasionally (**Table 11**). The GHFF camp is limited to the gully in the northern section of Cannes Reserve as shown in **Figure 15**.

The results of the counts show that camp numbers have fluctuated significantly through time (**Table 11**). For example, lows of between 5 and 80 individuals were recorded during the survey on the 20th February 2009, with a peak of 1,065 individuals recorded on 24th June 2010. A similar short term peak was recorded at Warriewood where GHFF numbers went from a low of 160 (month/year) to a peak of 3,425 in month/year. The high numbers of GHFF at Warriewood Reserve and Cannes Reserve may represent overflow from Ku-ring-gai Flying-fox Reserve, where between 30,000 and 37,000 individuals were reported to have been present between January to April 2010 (Nancy Pallin - Ku-Ring-Gai Flying Fox Reserve pers. comm. 2012). However, with the exception of a peak of 825 individuals in June 2011, the counts have remained stable since August 2010 between 200 and 300.

The sudden increase and rapid decline in camp numbers at Cannes and Warriewood Reserves may reflect sudden and short term increase in the availability of a particular food resource (Eby and Law 2008; Roberts 2006). GHFFs have no adaptive capacity to withstand food resource decline, therefore camp occupation patterns vary from being often, permanent and/or rarely visited (Eby and Law 2008). The boundary of the camp is dynamic and camp has been shown toThe status and occupancy rates of most camps is generally related to the availability of food resources that are located within nightly feeding distance of 25km to 50km from roost sites (Eby 1995: Roberts 2005). Therefore, it is possible that GHFF from this camp are taking advantage of the increased planting of nectar and fruit producing

trees. In recent years, camp numbers in the region have fluctuated with the level of flowering among local and regional Swamp Mahogany (*Eucalyptus robusta*) (N. Pallin pers. comm. 2012). Furthermore, the increased occurrence of GHFF camps in urban areas may be a response to planting of favoured food species in street and backyard plantings (van der Ree *et al.* 2006).

It also appears that the previous works undertaken under the section 95 Certificates, weed removal and habitat restoration works have had little impact on reducing the numbers of GHFF or moving the camp towards the centre of the reserve. However, the works may have stabilised the camp numbers around the 200-300 individuals (**Table 11**).

Table 11: GHFF count results leading up to and following the proposed works in 2010 and 2011.

Year	2009	Avalon	2010	Avalon	Warriewood	2011	Avalon	Warriewood
Month	Day	No. of individuals	Day	No. of individuals		Day	No. of individuals	
January			15	160	160		362	
February	20	5-80	19	180			360	
March	20	0	19	190			420	500
April	17	90-100	16	1140			360	
May	15	95	21	598			260-300	
June			8	870	2752		250-270	
			10	618	2665		825	
			12	410			250	
			15	920	3350		270	
			17	1012	3425			
			24	1065	2488			
July			3	535			285	
			8	503			290	
			22	343			270	
							280	
August	19	75	5	370			250-270	
	21	155	19	568			280	
			19	222			290	
September	18	140	2	232			300	
October	15	200		257		13	<320	
						18	<250	
						27	250	
November	15	165		223		3	225	
						11	<250	
						26	210*	
December	18	160		248				

Information source: Pittwater Council 2011a and Andrew Jennings pers comm. 2012.
* Juveniles present
Highlighted sections represent peaks in GHFF counts.

5 Assessment of Likely Impacts on Threatened Species and Populations

The DGRs state: '*Assessments of impacts must consider the nature, extent and timing of the proposal and all associated actions. The assessment must include the **direct and indirect** impacts of these activities which may occur both **on and off** the **subject site**.'*

5.1 ASSESSMENT OF SPECIES LIKELY TO BE AFFECTED.

The DGR's state that: *'An assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action.'*

The ecology and biology of each threatened species and population identified as potentially occurring within the ***locality*** is discussed in the following sections.

The initial identification of ***subject species*** (**Section 3**) identified one threatened flora species, 11 threatened fauna species, and two endangered populations are either known, likely or have the potential to occur within the study area. Following targeted field survey for the initial list of ***subject species***, and consideration of the likely impacts from the proposed activities, the list of has been refined to four threatened species that are known to be present and potentially (either adversely or beneficially) "affected" by the proposal and therefore require further consideration in accordance with section 5 of the DGRs (**Table 12**):

- Powerful Owl (*Ninox strenua*)
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- East Coast Free-tail Bat (*Mormopterus norfolkensis*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*)

Table 12 provides the rationale for the refinement of the ***subject species*** identified by the DGR's and literature.

Table 12: Rationale of the likely occurrence of the initial list of *subject species*

SCIENTIFIC NAME	COMMON NAME	LIKELY TO BE AFFECTED?
FLORA		
Syzygium paniculatum	Magenta Lilly Pilly	No – a detailed site assessment of Cannes Reserve by ELA staff failed to locate *S. paniculatum*. Suitable LR habitat for the species exists within the ***subject site***. The species was not recorded in previous assessments (Pittwater Council 2011) or during the current targeted surveys.

SCIENTIFIC NAME	COMMON NAME	LIKELY TO BE AFFECTED?
FAUNA		
Ninox strenua	Powerful Owl	Yes – this species was recorded within Cannes Reserve and Gunyah Place Reserve.
MAMMALS		
Dasyurus maculatus	Spotted-tailed Quoll	No - the necessary den habitat elements in the form of suitable hollow-bearing trees, fallen logs, caves and rock crevices were not located within the study area. This species have large home ranges and consequently require continuous tracts of intact native habitat, which no longer occurs in the region. Therefore, the removal or modification of vegetation from boundary Cannes Reserve is unlikely to significantly impact upon this species and the viability of any local populations.
Phascolarctos cinereus	Koala	No – Koalas were once widespread and common throughout the Barrenjoey Peninsula. The Koala population on the Barrenjoey Peninsula was considered the largest and best known in Sydney (Smith and Smith 2000). In the 1970's, it was estimated that more than 120 individuals were present within this population. By the end of the 1990's fewer than 10 individuals were present (Smith and Smith 2000). Since 2000, no Koalas have been recorded in the region and are possibly extinct in the area (Smith and Smith 2000).
Petaurus norfolcensis	Squirrel Glider	No - Squirrel Gliders are generally found in association with dry hardwood forest and woodlands (Menkhorst and Knight 2010; Quin 1995). Habitats typically include gum barked and high nectar producing Proteaceae and Myrtaceae species (Menkhorst *et al.* 1988). The presence of hollow bearing eucalypts is critical to reproduction and survival of young (Quin 1995). The last individual was an injured Squirrel Glider was found near Gunyah Park in 2001.
MAMMALS (BATS)		
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	Yes – species foraging habitat present and the species has been recorded within the ***locality***.
Mormopterus norfolkensis	Eastern Free-tail Bat	Yes – species foraging habitat present and the species was recorded within the ***locality***.

SCIENTIFIC NAME	COMMON NAME	LIKELY TO BE AFFECTED?
Pteropus poliocephalus	GHFF	Yes – species roosting habitat present and the species has been recorded within the ***locality***.
ENDANGERED POPULATIONS		
Phascolarctos cinereus	Koala in the Pittwater Local Government Area	No – as previously stated Koalas were once widespread and common throughout the Barrenjoey Peninsula. However, it possibly that the population has become extinct.
Petaurus norfolcensis	Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill	No – as previously stated, Squirrel Gliders prefers areas with dry forest and woodlands with gum barked and high nectar producing Proteaceae and Myrtaceae species (Menkhorst and Knight 2010). No Squirrel Gliders have been recorded in the region since 2001.

The DGR's state: '*The requirements in the remainder of this section need only be addressed for those species that are likely to be affected by the proposal."*

In this section each species is discussed separately to increase the flow of the document and allow for a better understanding of the relevant issues for each species.

The DGR's state that: *'an estimate for the local and regional abundance of those species or populations'*

The DGRs state that: '*Regional and local abundance of each **subject species** is considered individually. Regional abundance is considered across the Sydney Basin Bioregion. Local abundance is defined as the population extent within the **locality**.'*

In this section we discuss the regional and local distribution, habitat values present on site, conservation status and potential impacts of the four threatened fauna species that may be affected by the proposed works including the Powerful Owl, Eastern Bentwing-bat, East Coast Freetail Bat and Grey Headed Flying.'

5.2 POWERFUL OWL (*NINOX STRENUA*)

5.2.1 Discussion of regional and local abundance and distribution

Regional

Powerful Owls are endemic to eastern and south-eastern Australia and have a range that extends from Mackay in Queensland to south-western Vi**c**toria. The species is generally concentrated on the eastern side of the Great Dividing Range. Records of Powerful Owls on the western slopes of their range are sparse and scattered (DEC 2006a). In NSW, the species is widely distributed throughout the eastern forests from the coast inland to the tablelands DEC 2006a). The species appears to be monogamous, occurring in sedentary life-long pairs that occupy large permanent home ranges of approximately 300 – 1500 ha (this may vary with habitat productivity) (Smith and Smith 2000). In NSW the estimated population size for the Powerful Owl is 2,000 pairs or at least 10,000 individuals(DEC 2006a).

Powerful Owls prefer tall, moist and productive eucalypt forests on the eastern tableland edge, mosaics of wet and dry sclerophyll forests on undulating, gentle terrain nearer the coast, which support prey species (medium-sized species of arboreal marsupials) and provide suitable habitat elements for roosting and nesting (DEC 2006a). Roosting habitat for the Powerful Owl includes areas with dense mid-canopy trees or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines, but also adjacent to cliff faces and below dry waterfalls (DEC 2006a). Roosting sites are common among small groves of up to 2 ha of similar-sized trees with dense foliage in the height range 3-15 m. (DEC 2006a: Kavanagh 2003). The plant species that Powerful Owls prefer to roost among include a variety of mid-storey and canopy species, including *Acmena smithii* (Lilly Pilly) and *Doryphora sassafras* (Sassafras), *S. glomulifera* and *Eucalyptus* species.

The species preferred habitat has been significantly reduced, fragmented or modified due to clearing for agriculture, pine plantations, mining and major infrastructure, urban development (DEC 2006a). It is estimated that there has been a 20-50% declined in the distribution of Powerful Owls since European settlement (Debus and Chafer 1994). Presently, the majority of existing and potential habitat for this species is restricted to conservation reserves and state forests throughout NSW (DEC 2006a). Powerful Owls are known to infrequently occupy continuous forest on public lands and private lands, including suburban bushland (DEC 2006a). Within the Sydney Basin Bioregion, Powerful Owl is considered to be widely distributed and common in comparison to other forest owls (Kavanagh 2003) (**Figure 20**).

Local

Several breeding pairs are known to occur within the Cannes Reserve region, therefore there may be between 4 to 6 individuals in close proximity to Cannes Reserve. Pittwater Council staff recently observed an adult pair with chicks in close proximity to Cannes Reserve.

Discussion of other known local populations

Powerful Owls are known to occur throughout the Pittwater LGA (Smith and Smith 2000). According to the Atlas of NSW Wildlife there are 32 records of the species within a 10km radius of Cannes Reserve. However, this is unlikely to reflect all of the records in the region. According to Smith and Smith (2000) and Pittwater Council records, Powerful Owls are regularly recorded in the Ingleside, Warriewood, Church Point and Bayview regions of the Pittwater LGA. There are four historical records of the species from locations within Barrenjoey Peninsula. These records occurred at Newport in 1980, Bungan Beach in 1993, Mackay Reserve in 1998 and Avalon in 1999 (Smith and Smith 2000).

During the present survey, Powerful Owls were observed roosting in Cannes Reserve on two occasions. The observations were made from the edge of the Littoral Rainforest adjacent to 29 Therry Street and among the G. *ferdinandi* in Gunyah Place Reserve **(Figure 15)**. Powerful Owls were also heard calling during both nocturnal surveys that were undertaken on the 13th and 20th of February 2012.

The habitat present within the ***subject site*** appears only to represent roosting, refuge and foraging habitat for the species. The foraging value of the site is high due to the presence valuable prey species including Ravens, Australia Magpies, Common Ringtail Possums, Common Brushtail Possum and Grey-headed Flying-foxes (Kavanagh 2003; Cooke *et al.* 2005).

The site has low nesting potential due to an absence of large mature hollow bearing trees. Powerful Owls require old large hollow bearing eucalypts in long term undisturbed forest, that are located within 100 m of streams or minor drainage lines, with hollows greater than 45 cm diameter, 100 cm deep and are located 6m or more above the ground (DEC 2006a),. These hollows should be surrounded by structurally rich canopy trees, sub-canopy and understorey trees or tall shrubs. There is potential

nesting and breeding habitat in Stapleton Park and Angophora Reserves (pers. Obs.; Pittwater Council 2002a: 2002b) The single hollow bearing tree recorded at the site is unlikely to provide suitable nesting site due to an absence of suitable hollows.

5.2.2 Assessment of habitat

Description of habitat values

The habitat present at Cannes Reserve is suitable for roosting, refuge and foraging activities. The species was observed roosting in *S. glomulifera* and G. *ferdinandi* that are located in the mid-storey and were both surrounded by relatively structurally dense vegetation.

Discussion of habitat utilisation

The site supports populations of preferred prey species, including Ravens, Australian Magpie, Common Brushtail Possum, Common Ringtail Possum and GHFF. Both owl sightings occurred in close proximity to the GHFF camp. Although, Cannes Reserve does not support suitable breeding habitat for this species in the form of large, hollow bearing trees, Stapleton Park and Angophora Reserve do. Thus, potential nesting/breeding habitat for the Powerful Owl will not be impacted in the ***locality*** as a result of this proposal. Powerful Owls appear to be able display considerable resilience to low level habitat disturbance, this is evident through its occupancy of bushland among the outer suburbs of some of Australia's major cities (DEC 2006a). Provided that the Powerful Owl's prey base remains in the ***locality***, and suitable roosting and breeding habitat resources are retained, the Powerful Owl is likely to also remain in the ***locality*** (DEC 2006a).

Powerful Owls generally have sedentary life history strategies, occupy large permanent home ranges and the social unit consisting adult pairs and 1-2 dependent young (DEC 2006a). Therefore, the sighting of Powerful Owls at Cannes Reserve potentially indicates that other individuals are frequenting the site and adjacent areas. Further, the foraging home ranges of Powerful Owls can overlap and consequently the local abundance may consist of several individuals. The species is highly mobile and the habitat in the region is well connected forming corridors that extending beyond Cannes Reserve into Stapleton Park and Angophora Reserve and possibly into Ku-Ring-gai National Park.

Evidence of the presence of breeding habitat in the region, was confirmed with the recent sighting of two chicks and their parents in close proximity to Cannes Reserve by Pittwater Council staff.

5.2.3 Discussion of conservation status

The Powerful Owl is listed as vulnerable on Schedule 2 of the NSW TSC Act. It is not listed nationally under the Commonwealth EPBC Act 1999, although the species is listed as threatened in Victoria, vulnerable in Queensland, and a species of least concern (on a conservation priority scale) Australia-wide (Garnett and Crowley 2000).

The listing of the Powerful Owl under the TSC Act is based on a number of factors including:

- It has a population size between 1,000 and 10,000 individuals.
- Its population is suspected to be declining.
- Its current distribution within NSW is between 1,000 – 100,000 km2 and the area of this distribution is estimated to have declined considerably since European settlement (DEC 2006a).

5.2.4 Discussion of the likely effect of the proposal at local and regional scales

Significance within local context

The proposed works will make a very minor contribution to a known key threatening processes, the clearing of native vegetation and potentially (although unlikely) the removal of dead wood and dead trees. However, these works are unlikely to directly or indirectly cause major long term impacts on local populations of the species. The species is highly mobile and the extent of potential foraging and roosting habitat throughout the region is considerable. Although, both Powerful Owls were recorded among the areas targeted for tree removal and modification, there are alternative suitable roosting sites available with the ***subject site***, study area and ***locality***. The area of foraging habitat and roosting to be affected is extremely small, approximately 0.204 ha and the proposed works will not impact on any known breeding sites. Indeed, the proposed works include extensive weed control and bush regeneration of a currently highly degraded area that will improve habitat quality and foraging resources in the medium to long term.

The site does represent important foraging habitat for the species, due to the presence of several common prey species including GHFF. Powerful Owls prey upon GHFF and their presence in the reserve may explain why Powerful Owls occurrence in the ***subject site***. It is possible that the proposed works through its aims to reduce the population size of GHFF in the camp to around 200 individuals, will impact upon the foraging activities of the Powerful Owl although this is considered to be negligible. However, this impact is expected to be both minimal and short term, due to the extent of suitable roosting, foraging habitat and number of other prey species present throughout the region. Declines in prey species are unlikely, any impacts are expected to short term and minimal.

Discussion of connectivity

The proposed works will not contribute to fragmentation, isolation or reduce interconnectivity as the site is adjacent to an existing residential area along its boundaries and this connectivity will not be severed by the proposed works.

Consideration of threatening processes.

The proposed works are unlikely to directly or indirectly impact upon the foraging, roosting and breeding activities of the Powerful Owl would impact upon the local or regional population of this species.

Predation of Powerful Owl fledglings by foxes, dogs and cats is also a threatened process, although the proposed development is unlikely to alter the existing situation, particularly given that potential nesting sites for this species are likely to be some distance from the ***subject site***. The proposed works are unlikely to increase the existing levels threat.

5.3 EASTERN BENTWING-BAT (MINIOPTERUS SCHREIBERSII OCEANENSIS)

5.3.1. Discussion of regional and local abundance and distribution

Regional

The Eastern Bentwing-bat and its two subspecies have recently undergone taxonomic revisions that result in Eastern Bentwing-bat, *Miniopterus schreibersii oceanensis*, are now known as *Miniopterus orianae oceanensis* (Churchill 2008). The various subspecies of Bent-winged Bat have different distributions and abundances across Australia, cranial and genetic characters, as well as echolocation call features and maternity cave roost characteristics (Hoye and Hall 2008). However, as the listing of the Eastern Bentwing-bat was made for *M. s. oceanensis* under the TSC Act, discussions of the

Eastern Bentwing-bat in this document will focus on information available for *M. s. oceanensis*, with this subspecies hereafter referred to as the Eastern Bentwing-bat.

The Eastern Bentwing-bat occurs along the eastern Australian coast and ranges from Entrance Island north of Cape York Peninsula in Queensland through New South Wales, and south to central-southern Victoria. The species is commonly encountered foraging within its range, and of the cave bats in eastern Australia, is one of the most frequently encountered species (Hoye and Hall 2008).

The species displays both spatial and temporal variations in its distribution. During spring and summer months, females (and sometimes non-breeding females and juvenile males) converge in large numbers to one of the 12 known maternity roosts known nationwide (Hoye and Hall 2008). Maternity caves that Sydney populations may use include a cave located in Wee Jasper Nature Reserve, located approximately 25km south west of Yass (Church Cave), a cave in Bungonia State Recreation Area, located approximately 35km east of Goulburn (Drum Cave), and a cave in Willi Willi Caves Nature Reserve, located approximately 35 km west of Kempsey (Willi Willi Cave) (*pers. comm*. Greg Richards, Greg Richards and Associates, July 2010).

No recent estimates of population size have been made for Eastern Bent-wing Bat, either across its distribution or at a regional scale. For the maternity roosts likely to be used by a bat population around Sydney, 15,000 individuals have been estimated using Drum Cave in Bungonia State Recreation Area (NPWS 1998). Church Cave may support 10,000 individuals (Hamilton-Smith and Finlayson 2003). Willi Willi Cave is thought to support between 30,000 and 40,000 individuals (although this estimate includes individuals of two species other than Eastern Bentwing-bat- Eastern Horseshoe Bat, *Rhinolophus megaphyllus*, and Little Bent-wing Bat, *Miniopterus australis* {DEWHA 2010}).

Local

A total of four identifiable calls for this species were recorded during the survey night period. These calls were recorded from a single location on one night only where the LR adjoins a grassy residential backyard.

The low number of calls could be interpreted in a number of ways, including:

- Species may occur in very low numbers within the ***subject site*** and surrounding areas.
- The habitat present within Cannes Reserve is not optimal, and therefore only supports low numbers of the species.
- These individuals were conducting short term foraging activates or may be simply passing through the site on route to more optimal foraging or roosting habitat during the survey period.

The evidence suggests the latter, the calls that were recorded were not feeding calls and were recorded on one night, which strongly supports the suggestion that the species rarely uses the site (Peter Knock *pers. comm.* 2012).

Discussion of other known local populations

The calls recorded for the Eastern Bentwing-bat during the present surveys suggest that it occurs in low numbers within the study area. In addition, there are only 10 records of the species listed in the NSW Wildlife Atlas from within 10km of the ***subject site***. The species is known to be present throughout the Pittwater LGA, but there are currently no known roosting locations in the region (Smith and Smith 2000). The species will roost site in stormwater drains, culverts and beneath bridges (Hoye and Hall 2008). Currently there are no known roosts on the Barrenjoey Peninsula or in close proximity to Cannes Reserve.

5.3.2. Assessment of habitat

Description of habitat values

Eastern Bentwing-bat have general foraging habits and are known to forage among woodlands and forests along the east coast of Australia which support their preferred prey species (moths and other flying insects) (DEC 2010b). Although the species was only recorded in low numbers, the woodlands and forest habitats present within the ***subject site*** and surrounding area has the potential to support the foraging activities of the species. However, the site may not support the required habitats for day time roosting or breeding activities. This species preferentially uses caves as their primary roosting habitat (Churchill 2008) But the species also uses derelict mines, storm-water tunnels, buildings and other man-made structures (DECC 2010b). In winter, Eastern Bentwing-bats may require colder caves, mines, tunnels, drains and bridges to roost, particularly in the southern parts of Australia, where the species enter torpor to reduce their energy expenditure (Hoye and Hall 2008).

The breeding habitat for the Eastern Bentwing-bats is more specific (Churchill 2008). Breeding habitat is used by female Eastern Bentwing-bats during the spring and summer months. During this time, females congregate to form large colonies in maternity roosts. These maternity roosts have very specific temperature and humidity regimes, and are generally dome-shaped to retain heat within the cave (Hoye and Hall 2008; DECC 2010b). Therefore, it appears that ***subject site*** is unlikely to support quality habitat for the Eastern Bentwing-bat.

Discussion of habitat utilisation

The site does not support cliff faces, crevices and rocky outcrops or overhangs that offer suitable roosting habitat for the species. Several storm water drains occur in the area, but it is uncertain of their value to the species. No maternity roosts are present on the ***subject site***. As previously stated, the nearest known maternity sites are located near Yass, Goulburn and Kempsey (Willi Willi Cave) (Greg Richards per com. 2010).

5.3.3. Discussion of conservation status

The Eastern Bentwing-bat is listed as vulnerable on Schedule 2 of the NSW TSC Act. It is not listed nationally under the Commonwealth EPBC *Act 1999* or under Queensland legislation, although it is listed as threatened in Victoria. The conservation status of this species in a local context is largely unknown. However, it is likely to be similar to that for the region and state. This species is not at the limit of its known distribution. The listing of the Eastern Bentwing-bat under the TSC Act is largely based on the fact that the species relies on select maternity caves. Loss of any of these maternity caves places regional populations at risk.

5.3.4. Discussion of the likely effect of the proposal at local and regional scales

Significance within local context

The ***subject site*** may only represented low quality foraging and roosting habitat for the Eastern Bentwing-bat. While, areas within the adjacent study area and surrounding reserves, parkland and privately owned land represents more optimal foraging habitat for this species. This includes Stapleton Park and Angophora Reserves, which both contain many large hollow bearing *Corymbia maculata* and *Angophora costata* trees that have the potentially to provide important roosting and breeding habitat for the species.

Discussion of connectivity

Eastern Bentwing-bats are highly mobile and are capable of large regional movements in relation to food resources, reproductive behaviour and winter hibernation.

Potential roosting or breeding habitat was not considered to be present in the areas of the ***subject site*** to be impacted upon by the proposed works. The proposed works will not contribute to fragmentation or reduce interconnectivity. The site is adjacent to an existing residential area and the proposed works will not sever any connectivity in habitat.

Consideration of threatening processes.

It is unlikely that the proposal will have significant impacts on the Eastern Bentwing-bat which would place a local population of the species at risk of extinction. The development will contribute to key threatening processes relevant to the Eastern Bentwing-bat including the clearing of native vegetation and the removal of dead wood and dead trees. The clearing of vegetation which has the potential to impact on the Eastern Bentwing-bat through the removal of foraging habitat supporting prey species, however suitable foraging habitat is widely present through the region for this species.

5.4 EAST COAST FREE-TAIL BAT (MORMOPTERUS NORFOLKENSIS)

5.4.1. Discussion of regional and local abundance and distribution

Regional

The East Coast Freetail-bat has a distribution that includes the region east of the Great Dividing Range between southern NSW and south east Queensland. Little is known of the ecology, preferred habitat, maternal and refuge roosts habits of this species (Hoye *et al.* 2008). However, the limited knowledge for the species suggests that it prefers dry eucalyptus forest where it forages on flying invertebrates and roosts among the tree hollows, roofs or buildings and has been recorded occupying nest boxes (Hoye *et al.* 2008).

There is little knowledge of population sizes and demographics of the species either across its distribution or at a regional scale. However, the species has been recorded over a rocky river, in rainforest and wet sclerophyll forest.

Local

A total of four identifiable calls for this species were recorded during one survey night period. These calls were recorded from the open grassy habitat of Gunyah Place Reserve. The low number of calls could be interpreted in a number of ways, including:

- Species may occur in very low numbers within the ***subject site*** and surrounding areas.
- The habitat present within Cannes Reserve is not optimal, and therefore only supports low numbers of the species.
- These individuals were conducting short term foraging activates or may be simply passing through the site on route to more optimal foraging or roosting habitat during the survey period.

The evidence suggests the latter, the calls that were recorded were not feeding calls and were only recorded on one night, which strongly supports the suggestion that the species rarely uses the site (Peter Knock *pers com* 2012).

Discussion of other known local populations

The calls recorded for the East Coast Freetail-bat during the present surveys suggest that it occurs in low numbers within the study area. In addition, there has only been one record of the species within 10km of the ***subject site*** (NSW Wildlife Atlas 2012). According to Ecotone Ecological Consultants (2011), this species has previously only been recorded from Ingleside Chase Reserve. There are currently no known roosting locations in the ***locality*** for the species, it will roost in hollows, stormwater drains, culverts and beneath bridges (Hoye and Hall 2008). Although, these structures occur within the Pittwater LGA, this species does not appear to widely distributed within the region.

5.4.2. Assessment of habitat

Description of habitat values

Little is known of the habitat preferences of the East Coast Freetail-bat, although most records are from dry eucalyptus forests and woodlands along the east coast of Australia which support their preferred prey species (moths and other flying insects) (Hoye *et al.* 2008; DEC 2010b). Individuals have also been recorded in flying low over rocky rivers, through rainforest and wet sclerophyll forest (Hoye *et al.* 2008).

Discussion of habitat utilisation

It appears that the East Coast Freetail-bat is predominantly a tree-dwelling species and the large dead stag in the centre of the site may provide habitat for the species. The species will also use paddock trees and remnant native vegetation in farmland (Hoye *et al.* 2008). Although the species was only recorded in low numbers, the woodlands and forest habitats present within the ***subject site*** and surrounding area have the potential to support the foraging activities of the species.

5.4.3. Discussion of conservation status

The East Coast Freetail-bat is listed as vulnerable on Schedule 2 of the NSW TSC Act. It is not listed nationally under the EPBC Act or under Queensland legislation, although it is listed as threatened in Victoria. The conservation status of this species in a local context is largely unknown. However, it is likely to be similar to that for the region and state. This species is not at the limit of its known distribution. The listing of the East Coast Freetail-bat under the TSC Act is largely based on the loss of hollow bearing trees and changes to the structure of forests that would lead to fewer such trees in the future, as well as the use of pesticides (NPWS 2002). There will be no loss of hollow bearing trees or reduction in future potential hollows from the proposed action nor will it be necessary to utilise any pesticides.

5.4.4. Discussion of the likely effect of the proposal at local and regional scales

Significance within local context

The ***subject site*** may only represent low quality foraging and roosting habitat. The development will contribute to key threatening processes relevant to the East Coast Freetail-bat including the clearing of native vegetation and the removal of dead wood and dead trees. The clearing of vegetation which has the potential to impact on the Eastern Bentwing-bat through the removal of foraging habitat supporting prey species, however suitable foraging habitat is widely present through the region for this species.

Discussion of connectivity

There are numerous reserves, parkland and privately owned land that represent more optimal foraging habitat for this species, with considered abundance of flying invertebrates that are preyed upon by the East Coast Freetail-bat. The adjacent Stapleton Park and Angophora Reserves contain large hollow

bearing *C. maculata* and *A. costata* trees that have the potentially to provide important roosting and breeding habitat for the species.

Consideration of threatening processes.

The development contribute to a key threatening processes relevant to the East-coast Freetail Bats, which is the clearing of native vegetation and the removal of dead wood and dead trees. The clearing of vegetation from Cannes Reserve is unlikely to constitute a significant impact to this species.

It is unlikely that the proposal will have a significant impact on East-coast Freetail Bat to such a level to place a local population of the species at risk of extinction. Although, there is potential foraging habitat present within the ***subject site*** and surrounding area, the number of calls recorded suggests that the species only infrequently uses the ***subject site***. East-coast Freetail Bats are highly mobile and are capable of large regional movements in relation to food resources, reproductive behaviour and winter hibernation.

5.5 GREY-HEADED FLYING-FOX (*PTEROPUS POLIOCEPHALUS*)

5.5.1. Discussion of regional and local abundance and distribution

Regional

The Grey-headed Flying-fox (GHFF) is endemic to Australia and has a breeding range from Maryborough to Melbourne (Van Dyke and Strahan 2008), as far north as Rockhampton (Churchill 1998; Roberts *et al.* 2011).Its current breeding range approximately 750 km south of its historical extent (Tideman *et al.* 2008). The species has been noted to move south annually in spring and summer and return to the coastal forests of north-east NSW and south-east Queensland in winter, resulting in large fluctuations in numbers of this species in NSW from as few as 20% of the total population in winter up to around 75% of the total population in summer (Eby *et al.* 1999).

Thirty-nine camps are known to be used by Grey-headed Flying-foxes in the South-east NSW, including the Greater Sydney region south to the NSW-Victoria border and extending west to the escarpment and eastern tablelands (Eby and Law 2008). A number of camps in the Sydney metropolitan area have been established recently and are occupied continuously (Eby and Law 2008). In the Sydney region permanent camps exist at Clyde, Brownlow Creek, Menangle, Torrella, Gordon, Parramatta Park, Royal Botanic Gardens Sydney and Cabramatta Creek (van der Ree *et al.* 2009) (**Figure 22**).

Local

Prior to Cannes Reserve, there are no historical records of GHFF camps in the Pittwater LGA. The Cannes Reserve camp was initially occupied approximately 10 years ago and Warriewood in 2008 (Pittwater Council 2011a). Initially the camp was occupied by only males, in more recent times breeding females have been recorded. The numbers that have been recorded in the Cannes Camp have fluctuated significantly, with peaks as high as 1000+ individuals have been recorded (Pittwater Council 2011a).

The individuals presently occupying Cannes Reserve are possibly components of a large regional population of bats which move between roosting sites and populations within the Sydney metropolitan area and along the NSW coast.

Discussion of other known local populations

There are twenty-seven records of this species within a 10km radius of the ***subject site*** according to the NSW Wildlife Atlas, which includes Warriewood and Cannes Reserves. There is one other GHFF camp in the Pittwater LGA, a temporary camp located at Warriewood Wetlands Reserve. This camp is located approximately 10km from the Cannes Reserve Camp (**Figure 21**). The temporary nature of the camp at Warriewood suggests that the ***locality*** is only used for foraging purposes and in response to seasonal production of certain food resources. As previously stated Warriewood may represent a roosting spot for 'spill over' from other large camps in the region such as the at Ku-Ring-gai Flying Fox Reserve. This camp is located at Gordon approximately 24km west of the ***subject site***.

5.5.2. Assessment of habitat

Description of habitat values

The ***subject site*** provides GHFF with roosting, limited foraging and breeding habitat. The diet of GHFF comprises primarily nectar and pollen from blossom in the canopy of various vegetation types and pulp from the fleshy fruits of rainforest trees and lianas, with leaves and exudates from leaf-mining insects, such as psyllids also utilised as secondary dietary components (Eby and Law 2008). Eby and Law (2008) compiled a preliminary list of diet plants from published documents, unpublished reports and thesis, the field records of the authors and observations of others as reported to the authors. A total of 59 species were reported as being important components of the blossom diet of the species and 46 species components of the fruit diet. Of the 59 blossom diet species the following were the only ones recorded within the ***subject site***, *C. maculata*, *A. costata* and *Eucalyptus botryoides, Grevillea robusta Syncarpia glomulifera* and two fruit diet species *L. australis and Elaeocarpus reticulatus*.

Discussion of habitat utilisation

The ***subject site*** represents low foraging habitat in contrast to adjacent and surrounding reserves, parkland and privately owned land. These areas represents more optimal foraging habitat for this species, with higher abundance of high nectar producing species used by GHFF. Indeed, better quality foraging vegetation for the GHFFs, is limited within the ***locality*** but more widespread across the region includes (Eby and Law 2008):

- Stapleton Park, Angophora and Toongari Reserves contain *Corymbia maculata* (Spotted Gum), *Eucalyptus robusta* (Swamp Mahogany and *Melaleuca quinquenervia* (Broad-leaved Paperbark) (**Figure 4**).
- *Eucalyptus robusta* is strongly represented outside the Pittwater Region but within the 25 to 50km foraging range of the species (Nancy Pallin. Pers. comm. 2012).

5.5.3. Discussion of conservation status

The GHFF is listed as a vulnerable species under the NSW TSC Act, Victorian *Flora and Fauna Guarantee Act 1988*, Commonwealth EPBC Act and at the international level is listed on the IUCN Red List 2008. Historically, GHFFs were once more widely distributed that they are today, occupying in much of the eastern seaboard of Australia (NSW Scientific Committee 2001b). Counts of flying foxes over the past decade suggest that the national population may have declined by up to 30% with regular visits to flying-fox camps during this period have shown a marked decline in the numbers of animals using several camps (Roberts 2006; van der Ree *et al.* 2009). In addition to continued habitat loss

other factors which have contributed to population decline include shooting in commercial fruit crops, disturbance of roosting sites and electrocution on powerlines.

A Draft National recovery plan for the GHFF has been prepared by DECCW (2009). Specific objectives of the plan aim to identify, protect and enhance key foraging and roosting habitat; to substantially reduce deliberate destruction associated with commercial fruit crops; to reduce negative public attitudes and conflict with humans; and to involve the community in recovery actions where appropriate (DECCW 2009). Further objectives aim to address the impact on the species from artificial structures such as powerlines, loose netting and barbed wire fences; and to improve knowledge of demographics and population structure (DECCW 2009).

The nearest permanent camp to the Cannes Reserve is the Ku-Ring-gai Flying Fox Reserve located at Gordon (**Figure 21**). This camp is located within land jointly owned by Ku-Ring-gai Council and the NSW Government. A formal Conservation Agreement is attached to the title of the property and commits Ku-Ring-gai Council to on-going conservation of the camp.

5.5.4. Discussion of the likely effect of the proposal at local and regional scales

Significance within local context

The proposal will remove a number of potential and currently occupied roost trees to be removed from within a 7m buffer zone around the boundary of the reserve. The proposed works aim to remove or prune five *G. ferdinandi* trees and seven *L. australis* palms. The quality of this foraging habitat is low for this species. Alternative suitable habitat will remain where the camp is currently located within the centre of the reserve. The species has previously used the habitat at the centre of the site and it is hoped that although this section of the Cannes Reserve offers limited roosting habitat, future rehabilitation strategies will increase the quality of this section of the site. However, part of the amelioration for the proposed works is to restore this section to LR using known roosting trees species. This level of disturbance is unlikely to significantly cause impact that will impact upon the local and regional conservation status of this large highly mobile mega-chipertan bat species. This represents a small area of low quality foraging habitat will be lost to the species as a result of the proposal, with large areas of similar and better quality foraging habitat remaining within the ***locality***.

Discussion of connectivity

The results of the proposed tree removal and pruning works and subsequent compensatory restoration and weed management activities will not result in no net cumulative reductions, degradation or isolation of habitat to the GHFF. Furthermore, the main aim of the works is to retain and manage GHFF camp *in situ*, while encouraging individuals to move towards the centre of the reserve away from the residential areas. Pittwater Council, plan to enhance and plant known roosting trees within the centre of the site to provide habitat for the species. In addition, there are other permanent and temporary colonies within the 50km forging range, including Ku-Ring-gia Flying Fox Reserve and Warriewood that individuals from Cannes Reserve could immediately join. GHFFs is a highly mobile species and could easily migrate large distances if required to roost and forage. Therefore, it is of our opinion that the planned works which involve vegetation removal and subsequent restoration works will not significant contribute to the levels of fragmentation and isolation that present exist in the region.

Consideration of threatening processes.

The proposed works does contribute to key threatening processes relevant to the GHFF including the clearing of native vegetation and the removal of dead wood and dead trees. However, the scale of

these impacts is considered unlikely to significantly impact upon the species to the extent to such a level to cause a local population to be placed at increased risk of extinction.

5.6 DESCRIPTION OF FEASIBLE ALTERNATIVES

The DGR's state: '*a description of any feasible alternative to the actions that are likely to be lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regards to the biophysical, economics and social considerations and the principles of ecological sustainable development.'*

The preparation of the SIS aims to deliver an environmentally, politically, social and economically sensitive outcome for Cannes GHFF urban camp and local residents. Pittwater Council has applied for a Section 91 licence to remove or prune endemic trees from the north-west section of Cannes Reserve and on private properties adjacent to the reserve on two previous occasions. These applications have led to tree removal and pruning that has been been undertaken under the Section 95 Certificates No. 1115987 in 2010 and No. 1129225 in July 2011. The previous works include the pruning of two G. *ferdinandi* and the removal of a cluster of *H. forsteriana* trees near the entrance of 29 Therry Street, and one *Grevillea robusta* (Silky Oak) within Cannes Reserve. However, it appears that there has been no to little changes in the roost activities, location and numbers of GHFF present within the reserve (Pittwater Council 2011b). Despite the two failed efforts to move the camp further in the reserve, Pittwater Council aim to establish a 7m around the outer edge of the reserve. This buffer will be achieved through tree removal, pruning and intensive habitat restoration and rehabilitation of the site.

The restoration and rehabilitation of the site using local providence plant species of LR and PSGF origin will effectively retain all of the ecological values of the site and through the removal of the weeds, potentially enhance the attribute of the study site. The purpose of the SIS is to identify potential impacts and provide appropriate avoidance, amelioration and mitigation measures for any adverse impacts on threatened species, populations or ecological communities.

Do nothing approach

The natural alternative to minimise impacts is to not undertake any active management and leave the GHFF camp and EECs they presently are. However, this is considered an unrealistic alternative because:

- Conflicts will continue with GHFF camp and residents
- Noise, smell, impacts of property will remain the same
- Weeds will continue to dominate the site causing long term and irreversible damage and degradation of the LR and PSGF EECs
- In the past it has been reported that residents have taken control of the camp into their own hands and undertaken unauthorised and illegal disturbances
- Any unauthorised and illegal disturbance undertaken by local residents could be more harmful to GHFF. If the disturbance is undertaken at an inappropriate time of the year, for example during the reproductive period, it may result in:
- Increased stress levels resulting in the death to adult and juvenile individuals. Previous disturbances have resulted in the abortion of young and abandonment of dependant young leading to starvation and the threat of predation (van der Ree *et al.* 2009).
- Increased stress levels have been linked to the expression of diseases such as Lyssavirus {Australian Bat Lyssavirus - ABL} and Hendra Virus among GHFF (Roberts 2006).
- There is considerable uncertainty about the future camp dynamics and how the GHFF numbers may fluctuate with further large winter blossom events among the local E. robusta

trees. There is some probability GHFF numbers could return to similar peak levels observed previously.

- Future of translocations or relocations of large Flying-Fox colonies, such as the proposed program to move GHFF and Black Flying-Foxes from the RBG. This may lead to individuals from the RBG relocating to Cannes Reserve and effectively increasing their numbers and impacts on adjacent residents.

Alternatives to doing nothing and leaving the camp and EECs in their present state are discussed below. The proposed works aims to responds to the characteristics of the site, its constraints and is of an appropriate scale and nature

In this section we provide a review of potential alternative and supplementary measures aimed at managing and ameliorating the impacts of the proposed works on the Cannes Reserve GHFF camp and individuals. The initial alternatives that are discussed explain methods to retain and manage the camp *in situ* within Cannes Reserve as per the Cannes and Gunyah Place Reserves PoM.

Alternatives to doing nothing

Retain and managing the GHFF camp in situ

The option is to manage the GHFF camp *in situ* within Cannes Reserve is detailed in the Pittwater Council's PoM for Cannes Reserve and Gunyah Place Reserve (2011a). In order to achieve this roosting habitat will be removed from within a 7m buffer and subsequent works to improvement the roosting habitat towards the centre of the reserve. It is hoped that this will encourage the GHFF to roost away from the boundary of the reserve and mitigate conflicts between residents. These works are in accordance with the Flying-Fox Camp Management Policy (DECC 2007).

Although, it is of our opinion that the level of clearing proposed within the 7m buffer does not constitute a significant impact to the threatened species by increasing the risk of local extinction we have developed the following measures to further minimise and avoid impacts. Indeed, numerous approaches have been trailed to manage GHFF in situ, while attempting to limit the population size, alter location of camps and mitigate conflicts. In order to conserve, manage and maintain the GHFF camp at a certain size within Cannes Reserve, Pittwater Council aim to:

- Protect, conserve and restore the LR EEC.
- Regenerate area.

However, should these strategies fail to achieve the objectives set in the PoM and conflicts between residents continue, longer term strategies including more invasive methods of translocation or relocation must be considered. The stress and ill health presently affecting local residents provides considerable justification for considering these more invasive avenues to manage this GHFF camp. Given that most attempts to translocation or relocation GHFF have failed or been expensive, this option will only be considered a last resort.

The DGRs state that: *'A list of potential alternative and supplementary measures to manage and ameliorate the impacts of the Cannes Reserve GHFF camp on local residents (while retaining the colony in situ as per the Cannes Reserve and Gunyah Place Reserve PoM. A discussion as to why these measures (whether combined or in isolation) can or cannot be considered as feasible alternative to the proposal must also be included.'*

A list of alternative measures that have not been previously discussed in this SIS or have not been considered in the Pittwater Council PoM are provided **Table 13**.

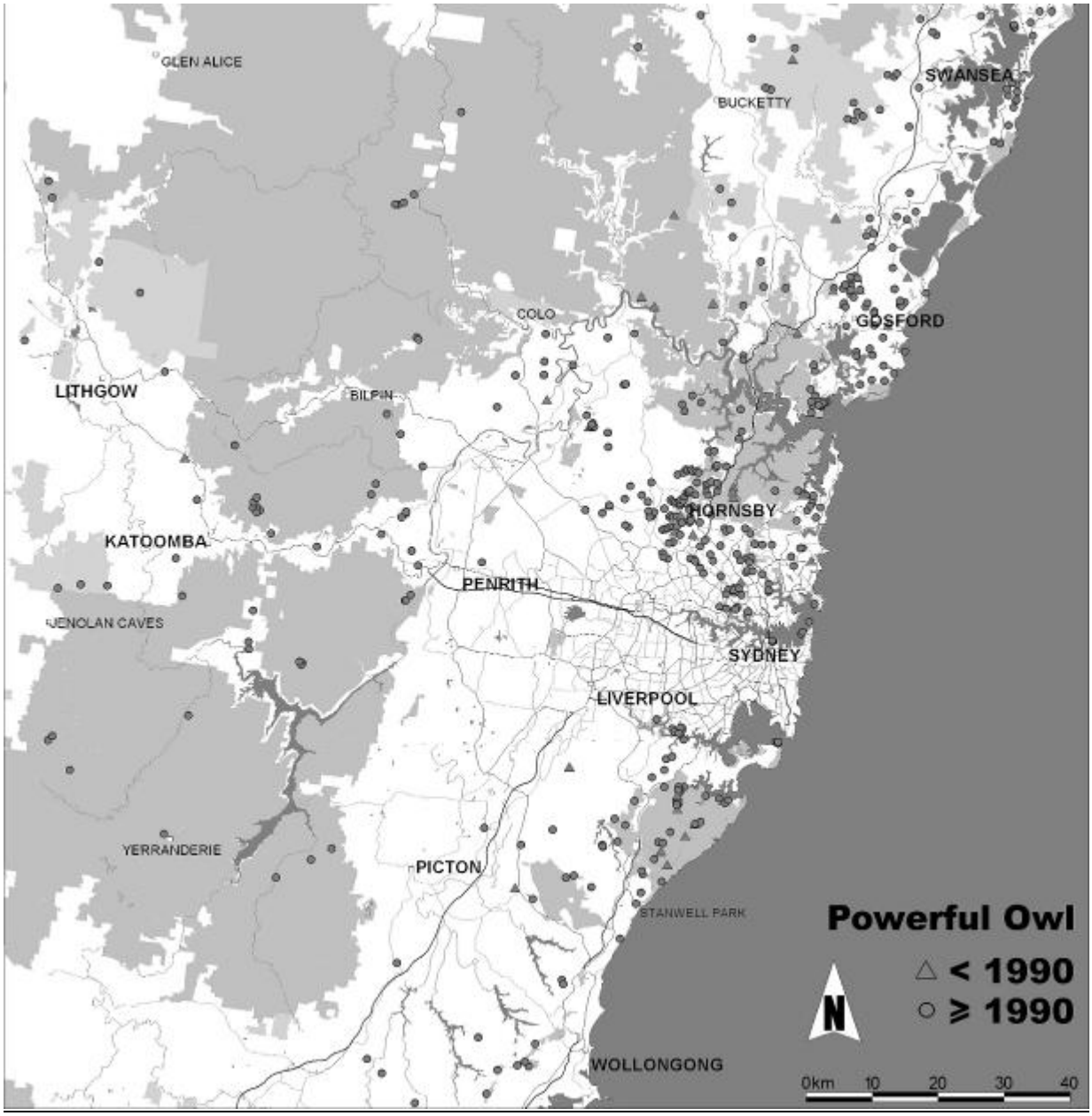

Figure 20: The distribution of Powerful Owls in the Sydney region (Source – Kavanagh 2003)

Figure 21: Location of GHFF camps in the Pittwater LGA

Figure 22: Locations of permanent GHFF camps in the Sydney IBRA

Table 13: Descriptions of alternatives, options and other factors that may contribute and some statements on success and failures

MANAGEMENT STRATEGY	MANAGEMENT ACTIONS	POSITIVES	NEGATIVE
Large physical barriers	The construction of barriers around at selected locations within the park to restrict roosting potential to GHFF. This will create a barrier between the local residents and the GHFF camp. Construction of Sonic Fence (http://www.birdgard.com.au/bird-pest-control/pest-control/flying-fox-control.htm). Netting or other structures that exclude GHFF from using the habitat or particular trees. **L**arge scale to cover the majority or entire reserve or to target single trees.	Camp will remain within Cannes Reserve. Natural dynamics associated GHFF will continue undertaking important ecological roles of pollination and seed dispersal in region. Food resource for Powerful Owls will be maintained.	Impact on GHFF camp unknown. Potentially expensive Difficult to design and manage Ugly and unsightly Distance local residents from reserve and reduce appreciation of natural assists. Unknown flow on impacts on the surrounding ecological process. Entanglement by GHFF – which have the potential to result in stress or death.
Modifications to existing buildings	Air conditioning in houses. Install blinds in houses adjacent to reserve. Shade sails. Insulation Double glazed windows. Cloths driers	No negative impacts of GHFF – the camp remains unchanged.	Disconnect locals from the local environment. Unable to open windows to gather fresh air. Increased electricity costs to run clothes driers. Reduced residential amenity. Many properties may be difficult to retro fit.
Planning and development	Through DA ensure designs incorporate the architectural designs mentioned above to lower impacts of noise and smell.	New residents are aware of existence of the GHFF camp	

MANAGEMENT STRATEGY	MANAGEMENT ACTIONS	POSITIVES	NEGATIVE
Deterrents	The aim of this technique to use brightly coloured and fluttering structural elements to frighten or encourage GHFF away from desired locations. Brightly coloured plastics and material. High visibility or safety vests Plastic bags that are either empty or contain products such as paradichlorobenzene (toilet deodoriser blocks), raw meat or explosives.	Cheap, easy to implement. Non-invasive to GHFF.	Previous assessments shown these methods have little impact on deterring GHFF Test conducted in the RBG showed GHFF moving to neighbouring trees and causing similar levels of damage. However, carbide being a noise disturbance was found to be successful at this time. The cost However, the cost of hiring a mechanical tower that can reach high canopies was high ($2,000 for 3 days). Plastic bags and high viz clothing is unsightly in trees. After windy periods will need replacing and may contribute to local litter. Source: Vander Ree *et al.* 2009

MANAGEMENT STRATEGY	MANAGEMENT ACTIONS	POSITIVES	NEGATIVE
Repellents	Use of chemicals, smells, invasive produces or the scent of known predators. Apply repellent to branches of the trees that repel the GHFF. Previous repellents that have been trailed include: Chilli paste. Fermented Shrimp Paste Prawn paste, honey and water. Envirospray Ultrawax. Python Excrement. D-ter and bird repellent (http://www.heinigerhg.com.au/productflyers/D_Ter.pdf)	Relative non-invasive. Will not cause significant levels of stress to GHFF.	Trails conducted at RBG were unsuccessful or logistically difficult to undertake. Difficult to apply to branches that are several metres above the ground. Effects are relatively short term Washes of when it rains.

MANAGEMENT STRATEGY	MANAGEMENT ACTIONS	POSITIVES	NEGATIVE
Loud noises	Using a variety of noise, from load, sudden and continuous. GHFF are very and therefore are easily affected by noises. This includes load recordings, synthesized sound of machinery, or use load engines, guns, fire-crackers and scare guns to make load noises to disrupt the roosting habits Flying-fox distress calls	Sound has proven to be successful (van der Ree *et al.* 2009).	To disrupt a GHFF camp in this manner a new Section 91 will application may be required. Trails have shown that synthesized noises,
Ultrasonic noise	The use of ultra-sonic devices such as Shu roo	Little impact on local human residents.	Shu Roos and ultra-sonic devices have little to no marked impact.
Lighting	Using intensity strobe lights. Lighting towers with very bright high powered spotlight.		Trials conducted at RBG found that the bright lights and strobes had little impact.

MANAGEMENT STRATEGY	MANAGEMENT ACTIONS	POSITIVES	NEGATIVE
Canopy sprinkler system	Use of sprinklers in trees to spray water onto roosting GHFF.	Non-invasive	Shown to have limited impact in Sydney RBG with GHFF moving away from tree while the sprinklers were operating. But soon returned after the sprinklers were turned off. There is concern of moving GHFF short distances into areas that are more sensitive to residential conflict.
Smoke	Using smoke from burnt vegetation to cause agitation and subsequently dissipate the Flying-foxes		GHFF at RBG became accustomed to the smoke. The use of smoke is generally discouraged.
Nudging	Nudging is a process utilising a low intensity of stimuli to encourage or 'nudge' animals from non-suitable roost sites to preferred areas of vegetation within a site, without scattering them.	Has proven to be an unreliable method and has often been unsuccessful (van de Ree *et al.* 2006). Will not impact or disrupt the ecological and biological processes of the GHFF. May not require huge effort and many person hours to undertake activities.	If used at wrong time of year or if animals this technique may result in stress and death GHFF have been known to continually return to original roosting site. Potential to be cost and time expensive.

MANAGEMENT STRATEGY	MANAGEMENT ACTIONS	POSITIVES	NEGATIVE
Disperse or consolidate GHFF camp using artificial deterrents	Artificial birds of prey. Reflective vests and material. Empty bags	Non-invasive or lethal. Could be used in small amounts to encourage GHFF from the	Limited effects. May not actually work – observations made during field surveys showed that short term to no reaction from GHFF with the Brown Falcon and Powerful Owls in the camp. Python urine and excrement may be difficult to obtain in volumes required to have significant impact on GHFF Disrupt ecological and biological process. HGFF become accustomed to the smell.
Cull	Reduce numbers in camp by shooting or poisoning individuals	Reduce numbers of GHFF in camp. Unlikely to occur due to ethical and statutory factors	The effect may only be short term, with the potential for new individuals from other regions or camps that are unaware of culling program will move into vacant areas of Cannes Reserve.

6 Assessment of likely impacts on threatened ecological communities

The DGRs state: '*Assessment of impacts must consider the nature, extent and timing of the proposal and all associated actions. Assessments must include the direct and indirect impacts of these activities.'*

6.1 ASSESSMENT OF CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES LIKLEY TO BE AFFECTED

The DGRs state: '*A general description of the ecological community present in the area that is subject of the action and in any area that is likely to affected by the action.'*

The following EECs occur within study area and will be impacted either directly or indirectly by the proposed vegetation removal and modification works (**Table 14**). Details on the survey and mapping and results are provided in **Section 4**. Although, PSGF does occur within the ***subject site***, this EEC will not be subjected to the proposed works for 2012 and therefore will not be addressed in this SIS. All efforts will be made to isolate, protect and minimise any impacts to the PSGF EEC (see **Section 6.5**).

Table 14: Threatened ecological communities that will be impacted on by the proposal

SCIENTIFIC NAME	LIKELIHOOD OF BEING IMPACTED BY THE PROPOSED WORKS
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Yes – this Endangered Ecological Communities was recorded within Cannes Reserve.
Pittwater Spotted Gum Forest	No – this Endangered Ecological Communities was recorded within Cannes Reserve and Gunyah Place Reserve, though no works are planned to occur within this community.

6.2 DESCRIPTION OF HABITAT

The DGRs state: *'a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region.'*

In this section the above requirements are addressed for the EEC that occur within and adjacent to Cannes Reserve that will be impacted upon by the proposed works. The present survey confirmed the presence and extent of Littoral Rainforest (LR) and Pittwater Spotted Gum Forest (PSGF) within the subject site (**Figure 16**).

6.2.1. Study area

Littoral Rainforest

LR is the dominant vegetation community in Cannes Reserve occupying 0.4ha (75%) of the Reserve and represents 0.001% of the regional occurrence of this community (Pittwater Council 2011a). LR is generally confined to the lower elevations in gully areas of Cannes Reserve and is generally associated with the riparian zone that passes through the centre of the ***subject site***. The structure and composition of this community is typical of LR Sub-alliance 19 (Floyd 1990), and Coastal Escarpment LR (DEWHA 2009), which typically occurs in protected gullies and some distance away from the ocean. The dominant species in the canopy included *L. australis*, *S. glomulifera*, and *G. ferdinandi*.

6.2.2. Locality

Littoral Rainforest

Twenty-five hectares of LR has been mapped in the Pittwater LGA, or approximately 0.005% of the LGA (Pittwater Council 2012). Littoral Rainforest also occurs in other Pittwater LGA managed parks and reserves including, Betty Morrison, Bungan Beach, Attunga, Porters and Frog Hollow Reserves as well as Hordern and Wiltshire Parks.

LR is generally confined to the lower sections of Cannes Reserve. The core section of the LR habitat is associated with the riparian zone that passes through the centre of the survey site. The dominant species in the canopy included *L. australis*, *S. glomulifera*, and *G. ferdinandi*.

6.3 DISCUSSION OF CONSERVATION STATUS

The DGRs state: *'for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threaten abatement plan applying to it.'* Furthermore and in accordance with Section 110(3)(b1) and 110(3)(b2) the following must also be addressed:

- *An assessment of whether those ecological communities are adequately represented in conservation reserves (or other similar protected areas) in the region.*
- *An assessment of whether those ecological communities are at the limit of its known distribution.'*

This section addresses the conservation status, distribution and status of the LR EEC that will most impacted by the proposed works.

'Littoral Rainforest in the NSW North Coast, Sydney Basin and South Coast Bioregions' is listed as an Endangered Ecological Community (EEC) in Part 3 of Schedule 1 of the TSC Act 1995. This community has been listed due to the increasing threat from becoming extinct due to urban development, further fragmentation, weed invasion, dumping of garden refuge and from wild fire.

'Littoral Rainforest in the NSW North Coast, Sydney Basin and South Coast Bioregions' is the equivalent to 'Littoral Rainforest and Coastal Vine Thickets of Eastern Australia' ecological community, which is listed as Critically Endangered under the EPBC Act listed, though due to condition thresholds under this listing the subject remnant does constitute the CEEC, as listed under the EPBC Act.

The viability of the Cannes Reserve LR is significantly under threat from extensive invasion of exotic weeds and damage caused by what has become a permanent GHFF camp, whose numbers have peaked at over 1,000 individuals in June 2010. At least 70% of the site is severely infested by dense

patches of exotic weeds and is especially infested by *Lantana camara* (Lantana) and *Tradescantia fluminensis* (Wandering Jew). Current weed densities are effectively suppressing the recruitment and survivability of native plants species. 'Invasion, establishment and spread of Lantana (*L. camara*)' is listed as a Key Threatening Process, under the TSC Act.

This community has a naturally disjunct distribution across its range and occurs within a range of land forms, from sandy dunes or on soils derived from underlying rock (NSWSC 2004). The community is fire sensitive and consequently located in areas that are protected by fire (DECC 2008).

Littoral Rainforest EEC covers approximately 0.005% of the Pittwater LGA (Pittwater Council 2012). Generally the community occurs in small disjunct patches located in sheltered gullies and along the coast. The distribution and extent of LR within the ***locality*** is shown in **Figure 17**. The 0.4ha in Cannes Reserve represents 1.6% of the LR that is present within the ***locality***. Therefore, the 0.12ha that will be affected by the proposed tree removal or modification is less than 0.48% of the LR in the region.

6.4 DISCUSSION OF THE LIKELY EFFECT OF THE PROPOSAL AT LOCAL AND REGIONAL SCALES

6.4.1 Significance within a local context

The DGR's state: *'The significance of the impacts in the study area for conservation of the affected EEC in the locality must be discussed. This includes an assessment of the significance of such impacts must consider and take into account the differences in remanent sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the locality with those in the study site.*

Littoral Rainforest

Littoral Rainforest (LR) is a closed forest community that is found along the east coast of Australia and typically located within two kilometres of the coast or adjacent to a large body of salt water such as estuaries and offshore islands. There were 433 LR patches known in NSW of which 90% are less than 10ha in size (DEWHA 2009; OEH 2011). The largest patch of LR in NSW covers an area of 136ha. This patch occurs in the Iluka Nature Reserve and subsequently is protected (Wetland Care Australia). The total area that LR occupies in NSW is approximately 1,600ha (DECC 2007).

The total extent of LR that remains in the 5km radius or ***locality*** is approximately 25ha in size (**Figure 23**). This 25ha is distributed among a number of remanent patches that are protected in Pittwater Council managed parks and reserves (Pittwater Council 2011a). There are three types of LR within ***locality*** including Coastal Dune (0.22ha), Coastal Escarpment (23.87ha) and Coastal Headland LR (0.81ha) (**Figure 23**) (SCIVI). The LR remnant in Cannes Reserve is recognised as, Coastal Escarpment LR, which is well represented in NSW, the region and the ***locality***, with a total of 23.87ha. Coastal Escarpment LR is represented in a number of reserves, including Angophora, Horden and Whiltshire Reserves. Personal observations of the LR in these reserves found them to be in a much better condition state than that at Cannes Reserve, which is discussed **Section 6.3**. This was mainly due to an absence of the exotic weeds (*L. camara* and *T. fluminensis*), that dominate the Cannes Reserve understorey, which is a direct result of bushland management activities undertaken by Pittwater Council.

As previously discussed in this SIS, LR occupies 0.4ha (75%) of Cannes Reserve, which occurs in the lower slopes in association with the drainage system. Sections of the Cannes Reserve have been disturbed for drainage works, which may have contributed to severe exotic weeds infestation that

presently occurs in the reserve. Additional disturbance presently impacting Cannes Reserve includes resident encroachment, through the disposal of litter, garden and lawn clippings.

The planned works will impact on 0.124ha of weed infested LR over a 5 year period, but will not result in a net loss to the LR remnant. All resulting impacts will be subsequently mitigated by significant weed control, habitat rehabilitation and restoration works. Therefore the planned works will not result in a net loss of LR in the region and will result in increasing the quality and long term viability of this patch of EEC. Therefore, the loss of habitat and potential impacts are unlikely to be significant in the ***locality***.

6.4.2 Extent of planned habitat removal or modification for 2012.

In 2012, Pittwater council proposes to remove and/or lop 12 trees and palms to ameliorate the impact that the GHFF camp has on residents to the northern end of Cannes Reserve. The GHFF colony is predominantly camped in the north western buffer.

The total number of trees to be removed/lopped in 2012 includes:

- Four *G. ferdinandi* and three *L. australis* from Cannes Reserve.
- One *G. ferdinandi* and four *L. australis* from 29 Therry Street.
- Several exotic species including all *Ligustrum* spp and from the 7m buffer and drainage line as well as two *J. mimosifolia* from the eastern boundary of the site.
- One dead stag.

All of the trees that will be removed or pruned are canopy trees that range in height from 8 to 12 metres. It is noted that the canopy of several of the G. *ferdinandi* have been severely defoliated by the actions of the roosting GHFF. One G. *ferdinandi* is exhibiting heavy coppicing due to having been pruned during the 2011 tree works. Further, several of the multiple trunked G. *ferdinandi* will have one trunk lopped to remove roosting limbs thus retaining the tree in part as one trunk, to remain viable.

The proposed works will be undertaken using best practice techniques and by limiting noise to the colony generated by the works. To limit impacts to roosting bats it is proposed that tree works will be carried out at night when the majority of individual GHFFs will be away from the camp foraging. The suggestion of night works was raised between Council and OEH prior to the commencement of works carried out in 2011. Residents have previously agreed with night work operations, if the works do not occur 11pm.

Removal of exotic weeds and trees

The weed removal from Council includes all *Ligustrum spp*. present within the 7m buffer zone and along the drainage line. Privet (all age classes) will be stem injected *in situ* using a cordless drill (which is unlikely to disturb the GHFF while works are being underneath them) and treated by stem injection using Roundup Bi-active. Two Jacaranda behind 17 Net Road (both are multi-trunked in the buffer) will be removed.

Incremental removal of *T. fluminensis* will continue as per the PoM and Pittwater Council (2011b).

The weed densities present within Cannes Reserves are extremely high. Indeed, at least 70% of the site is severely infested by dense patches of exotic weeds and is especially infested by *L. camara* and *T. fluminensis*. These weed densities are effectively suppressing the recruitment and survival ability of native plants species. The viability of the Cannes Reserve LR is significantly under threat from the current extent of exotic weeds. 'Invasion, establishment and spread of Lantana (*L. camara*)' is listed as a KTP, under the TSC Act. Its control will therefore assist in the amelioration of this KTP.

'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is also listed as a KTP. Littoral Rainforest is a fire sensitive ecological community and high abundance of *L. camara* is known to increase the threat and subsequent intensity of fire (Ensbey 2008). As such, works to reduce the amount of *L. camara* present within Cannes Reserve help to reduce the risk posed to the remnant by inappropriate fire regimes.

Therefore, the weed removal program is considered a benefit to the health and status of the LR and PSGF EECs that are present within Cannes Reserve. It is proposed that the removal of this species will potentially encourage recruitment, increased diversity and abundance of native flora and fauna species to Cannes Reserve. It is possible that by encouraging the occupancy among a variety of fauna guilds, ecological functions of pollination, mycophagy (relationships between fungi, fauna and plant species) and control of invasive invertebrates may be enhanced and maintained while subsequently increasing the health of each EEC.

6.4.3 Discussion of connectivity

The DGR's state that: *'The potential of the proposal to increase fragmentation of each EEC, its relation to adjoining vegetation and to exacerbate edge effects or to decrease the ability for movement of individuals and/or gene flow needs to be discussed.*

The proposed works will not impact on the connectivity and/or fragmentation of LR, rather they will enhance the quality and connectivity of LR within Cannes Reserve.

Comprehensive bush corridors exist within the Pittwater LGA. These corridors occur through the existing parks, reserves and the surrounding natural bush that occurs within private residents (backyard bush) (Pittwater Council 1995). Pittwater Council (1995) identifies the importance of habitat corridors to the conservation of local biodiversity and has been established objectives to ensure that they are enhanced and protected, including:

- Identifying existing corridors and designating protected areas away from and between proposed developments.
- To retain habitat features important, such as dead trees to maintain connectivity within the region.
- To undertake bush land regeneration and restoration programs in significant reserves and privately owned properties to enhance and maintain habitat connectivity.
- To prevent development destroying, damage or otherwise have an adverse effect on those values.

Cannes Reserve is located in close proximity to a number of regional parks including Stapleton Park, Angophora, Frog Hollow and Toongari Reserves. There is also considerable backyard bush present surrounding each of these reserves that could potentially link the reserves and maintain connectivity for fauna species and enhance connectivity within the region (**Figure 4**).

The removal of the five trees and seven palms from the inside the boundary of the ***subject site***, while retaining core habitat is unlikely to contribute to the existing levels of fragmentation and isolation that presently exist. Furthermore, the planned restoration and rehabilitation programs will mitigate the potential impacts of edge effects and will not effectively decrease the size of existing patch of LR.

6.4.4 Consideration of threatening process.

The following KTPs are currently acting upon the LR remnant at Cannes Reserve:

- Invasion and establishment of exotic vines and scramblers
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition
- Invasion, establishment and spread of Lantana (*L. camara*)
- Anthropogenic climate change.

There are number of potential threatening process that can impact LR including:

- Clearing of land for residential development
- Changes to water run-off

Given the level of land clearing, subsequent restoration works and the fact that Cannes Reserve is located within an urban environment, these potential threats are unlikely to be exacerbated by the proposed works to the extent that they would have a significant impact on this patch of LR.

6.5 DESCRIPTION OF FEASIBLE ALTERNATIVES

The DGRs state that: *'a description of any feasible alternative to the action are likely to be of lesser affect and the reasons justifying the carrying out of the action in the manner proposed having regard tp the biophysical, economic and social considerations and the principles of ecological sustainable development.'*

Refer to **Section 5.6**. and **Section 7.1.**

Figure 23: Distribution and extent of LR within a 5km radius of Cannes Reserve

7 Ameliorative and Compensatory Measures

7.1 DESCRIPTION OF AMELIORATIVE MEASURES

The DGR's state: *'a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations {s. 112(2)(i)} {or} ecological community (s. 110(3)(f)} including a completion (in a single section of the statement of those measures*.

OEH strongly supports the view that proposals should, in order of preference:

- *Avoid any impacts.*
- *Minimise on- and off-site impacts such that a significant impact is not likely.'*

The OEH Flying Fox Camp Management Policy (FFCMP) (DECC 2008) provides guidelines for and information on conserving and managing flying-foxes and their camps, as well as advising on alleviating concerns about perceived negative impacts of flying-foxes and their camps.

The proposed actions in this SIS are consistent with the policy objectives of this document, as outlined in Section 3.1 (DECC 2008). The following objectives are drawn from the Policy and discussed with reference to Pittwater Councils proposed methodologies to avoid and minimise on and offsite impacts.

Objective 1. To assist DECC and others in managing flying-foxes and their camps in a manner that will ensure the maintenance of a network of flying-fox camps throughout their range, and the conservation of the flying-fox population.

Objective 2. To provide a consistent approach when managing flying-fox camps so:

- Public health and safety are not compromised.
- Legislation, animal welfare and conservation objectives, including recovery planning, are considered.
- The extent to which people feel that their interactions with flying-fox camps are negative is reduced.
- Relevant agencies and organisations are jointly engaged in resolving the issues associated with flying-fox camp management.
- Accessible, best practice management tools to guide policy implementation are provided by DECC and other stakeholders.

Pittwater Council has prepared a Plan of Management for the GHFF camp in Cannes and Gunyah Place Reserves (Pittwater 2011), in consultation with the OEH, which is consistent with Section 3.2 of the OEH FFCMP which aims to achieve the following objectives:

- Retaining and managing the Cannes Reserve camp in situ (that is, in their original position). The aim of the present proposal is create a barrier around the edge of the park, plant non-roost species to create a vegetation buffer that will also minimise the impact of weeds and edge effects.

- Additional regeneration program will enhance potential roost sites in the centre of the park away from residential house and improving roost habitat quality in suitable areas to ensure flying-foxes have alternative habitats available (eg. Warriewood Wetland Reserve).
- Bushland restoration activities will be undertaken to improve the quality, quantity and integrity of habitat in flying-fox camps and maintain camp function.
- Pittwater Council has produced plans of management for flying-fox camps on council land, and on land under councils' care and control.
- Encourage management of camps near residential areas which minimise the impacts of flying-foxes on residents while maintaining viable habitat.
- Comply with legislative requirements; animal welfare and conservation objectives.
- Endeavour to ensure all outcomes balance the amenity of local residents with viable habitat for the Grey-headed Flying-foxes. Considering the small size of the Reserves and close proximity of adjoining residences.
- Maintain Grey-headed Flying-fox numbers at a sustainable level in relation to local amenity.
- Endeavour to ensure that public health and safety are not compromised.
- Protect, restore and enhance the EEC vegetation.
- Provide community education and awareness of Grey-headed Flying-fox and biodiversity issues in relation to Cannes Reserve on Council's web site.

Pittwater has developed an education and communication strategy consistent with Section 4.2 of DECC 2008.

The proposed removal and modification of the vegetation and subsequent habitat restoration within the 7m buffer is unlikely to constitute a significant impact on the subject species, with significant positive impacts for the EECs within Cannes Reserve. The following sections outline a number of measures to further ameliorate any potential impacts from the proposal.

Habitat modification

The preferred option that would provide the least stress to the animals and is consistent with the PoM, is to modify the roosting habitat of the GHFF within a 7m buffer directly adjacent to residential properties surrounding the site. The planned works will occur on an incremental basis, with the 2012 the works planning to remove five *G. ferdinandi* trees and seven *L. australis* palms from the LR. A number of exotic trees will also be removed. It is considered that by undertaking adaptive management which involves incremental clearing of trees, weed removal, followed quickly by habitat restoration using local providence LR or PSGF vegetation species, the proposed works are unlikely to have a long term or significant impact that will heighten the threat of extinction to the subject species within Cannes Reserve.

The proposed clearing of the 7m buffer and associated works is a preferred option as:

- The proposed works would constitute a short term disturbance to the LR and the roosting habitat of the GHFF, with vegetation management providing positive improvements to the EEC and potential roosting habitat in the core of the remnant, consistent a Vegetation Management Plan (VMP) prepared by Pittwater Council (Pittwater 2012).
- The vegetation in the study area will not be isolated or fragmented from any currently connecting areas of habitat given the high mobility of the species.
- Incremental and small areas of roosting or breeding habitat will be impacted upon by the proposed works each year to progressively move the camp towards the centre of the

reserve. Although, restoration works are planned for the centre of the trees will not achieve a suitable size for 10 -20 years. However, there is alternative roosting habitat within region at Ku-Ring-Gai and Warriewood Reserve that may be able to support any GHFF individuals that become displaced.

- The species is large, highly mobile and migratory. If required the species is able to travel long distances to locate food and roosting resources.

The following safeguards are incorporated into the VMP to avoid unnecessary impacts, and where impacts are unavoidable to minimise these disturbances.

- Minimise or avoid the removal of native vegetation from the LR and PSGF EEC if possible.
- Incremental and systemically remove plant species with a focus on the exotic tree and shrub species, *Ligustrum* spp., *Musa* spp. (Banana) and the climbers Ipomoea coccinea) *Cissus hypoglauca*, *Araujia sericifera*, *Cardiospermum grandiflorum*.
- Avoid impacts and maintain endemic plant species and the integrity of the LR and PSGF EEC.
- Undertaking intensive pre, during works and post surveys to ensure that the site occupancy, health status, avoid injuring or causing death to and excessive damage to any threatened and non-threatened animals or vegetation communities.

Managing to mitigate significant impacts prior to, during and after the vegetation removal.

- Pre-clearing stage works will occur on an incremental basis, with the 2012 the works planning to remove five *G. ferndindari* trees and seven *L. australis* palms.
- All vegetation removal and modification works will be scheduled to take place in June-July period to avoid critical phases of the life history of GHFF i.e. when lactating females are present. GHFF are sensitive and easily stressed which can result in the mothers aborting their young, dropping of young and abandonment of young after they become too heavy for the mother to carry to alternative roosts.
- A suitably qualified and experienced ecologist will be present on site on the day that the proposed works occur to undertake pre-clearance surveys searches for Powerful Owls and other fauna `immediately' prior to any vegetation removal.
- If a threatened species is recorded then that immediate location should be avoided during the works.
- If a threatened species is found to within the area to be cleared, then works should be postponed and undertaken when the species is not present within the site.

Clearing Stage

- All trees to be removed are flagged or marked for identification by an OEH officer prior to the commencement of works.
- Timing – avoid undertaking any removal of vegetation (except understorey weed removal) during the GHFF breeding period from September through to March the following year until the young are dependant.
- All clearing works to be conducted by a professional tree contractor who is a member of an appropriate professional body such as the Arborist Association and according to AS4373 (Australian Standard – Pruning of Amenity Trees) that will be employed Pittwater Council.
- Proposed tree works be carried out at night when most of the colony will be active and away from the camp foraging. Night works will limit the direct impacts of noise and human activity on the camp because numbers of GHFF are likely to be low. The suggestion of

night works was raised between Council and OEH prior to the commencement of works carried out in 2011 and then put to residents, all of whom at the time, did express that they would be comfortable with any night work operations as long as the works didn't exceed beyond11pm.

- Machinery that will be used consists of chainsaws to cut limbs and trunks. Council seeks to maintain the same contractor as was used in 2011 during similar works to maintain a level of consistency and site familiarity in these proposed new works for 2012.
- If a threatened species within the region where the vegetation clearing is to occur, all works must cease immediately and not re-start until the species leaves the site.
- An ecologist or Wildlife Carer must be present to salvage any fauna injured or killed during the works.
- If any animal is injured or deceased due to the works, a report must be submitted OEH immediately.
- All the vegetation that is being removed should be done incrementally to allow for displaced fauna to relocate into existing and intact vegetation.
- Do not impact upon the two known Powerful Owl roosting trees.
- Do not undertake planned tree removal during periods of adverse climatic conditions. GHFFs are susceptible to hot weather conditions.

Post clearing Stage

- All the vegetation to remove incrementally to allow for fauna to move from the area to safe locations while the works are being undertaken. This will also discourage impacting upon the other plant species and the EECs present within the area.
- Encourage that the works take place when Powerful Owls and the GHFF are absent from diurnal roosts. Works should be conducted at night or early in the morning.
- As previously, stated if an animal is injured or killed all work must stop and local Wildlife Carer or Veterinarian is take care of the injured animal until it is of sufficient health to be released back in the region.
- Replanting and rehabilitation of areas affected by the tree removal and must be undertaken. Replanting should only use LR and SPGF species of local providence.
- All (fine thickness > 10cm) and course woody (fine thickness < 10cm) must be retained from and used during the rehabilitation of the site. Fine and course woody debris provide important structural elements to understorey and are known to provide habitat for a range of small to medium fauna species. The terrestrial Long-nosed Bandicoot occurs within Cannes reserve and would potential benefit from the creation of artificial nesting and foraging habitat.

7.1.1. Long term management strategies

The DGRs state that: *'Consideration must be given to developing long term management strategies to protect areas within the study area which are of particular importance for the threatened species, populations and ecological communities likely to be affected. This may include proposals to restore or improve habitat on site where possible.'*

The threatened species that were recorded within the ***subject site*** are generally highly mobile and migratory. Features of high ecological significance that require protection include the large dead stag, which is located centre of the reserve, the ephemeral creek line and the PSGF that buffers the LR.

Strategies aimed at protecting and enhancing the site have the potential to encourage non-threatened and threatened species to occupy the site. This includes the removal and ongoing control of exotic weeds and the subsequent rehabilitation. Weed removal and site rehabilitation works programs were

included in the previous Section 95 Certificates and should be extending to any further Section 91 applications. Due to the extent of weed infestation, their removal and the site rehabilitation will be ongoing for considerable length of time.

A VMP has been drafted by Council (Pittwater 2011a) to set future strategies and set goals to protect and enhance the natural resources present within the reserve. ELA also recommends establishing a variety of artificial fauna habitats through Cannes Reserve. This includes using the fine and course woody debris to create refuge and foraging habitat for small mammals. As previously stated, by encouraging the occupancy among a variety of fauna guilds, ecological functions of pollination, mycophagy (relationships between fungi, fauna and plant species) and control of invasive invertebrates may be enhanced and maintained while subsequently increasing the health of each EEC.

7.1.2. Compensatory strategies

The DGRs state that: '*Where the proposal will result in loss to a threatened species, populations and ecological communities (or their habitats), strategies to compensate (offset) for the loss(es) should be considered. These include other off-site or local area proposals that will contribute to long term conservation of the applicable threatened species, populations and ecological communities.'*

Given that the proposed works will only partially modify and not remove any EEC and all attempts will be made to enhance the quality of the vegetation as well as the flora and fauna habitats they provide, it is considered there will be no net loss to any threatened species habitat or extent of EECs and as such it will not be necessary to provide compensatory habitats (i.e. offsets). As previously discussed, comprehensive works aimed at removing the weeds and allowing for natural regeneration and the replanting of native species will have a significant positive impact on the integrity of the LR and its long term viability. These works will effectively provide a net positive outcome for threatened species and EECs present within the ***subject site*** by improving the quality of the habitat in what is currently a very degraded site (see **Section 4** for discussion of site condition).

7.1.3. Translocation (Dispersal of GHFF)

The DGRs state that: *'OEH does not consider the translocation of threatened species, populations or EECs to be an ameliorative measure for the purpose of considering impacts of a particular development or activity. Translocation is usually only supported by OEH in specific conservation programs (recovery planning) but only as a last resort after in situ conservation options have been exhausted'*

No translocation of any threatened species, including GHFF is proposed in this SIS. Generally most previous attempts to permanently translocate or relocate GHFF have proven to be unsuccessful with camps often moving to an unanticipated or undesirable location, time consuming and are often expensive (Roberts 2009; Roberts *et al.* 2010; Geolink 2010). Translocation or relocation is only discussed as a last resort option if the proposed measures do not provide a satisfactory solution to the current conflict between the location of part of the GHFF camp and adjacent residences. On this basis only a brief description of the failed and successful translocation/relocation programs for GHFF are mentioned. Indeed, Chapter 6 of the FFCMP deals with disturbing and relocating flying-fox camps. The following excerpt is taken from the FFCMP:

'Cost-effective, reliable techniques for relocating flying-fox camps have not yet been developed. The result of relocation attempts such as the use of loud music or other loud noises, shooting or hosing with water has generally been that the animals have not deserted their old camp, or, if forced to desert the camp, have not relocated to the selected new location. Instead, they have relocated to less desirable locations, for example, they have scattered throughout a town or joined nearby camps in other towns, compounding problems at those sites. The stress caused to the animals has sometimes resulted in fatalities, with pregnant females and dependent young being particularly vulnerable. Consequently,

DECC does not generally support disturbing camps or attempting their relocation. However, DECC recognises that there may be exceptional circumstances when such action may be warranted.' (DECC 2007)

The local residents who's wellbeing and ill health is being impacting is considered more than reasonable justification for considering translocation and relocation of GHFF from Cannes Reserve should the suite of measures currently proposed not satisfactorily resolve the current conflict.

Translocating or relocating involves considerable efforts to identify potential alternative sites and designing strategies to encouraging the GHFF to roost there. Indeed, where camps have been successfully removed, a suitable camp site nearby had been identified (Hall and Richards 2000; GHFFACTF 2001). GHFF camps occur in a range of habitats and consequently there is considerable uncertainty of the reasons why GHFF select certain areas above others (Eby 2006; Roberts 2006). Consequently, therefore it is often difficult to be certain of where the relocating individuals will form camps.

As previously stated translocating/relocating the Cannes GHFF is not considered an immediate or feasible option, however, Pittwater Council will seek to enhance the habitat at Warriewood to provide a potential alternative camp site which flying foxes may voluntarily move to (Pittwater 2011b). Warriewood is a preferred location for a GHFF camp as the likelihood of conflicts is considerably lower due to a lack of residential dwellings in close proximity and the large size of the reserve. Warriewood is currently only occupied by GHFF during the months of March and April (mating season).

As compensation for the work under the previous Section 95 Certificate, Pittwater Council aim to enhance the habitat at Warriewood Wetland Reserve through habitat tree plantings and undertaking primary and secondary weed control works. Indeed, there are a number of areas within the Warriewood Wetland Reserve with potential for GHFF habitat creation. These include windrow areas which are long, narrow banks of dry sandy soil between permanent pools. Ongoing advice may be required from ecologists with expertise in the GHFF as to what further measures may be required to improve this site without having a negative impact on the existing EECs (Pittwater 2011b). There are significant gaps in our understanding of how GHFF select their camp locations, therefore considerable research is required to determine which roost and habitat trees should be planted. Although, our understanding of camp selection is limited, any program should use the vegetation diversity and structure at Cannes Reserve and the Ku-Ring-Gai Flying Fox reserve as a guide. The works currently proposed include planting additional rows of *Casuarina glauca* and *L. australis.* A timetable for proposed bush regeneration and revegetation works for Warriewood Wetlands has not been developed. However, because many of these tree species take many years to mature, a timeline to enhance the habitat in Warriewood should be considered as soon as possible.

7.1.4. Ongoing monitoring

The DGR's state that: *'Any proposed pre- and post-development monitoring plans of the effectiveness of the mitigation or compensatory measures must be outlines in detailed, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies which have not been proven effective should be undertaken under experimental design conditions and be appropriately monitored.'*

Grey-headed Flying-fox

In addition, the DGRs included specific monitoring conditions for the GHFF population at Cannes Reserve in so far that it must be monitored in accordance with the s95 Certificate issued to Pittwater Council on 8th July 2011 (Pittwater 2011a) and the Cannes Reserve PoM (Pittwater 2011b). The monitoring program includes:

- Camp assessments and GHFF counts already commenced to be continued to immediately prior to the works beginning and then the day before, on the day, the day after, one week later and then monthly until at least June 2012 (or as this date will already have passed before the SIS is determined for around 6 months after the event).
- A camp assessments and GHFF count to be undertaken the day before the vegetation removal or modification works.
- Counts to continue during the works, the day after, one week later and weekly for at least 6 months.
- The observers undertaking the counts must have previous knowledge and experience in the behaviour of GHFF and previous population counts.
- Council staff must be present to supervise all works and counts through the duration of the monitoring program.

The objective of this proposal is to encourage the GHFF to roost away from the boundaries of the site and into the core of the remnant. Success of the proposed action shall be measured by the stabilisation of the population at approximately 200 animals, residing in the core of the Cannes Reserve. The PoM sets out a 5 year timeframe for success, which will be measured against the ability of the plan to:

- Protect the Grey-headed Flying-fox colony in-situ, maintaining their well-being.
- Provide residents with a reasonable level of amenity.
- Provide local residents with access to health services to assist with their well-being.
- Restore and conserve the EEC.
- Adapt to new issues associated with the GHFF camp as they arise.

To minimise the impacts and to gain a full understanding of works we encourage the following recommendations be applied. These recommendations as per those outlined in the documentation submitted to OEH and the conditions in the Section 95(2) Certificate.

- The numbers of GHFF within the camp to be verified through ongoing monitoring by appropriately trained Council staff or volunteers, as agreed by OEH.
- Camp assessments and local population counts be made at Cannes Reserve must be undertaken and continued for a least a fortnightly basis until immediately prior to the proposed works occurring. Immediately prior to the works, GHFF counts are to be undertaken the day before the works, on the day of the works, the day after, one week later and then monthly until for at least 6 months after the works.
- To accompany this data collection and to ensure effective management of GHFF in the locality and Pittwater LGA assessments and counts must be conducted at the Warriewood GHFF camp before the works, on the day after the works, one week after the works and monthly thereafter for at least 6 months.
- Assessments should also be conducted of Stapleton Park, Angophora, Toongari and Frog Hollow Reserves for GHFF before the works, on the day after the works, one week after the works and monthly thereafter for at least 6 months.
- To ensure the health and wellbeing of the GHFF's is maintained throughout the works, an observer with the knowledge and experience in the behaviour of the species must be present throughout the duration of the works to assist in monitoring the responses of the species during the disturbance. Council staff must also be present on site to supervise the works.
- If the works are undertaken at night, the majority of the GHFF may be absent from site to while conducting their foraging activities. However, if this does not occur and/or 10% of the camp populations (as determined from the prior to works counts) take to the air once the works begin and are still flying 10 minutes later, the works must cease for a period of 10

minutes to allow for the bats to settle in the trees. A further 10 minute increment must be applied to allow the bats to a rest period before the works can begin again. No more than two unsuccessful attempts must be made before the works must cease altogether. Following this, no works to begin until consultation with Council Staff, OEH and the field experts.

- Works should not be undertaken in adversely hot, cold or wet weather conditions.

Monitoring of vegetation modification

Pre, during and post monitoring programs have been developed for the fauna and LR EEC and are discussed in Section 7

Weed removal and habitat enhancement programs

The weed removal and habitat enhancement programs are from Pittwater 2011a and 2011b. Contract works to remove weeds commenced on 5th September 2011. The works were as per those outlined in the documentation submitted to OEH and all conditions of the Section 95(2) Certificate will be met by the contractor under the guidance of council's Bushland Management Officer (BMO). Measures were set and taken to avoid or ameliorate the impact from the bush regeneration/restoration activities on the GHFF, particularly any 3rd trimester pregnant females which have been observed roosting in the camp (as of Sept 1st 2011). No machinery such as chainsaws or whipper snippers will be used during the restoration works.

A timetable for future bush regeneration that will take place in Cannes Reserve

All bush regeneration work will be carried out using best practice methods that target aggressive woody weed species including *L. lucidum, L. sinense* , *Cestrum parqui*, *L. camara*, *C. grandiflorum* and *Ipomea indica* will be removed. It is hoped that the removal of the weed species will allow for the EEC host species such as *S. glomulifera* and *G. ferdinandi* to develop and reach their full potential as suitable roost trees for the GHFF. All planned works will also be undertaken in a gradual and careful manner to ensure that the relative humidity and fauna habitat is not severely compromised to put other species at threat.

The works plan to enhance the floristic composition of the EEC through restoration works and weed removal together and further enrichment planting of EEC understorey species. Pittwater Council aim to replant low resilience species such as *Eupomatia laurina*, *Wilkea heugliana*, *P. multiflorum*, *Synoum glandulosum*, *Gymnostachys anceps*, *Elaeodendron australe*, *Claoxylon australe* and *Maclura cochinchinensis* together with other endemic EEC species. Natural regeneration will be encouraged following the removal of exotic weeds. Where natural regeneration has been triggered as a response to minimal soil disturbance and increased light levels, the area will be marked with stakes for future monitoring. Those areas that show little or no natural regeneration will be flagged as suitable for planting. The translocation of certain species will be undertaken to replace the herbaceous weed species *T. fluminensis*. Weed spraying is not to be permitted near the two water courses, the property boundaries or within the GHFF colony.

Monitoring public health issues

If the this GHFF colony is to be retained and protect in situ within Cannes reserve then, the health and well-being of residents living adjacent to Cannes Reserve also requires regular assessments and monitoring. Evidence collected during community discussion has shown that health and well-being of local residents is being possibly affected by the presence and activities of the GHFF. These assessments and monitoring programs should be supported, undertaken and funded by the Department of Primary Industries and NSW Health. In addition, these departments should provide opportunities for

residents to undertake counselling, visit generally practitioners and provide immunisation against the Hendra and ABL viruses.

8 Assessment of Significance of Likely Effect of Proposed Action

The DGRs for this SIS require a revised Assessment of Significance based on the detailed assessment and consideration of alternatives and/or ameliorative measures proposed in the SIS, a re-assessment of the significance of impact (section 5A EP&A Act or rather s.94 of the TSC Act as the SIS is for a s.91 licence) is to be carried out for each of the entities (threatened species, population or ecological community) identified in the SIS as being likely to be affected.

Revised assessments of significance (7 part test) for the proposed action on the subject species of this SIS are provided below. These assessments of significance have been undertaken in accordance with the s.5A of the EP&A Act and have been carried out in accordance with the Threatened Species Assessment of Significance Guidelines (DECC 2007).

8.1 POWERFUL OWL (NINOX STRENUA)

The Powerful Owl (*Ninox strenua*) the ecology, biology, local and regional distribution and conservation status of the species is discussed in **Section 5**.

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 the risk of extinction.

Factors likely to have an adverse effect on the life cycle of the Powerful Owl would include a substantial loss and/or fragmentation of foraging habitat, loss of suitable nesting and roosting habitat, disturbance to nesting habitat, high frequency hazard reduction burning (affecting prey availability), secondary poisoning, road kills, and predation of fledglings by foxes, dogs and cats.

The proposal will remove two exotic Jacaranda trees, five *G. ferdinandi* trees and seven *L. australis* palms from Cannes Reserve from private property at 29 Therry St, Avalon, in an attempt to move the camp into the centre of Cannes Reserve, by reduce the available roost sites for GHFF. Given the conservation sensitive approach of systematically removing small sections of the habitat from the site it is considered that the primary impact of the proposed works would be on areas of potential foraging habitat.

Ample roosting and foraging habitat is present and will be retained within the ***subject site*** and adjoining areas that will provide ongoing foraging and roosting resources for the species. The roosting and foraging habitat in the ***locality*** is of substantially higher quality than the roosting and foraging habitat present in the study area. Similar foraging habitat that will be impacted in the ***subject site*** is present within Stapleton Park, Angophoras Reserve and Ku-Ring-gai National Park. The site is considered suitable for foraging by Powerful Owl, due to the presence of prey such as Common Ringtail Possum, Common Brush-tail Possum, and Grey-headed Flying Fox (DEC 2006a). Whilst contributing to the cumulative loss of habitat that has previous occurred at Cannes Reserve will be minimal and is unlikely to have a significant impact on the Powerful Owl. Additional factors that could have an adverse effect on the life cycle of the Powerful Owl, secondary poisoning, road kills, and predation of fledglings by foxes, dogs and cats that are unlikely to increase as a result of the proposed development.

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

Not applicable. The Powerful Owl is not an endangered population.

c) in the case of an endangered ecological community or critically 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.

Not applicable. The Powerful Owl is not an endangered ecological community.

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*,

The proposal will remove two exotic Jacaranda trees, five *G. ferdinandi* trees and seven *L. australis* palms from Cannes Reserve from private property at 29 Therry St, Avalon, in an attempt to move the camp into the centre of Cannes Reserve, by reduce the available roost sites for GHFF. Given the conservation sensitive approach of systematically removing small sections of the habitat from the site it is considered that the primary impact of the proposed works would be on areas of potential foraging habitat.

The proposal will result in the removal and modification of 12 native and exotic trees to form a buffer between residents within Cannes Reserve. The removal or modification will be gradual, to minimise severe changes. In addition, the roosting and foraging habitat is extensively distributed throughout the ***locality*** and includes natural habitat in reserves and on private property. The amount of habitat that will be removed or modified in the ***subject site*** represents a small proportion of habitat available to the species in the ***locality*** and is not considered to provide critical habitat resources such that this impact is not considered significant. Some minor losses and impacts will occur to the present roosting habitat. However, considerable roosting and foraging habitat will be retained immediately within the ***subject site*** and in the adjacent areas surrounding the reserve. (e.g. in Stapleton Park and Angophora Reserve) is larger and less disturbed than that in the ***subject site***.

The removal of potential foraging habitat due to the proposal will occur adjacent to Cannes Reserve and will not isolate any currently interconnected areas of potential habitat. As such, the loss of habitat will not result in the fragmentation or isolation of habitat for Powerful Owl.

Habitat that will be removed or modified under the proposed development is not likely to be crucial habitat for the species. This is due primarily to the small loss of potential foraging habitat relative to that that is protected in the region. Breeding has been recorded at the site. However, if the proposed works

are conducted between April and August, the proposal is unlikely to impact on the breeding patterns and the survival of the young. Therefore the removal and modification of foraging and roosting habitat is not likely to affect the long-term survival of Powerful Owl in the ***locality***.

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

Critical habitat cannot be declared for the Powerful Owl as it is a vulnerable species. Therefore, this question is not applicable.

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

A recovery plan for the Large Forest Owls, which includes the Powerful Owl (DEC 2006a) follows these objectives or actions:

- Model and map owl habitat and validate with surveys.
- Monitor owl population parameters.
- Audit forestry prescriptions.
- Manage and protect habitat off reserves and state forests.
- Undertake research.
- Increase community awareness and involvement in owl conservation.
- Provide organisational support and integration.

The proposed development will result in a small reduction of roosting habitat only. Recovery Objective 4 requires that impacts on large forest owls and their habitats should be adequately assessed during the environmental assessment process, and that adverse impacts should be avoided, minimised and ameliorated.

The site provides roosting and foraging habitat for Powerful Owls. However, the species may not be reliant on the habitat for survival or to avoid extinction, especially in the context of the areas of higher quality habitat elsewhere in the ***locality***. As such, the proposed works are not considered unlikely to significantly impact the Powerful Owl habitat present within the ***locality***.

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 of relevance to the Powerful Owl include the clearing of native vegetation and loss of hollow bearing trees.

The proposed development will clear and modify native vegetation. This will result in the small loss of potential foraging habitat for Powerful Owl. As discussed above, it is expected that the species is not reliant on this vegetation, particularly when considering amount of available habitat surrounding in adjacent areas. No hollow-bearing trees will be removed.

Conclusion of the 7 Part Test for Powerful Owl

The proposed development is unlikely to impose a significant impact on the Powerful Owl given that the proposed works:

- Would remove only small amount of foraging habitat within the subject site, with this habitat well represented in the ***locality***.

- Prey species including Common Brushtail and Ringtail Possums, GHFF and assorted bird species were commonly recorded within Cannes Reserve.
- Would seek to maintain potential roosting habitat and foraging habitat resources within the APZ.
- Would not remove any potential breeding habitat for the species.
- Would not isolate an area of known habitat from currently interconnecting areas of potential habitat for this wide ranging species.

On the basis of the above considerations, it is unlikely that the proposed development will result in a significant effect on the survival of the Powerful Owl.

8.2 EASTERN BENTWING-BAT (*MINIOPTERUS SCHREIBERSII OCEANSIS*)

The ecology, biology, local and regional distribution and conservation status of the Eastern Bentwing-bat (*Miniopterus schreibersii oceansis*) is discussed in **Section 5**.

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 the risk of extinction.

The proposal will remove two exotic Jacaranda trees, five *G. ferdinandi* trees and seven *L. australis* palms from Cannes Reserve from private property at 29 Therry St, Avalon, in an attempt to move the camp into the centre of Cannes Reserve, by reduce the available roost sites for GHFF. Given the conservation sensitive approach of systematically removing small sections of the habitat from the site it is considered that the primary impact of the proposed works would be on areas of potential foraging habitat.

The proposal will result in the removal and/or modification of vegetation that may constitute potential foraging habitat. It is very unlikely that the species uses the site sheltering or breeding habitat due to an absence of caves and anthropogenic structure within Cannes Reserve.

The loss of potential foraging habitat is expected to be minimal when considering the large undisturbed areas of potential habitat available on site and in the surrounding landscapes. Furthermore, there was only a small number of calls were recorded for this species during the present study, suggesting that the species either is very rare in the area or infrequently uses the site. Either way, it is unlikely that the loss of vegetation will significantly disrupt the life cycle of the species such a point that a viable local population is placed at risk of extinction.

Foraging habitat is potentially present within the onsite and ***locality***, which will provide ongoing foraging resources for the species. Eastern Bentwing-bat are highly mobile and are capable of large regional movements in relation to seasonal reproductive behaviour and winter hibernation. The species can also move large distances during foraging excursions (Hoye and Hall 2008). It is unlikely that the proposal's direct impact to known foraging habitat will influence the species to the extent that it would place a viable local population at risk of extinction.

Remaining factors that could have an adverse effect on the life cycle of the Eastern Bent-wing Bat, damage or disturbance to roosting or breeding habitat, application of pesticides in or adjacent to foraging areas, and predation by feral cats and foxes, will not be increased as a result of the proposed development.

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

Not applicable. The Eastern Bent-wing Bat is not an endangered population.

c) in the case of an endangered ecological community or critically 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.

Not applicable. The Eastern Bent-wing Bat is not an endangered ecological community.

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*,

The proposal will remove or modify five*G. ferdinandi* trees and seven *L. australis* palms to create the 7m buffer surrounding the site. The vegetation being removed may only represent potential foraging habitat. This level of habitat removal is considered to be minimal, when considering the large undisturbed areas of potential habitat available in the surrounding ***locality***, including the Stapleton Park, Angophora Reserve and the urban bush land system associated with private properties. These areas would possibly contain a higher density of resources for these species. Therefore, the amount of habitat lost due to the proposed development is not likely to represent a significant loss to the species.

The habitat that will be removed or modified under the proposed development is not likely to be crucial habitat for the species. This is due primarily to the small loss of foraging habitat relative to the species' movement range and the availability of habitat in the ***locality***.

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

Critical habitat cannot been declared for the Eastern Bentwing-bats it is a vulnerable species. Therefore, this question is not applicable.

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

No recovery plan has yet been developed for the Eastern Bent-wing Bat. No relevant threat abatement plans have been prepared for the 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 of relevance to the Eastern Bentwing-bat include the clearing of native vegetation.

The proposed development would result in the clearing of native vegetation. This would result in the loss or modification of known foraging habitat for Eastern Bent-wing Bat. As discussed above this species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding foraging habitat available onsite and in adjacent reserved lands. No roosting or breeding habitat will be impacted.

Conclusion of the 7 Part Test for Eastern Bent-wing Bat

The proposed development is unlikely to impose a significant effect on the Eastern Bentwing-batgiven that the proposed works:

- Would only remove a small area of foraging habitat within the study area relative to Eastern Bentwing-bat movement capacities;
- Would not disturb any roosting habitat or maternity caves; and
- Would not isolate an area of known habitat from currently interconnecting areas of potential habitat for this species. Larger areas of suitable foraging habitat are present within surrounding land.

On the basis of the above considerations, it is not likely that the proposed development will result in a significant effect on the survival of the Eastern Bent-wing Bat.

8.3 EAST COAST FREE-TAIL BAT (*MORMOPTERUS NORFOLKENSIS*)

The ecology, biology, local and regional distribution and conservation status of the East Coast Freetail-bat (*Mormopterus norfolkensis*) is discussed in **Section 5**.

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 the risk of extinction.

The proposal will remove two exotic Jacaranda trees, five *G. ferdinandi* trees and seven *L. australis* palms from Cannes Reserve from private property at 29 Therry St, Avalon, in an attempt to move the camp into the centre of Cannes Reserve, by reduce the available roost sites for GHFF. Given the conservation sensitive approach of systematically removing small sections of the habitat from the site it is considered that the primary impact of the proposed works would be on areas of potential foraging habitat.

The proposal will result in the removal and/or modification of vegetation that may constitute potential foraging habitat. It is very unlikely that the species uses the site sheltering or breeding habitat due to an absence of caves.

The loss of potential foraging habitat is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding landscapes. Furthermore, there was only a small number of calls were recorded for this species during the present study, suggesting that the species either is very rare in the area or infrequently uses the site. Either way, it is unlikely that the loss of vegetation will significantly disrupt the life cycle of the species such a point that a viable local population is 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

East Coast Freetail-bat is not an endangered population and therefore this question does not apply.

c) in the case of an endangered ecological community or critically 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.

East Coast Freetail-bat is not an endangered population and therefore this question does not apply.

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

The proposal will result in the removal or modification of five trees and seven palms. Some of the vegetation to be removed may represent potential foraging habitat. The loss of potential foraging habitat is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding ***locality***, including the Stapleton Park, Angophora Reserve and the urban bush land system associated with private properties. These areas would be expected to contain a higher density of resources for these species. Therefore, the amount of habitat lost due to the proposed development is not likely to represent a significant loss to the species.

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

Habitat to be removed is unlikely to isolate or fragment any currently interconnected areas of potential habitat or populations of this highly mobile species. This is mainly due to the species being highly mobile, the extent of bushland surrounding the site and the apparent limited use of the site by the species.

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*,

Habitat to be removed and/or modified is unlikely to be important to the long term survival of the species in the ***locality***. This is because this highly mobile species does not appear to regularly use the site, therefore the site is unlikely to present crucial habitat for these species.

The primary roosting habitat for this species, which includes caves, hollow bearing trees, culverts or bridges, will not be affected by the proposed works. This is because none of these natural or man-made structures exist within the areas where the habitat removal and modification will occur. Therefore the proposed habitat removal and modification of the small amount of habitat is not likely to affect the long-term survival of East Coast Freetail-bat in the ***locality***.

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

No critical habitat for the East-coast Freetail Bat has been identified for this species.

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

No recovery plan or threat abatement plan has been prepared for East-coast Freetail Bat. However, there are a number of strategies and subsequent Priority Actions have been identified to help manage and recover each species. One of the priority actions common across these species is the retention of hollow-bearing trees, maintaining diversity of age groups, species diversity and structural diversity. The current development is not in conflict with this priority action.

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.

Several KTP's are relevant to this species on the site, as follows:

The proposal will result in the modification of the ***subject site*** and the removal five *G. ferdinandi* trees and seven *L. australis* palms from Cannes Reserve from private property at 29 Therry St, Avalon. This level of removal of native vegetation is considered to represent a marginal cumulative contribution to the Key Threatening Process: 'clearing of native vegetation'.

Whilst the proposal will cumulatively add to some of the above KTP's, the impacts are considered to be minor.

Conclusions

The proposed development is unlikely to impose a significant effect on East-coast Freetail Bat given that:

- The proposed works would only remove a small increment of total potential foraging habitat present within the study area, ***locality*** and region.
- Pre clearing surveys and presence of an ecologist or a suitable qualified Wildlife Carer are required to be on site during clearing should minimise direct mortality during construction.
- Would not isolate an area of known habitat from currently interconnecting areas of potential habitat for this species.
- Larger areas of potentially more suitable roosting foraging habitat are present within surrounding ***locality***.
- Planned restoration and rehabitation of the LR may enhance the quality of the habitat within the reserve and over time encourage this species to use Cannes Reserve on a regular basis for nesting and roosting.

On the basis of the above considerations, it is not likely that the proposed development will result in a significant effect on the survival of the East-coast Freetail Bat.

8.4 GREY HEADED FLYING FOX (*PTEROPUS POLIOCEPHALUS*)

The species occupies open forest and woodlands in the coastal lowlands, tablelands and slopes of south-eastern Australia from Bunbury in Queensland to Geelong, south-western Victoria. Individuals of the species are generally migratory and move throughout the landscape in response to presence or absence of food resources. The GHFF is colonial species that roost in large aggregations or camps in the exposed branches of canopy trees. Camps are vital to the conservation of the species because they provide resting habitat, refuge, protection from predators, climatic extremes as well as for social interactions, significant life history phases including conception, birth and lactation (Parry-Jones and Augee 1992; Geolink 2010). Camps can be occupied on a seasonal or permanent basis and provide important stop overs for migrating and foraging animals. Camps are generally occupied and located in the response to food resources (DECCW 2008; Eby and Law 2008).

The GHFF is a highly mobile species whose migration patterns are determined by the availability of flowering food resources. The species is a canopy-feeding frugivorous, blossom-eater and nectarivore that uses rainforest, woodlands, paperbark swamps and Banksia woodlands. This species feeds in particular on the nectar and pollen of native trees, especially *Eucalyptus* spp., *Melaleuca* spp. and *Banksias* spp., and fruits of rainforest trees and vines. During times when native food resources are limited, GHFFs forage on fruit crops and cultivated gardens. GHFFs congregate in large colonies of up to 200,000 individuals in the summer season. Camp sites are generally located next to rivers or creeks, and occur in a range of vegetation communities including rainforest, wet sclerophyll forest, Melaleuca woodland, Casuarina forest or mangroves. These sites have a dense canopy, providing them with the moist, humid microclimate they require. Campsites are critical for mating, birthing, rearing of young and as diurnal refuge from predators. Urban gardens, cultivated fruit crops and roadside verges may also provide temporary roosting habitat for this species.

There are two GHFFs camps in the Pittwater LGA including a temporary camp at Warriewood Reserve and the more permanent Cannes Reserve camp. Each camp is separated by a distance if approximately 8km GHFFs are recent occupants to Cannes Reserve and were only initially recorded approximately 10 years ago (Pittwater Council 2011) (**Figure 21**). Since then, they have become regular visitors and the permanent camp has been established. Initially the camp was occupied by only males but in more recent times breeding females have been recorded. The numbers that have been recorded in the Cannes Camp has fluctuated significantly with as many as 1200 individuals being recorded at any given time (Pittwater Council 2011).

- There are 27 further records of this species within a 10km radius of the ***subject site*** according to the NSW Wildlife Atlas, including Warriewood and Cannes Reserves. The temporary nature of the camp at Warriewood suggests that the ***locality*** is only used for foraging purposes and in response to seasonal production of certain food resources. Outside Pittwater Council, the nearest known camps include the Ku-Ring-gai Flying Fox Reserve at Gordon approximately 24km west of the ***subject site***, which is known to contain habitat for approximately 30,000 individuals.

The individuals presently occupying Cannes Reserve are likely to be components of a large regional population of bats which move between roosting sites and populations within the Sydney metropolitan area and along the NSW coast.

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 the risk of extinction.

The proposal will remove two exotic Jacaranda trees, five *G. ferdinandi* trees and seven *L. australis* palms from Cannes Reserve from private property at 29 Therry St, Avalon, in an attempt to move the camp into the centre of Cannes Reserve, by reduce the available roost sites for GHFF. Given the conservation sensitive approach of systematically removing small sections of the habitat from the site it is considered that the primary impact of the proposed works would be on areas of potential foraging habitat.

Factors likely to have an adverse effect on the life cycle of GHFF would include a substantial loss and/or fragmentation of foraging habitat, disturbance to roosting habitat, unregulated shooting, and electrocution on powerlines.

The works involve the removal of five *G. ferdinandi* trees and seven *L. australis* palms within the ***subject site***. This habitat removal or modification is not considered to be vital to the long-term survival of the species. The removal of this vegetation is unlikely to impact upon the foraging behaviour and therefore health and survival potential of the species. The diet of Grey-headed flying foxes comprises primarily nectar and pollen from blossoms in the canopy of various vegetation types and pulp from the fleshy fruits of rainforest trees and lianas, with leaves and exudates from leaf-mining insects, such as psyllids also utilised as secondary dietary components. Of the 59 primary blossom diet species and 46 fruit diet species identified for the species (Eby and Law 2008). Only two species from Eby and Law (2008) list of food tree species were recorded within the ***subject site*** including *S. glomulifera* and *Ficus coronata* (Sandpaper Fig). Therefore, due to the generally lack of diversity among the potential food trees it is likely that the site does not represent at the represent critical foraging habitat for GHFF. Better foraging habitat is present at Stapleton Park were a range of blossom diet species are present including *Angophora costata* (Smooth-barked Apple), *Angophora floribunda* (Rough-barked Apple), *Corymbia maculata* (Spotted Gum), *E. botryoides* (Bangalay), *E. gummifera* (Red Bloodwood). *E. paniculata* (Grey Ironbark), *E. piperita* (Sydney Peppermint), *E. punctata* (Grey Gum), *E. resinifera* (Red Mahogany) and *S. glomulifera*. Further, the vegetation in Toongari Reserve, which is located less than 1km away from Cannes reserve, is dominated by important blossom food trees including *E. robusta*, *Melaleuca quinquenervia* and *A. costata*. All of these species are regarded by Eby and Law (2008) as having moderate to having high blossom productivity and reliability scores for GHFF.

The proposed works could potentially impact on the roosting and breeding behaviour of the species at this camp. The north-east corner of Cannes Reserve of the ***subject site*** represents roosting and breeding habitat. This also represents the target area for the majority of vegetation removal to occur to have the maximum effect on moving the GHFF's. GHFFs are synchronised seasonal breeders with mating behaviour beginning in January, conception occurring in May and births occurring in October-November (DECCW 2009). The reproductive rate of the species is low with only one pub born each year which are then dependant on their lactating mothers for another six months (Tideman *et al.* 2008). Impacts on breeding and lactating mothers can be mitigated by undertaking any proposed works outside the mating and maternal periods. Therefore, proposed works should occur between April and August.

The site does not represent foraging habitat for this species. The impact associated with the loss of foraging habitat within the ***subject site*** is expected to be minimal when considering the large undisturbed areas of more suitable potential habitat available in the ***locality***. Furthermore, much of this land and the availability of it for foraging by the GHFF, is considered secure in the long-term as it is either part of the formal reserve system or is under the ownership of the crown. The species is large in size and highly mobile and there are a number of other GHFF camps with the 50km foraging range of the species that could provide interim or long term roosting habitat it Cannes Reserves is becomes less suitable to some individuals.

Therefore, because of the small level of disturbance (loss of 12 native trees), the mobility of the species and the number of regional camps with 50km of Cannes Reserve it is unlikely that the proposed works would not place a viable local population of the species 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

Not applicable. The GHFF is not an endangered population.

c) in the case of an endangered ecological community or critically 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.

Not applicable. The GHFF is not an endangered ecological community.

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*,

The works involve the removal of five *G. ferdinandi* trees and seven *L. australis* palms within the *subject site*. This habitat removal or modification is not considered to be vital to the long-term survival of the species.

However, it is not intended that the proposed works will render the entire ***subject site*** unsuitable for roosting and breeding by GHFFs. A component of the proposed works is to rehabilitate and increase the roosting habitat in the centre of the reserve. Therefore, encouraging those individuals utilising the trees or areas marked for removal or modification will roost in the centre of the reserve.

As previously discussed the proposed works should not impact on the foraging behaviour of the species. There will some loss of habitat within the boundary of the reserve, but this planned outcome.

The proposed works will not isolate or contribute further to the fragmentation of any currently interconnected areas of roosting and foraging habitat.

The works involve the removal of five *G. ferdinandi* trees and seven *L. australis* palms within the ***subject site***. This habitat removal or modification is not considered to be vital to the long-term survival of the species. This level of habitat removal is not considered to be vital to the long-term survival of the species. The site represents low quality foraging habitat that is surrounded by better quality habitat for this species throughout ***locality***, including urban areas. The Cannes Reserve camp has only recently become a breeding colony, however, if the works are timed to occur outside the breeding period it is unlikely that the works will have a significant impacted. As such, the proposed vegetation clearing or modification of habitat is unlikely to result in the fragmentation, isolation of foraging or roosting habitat for the GHFF to such a point to impact on the long-term survival of the species.

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

Critical habitat cannot be declared for the GHFF as it is a vulnerable species. Therefore, this question is not applicable.

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

A draft National recovery plan for the GHFF has been prepared by DECCW (2009). The specific objectives of this recovery plan are:

- To identify and protect foraging habitat critical to the survival of GHFFs throughout their range.
- To protect and increase the extent of key winter and spring foraging habitat of GHFFs.
- To identify roosting habitat critical to the survival of GHFFs.
- To protect and enhance roosting habitat critical to the survival of GHFFs.
- To substantially reduce deliberate destruction of GHFFs in fruit crops.
- To reduce negative public attitudes toward GHFFs and reduce conflict with humans.
- To increase public awareness and understanding of GHFFs and the recovery program, and to involve the community in recovery actions, where appropriate, to reduce the threat of negative public attitudes and conflict with humans.
- To monitor population trends in GHFFs so as to monitor the species' national distribution and status.
- To assess and reduce the impact on GHFFs of electrocution on powerlines and entanglement in netting and on barbed-wire.
- To improve knowledge of the demographics and population structure of GHFFs in order to increase understanding of the ecological requirements of the species.
- To increase the effectiveness and efficiency of recovery initiatives for GHFFs by working cooperatively with conservation and management programs with overlapping objectives to remove or reduce the impact of threatening processes on the species.
- To maintain an effective GHFF National Recovery Team to oversee the implementation of the GHFF National Recovery Plan to remove or reduce the impact of threatening processes on the species.
- To provide long-term economic benefits associated with the protection of ecosystem services, promotion of sustainable forest management, improved crop protection regimes, promotion of sustainable agricultural practices and increased viability of some commercial fruit industries.

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.

The development will contribute to key threatening processes relevant to the GHFF including the clearing of native vegetation. However as discussed above, these impacts will not impact upon the foraging habitat of this species, which is widespread within and beyond the ***locality***. The species is migratory, and therefore has the ability to join or create other camps elsewhere that have long-term tenure security and provide higher quality habitat. In addition, mitigation measures will be developed and implemented that intended to rehabilitate and enhance the potential GHFF habitat in the centre of the reserve. As such the scale of these impacts is considered unlikely to significantly impact upon any local population of the species to the extent that the local population would be placed at increased risk of extinction.

Conclusion of the 7 Part Test for GHFF

The proposed vegetation clearing and modification are unlikely to impose a significant effect on the GHFF given that the proposed works:

- In 2012, two Section 91a licences applications will be submitted for the following proposed works.
    - Removal or pruning of two exotic Jacaranda trees, four *G. ferdinandi* trees and three *L. australis* palms from Cannes Reserve.
    - Removal or pruning of one unhealthy *G. ferdinandi* tree and four *L. australis* from private property at 29 Therry St, Avalon.
- The impacts will be small and gradual. Similar and potentially suitable habitat exists within the foraging range of the species in the region. However, many of these patches are in close association with residential housing. Therefore, the same conflicts Warriewood and Ku-Ring-gai of this species is well represented in the ***locality***.
- Are unlikely to significantly impact on the potential foraging habitat within the ***locality***.
- Would not isolate a patch of known habitat or known population habitat from the currently interconnected areas of habitat and known camps for this wide ranging species.
- Are not inconsistent with the objectives of the recovery plan prepared for this species.
- Mitigation measures will be developed to maintain, enhance and ensure that the Cannes Reserve population can persist in manner that does not conflict with local residents.

On the basis of the above considerations, it is unlikely that the proposed works will result in a significant or negatively impact on the survival of the GHFF.

8.5 LITTORAL RAINFOREST IN THE NEW SOUTH WALES NORTH COAST, SYDNEY BASIN AND SOUTH WEST CORNER BIOREGIONS

Littoral Rainforest (LR) is a closed forest community with a vegetation structure ranges from low thickets when in close proximity to the ocean to tall forest in protected locations that often occur further inland. This community is found along the east coast of Australia and typically located within two kilometre of the coast or adjacent to a large body of salt water such as estuaries or on an offshore island (DEWHA 2009). The distribution of this community extends from Princess Charlotte Bay on the southern extent of Cape York Peninsula in Queensland through to the Gippsland Lakes in the Victoria. In NSW, it occurs in small patches along the entire coastline (DEWHA 2009). Presently, there are 433 known LR patches in NSW of which 90% are less than 10ha in size. The largest patch of LR in NSW covers an area of 136ha. This patch occurs in the Iluka nature Reserve and subsequently is protected (Wetland Care Australia). This vegetation community also occurs on offshore islands. The total area that LR occupies in NSW is approximately 1600ha.

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 the risk of extinction.

Not applicable. The LR is not a threatened 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

Not applicable. The LR is not an endangered population.

c) in the case of an endangered ecological community or critically 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.

Not applicable. The LR is not an endangered ecological community.

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*,

The proposed development will result in the removal and modification of five *G. ferdinandi* trees and seven *L. australis* palms.

The works involve the removal of five *G. ferdinandi* trees and seven *L. australis* palms within the ***subject site***. This habitat removal or modification is not considered to be vital to the long-term survival of the species.

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

Critical habitat has not been declared for LR. Therefore, this question is not applicable.

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

There is currently no Recovery Plan prepared for Littoral Rainforest EEC (Note: Littoral Rainforest and Coastal Vine Thicket EEC is the equivalent community listed at the national level and does not have a recovery plan ether).

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.

The development will contribute to key threatening processes relevant to LR including the 'clearing of native vegetation'. This impact is well mitigated by the proposed bush regeneration works proposed at the site, including the rehabilitation of the site with local provenance LR flora, as discussed in detail above.

'Invasion, establishment and spread of Lantana (*L. camara*)' is listed as a KTP, under the TSC Act. The viability of the Cannes Reserve LR is significantly under threat from the current extent of Lantana camara, and its control will therefore assist in the amelioration of this KTP.

Conclusion of the 7 Part Test for Littoral Rainforest

The proposed vegetation clearing and modification is unlikely to impose a significant impact LR given that the proposed works:

- Would remove or modify only five *G. ferdinandi* trees and seven *L. australis* palms from within the study area. The impacts will be small and gradual.
- The viability of the Cannes Reserve LR is significantly under threat from the current extent of exotic weeds. 'Invasion, establishment and spread of Lantana (*L. camara*)' is listed as a KTP, under the TSC Act. Its control will therefore assist in the amelioration of this KTP.
- Bush regeneration works at the site will improve the current health and viability of the community.

On the basis of the above considerations, it is unlikely that the proposed works will result in a significant or negative impact on the LR at Cannes reserve, to the contrary they area likely to have a net positive effect.

9 Additional Information

QUALIFICATIONS AND EXPERIENCE

This SIS has been prepared by ELA, with inputs from a number of staff. **Table 15** below shows the ELA staff who have been involved with preparing the SIS, and their qualifications and experience are attached as **Appendix F**.

Table 15: ELA staff involved with preparing this SIS

STAFF MEMBER	SIS CONTRIBUTION
Rodney Armistead	Survey & SIS report preparation
Lucas McKinnon	Advice, Review & SIS report preparation
Robert Humphries	Advice, Review of SIS
Elizabeth Norris	Survey & Advice
Bruce Mullins	Advice
Joanne Daly	Mapping

9.1 OTHER APPROVALS FOR THE DEVELOPMENT OR ACTIVITY

The DGR's require:

- *' A list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population or ecological community (Section 110(3)(g))', and*
- *'Where an approval(s) is required under Part 5 of the Environmental Planning and Assessment Act 1979, the name of the determining authority(ies), the basis for the approval and when these approvals are proposed to be obtained should be included.'*

The proposal is being assessed under a Review of Environmental Factors (REF). The determining authority is Pittwater Council. The basis for approval is the need to mitigate conflicts between local residents and conserve a population of the threatened Grey-headed Flying-Fox.

Assessments to determine whether the proposed development will have a significant impact on matters of NES have not been undertaken as a component of this SIS. If an assessment is made that concludes the proposed development is likely to have a significant impact on a matter of NES, than the proposed action will need to be referred to the Minister for the Sustainability, Environment, Water, Populations and Communities to determine the nature of the action and required approvals.

The relevance of Tree Protection Orders (TPOs) to the proposed works should be assessed.

9.2 LICENSING MATTER RELATING TO THIS SURVEY

The DGR's note that persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. ELA's NSW National Parks and Wildlife Regulation 2009 Scientific Licence to undertake general flora and fauna surveys is **SL100243.**

9.3 SECTION 110 (5) REPORTS

As per the Director General Requirements (DGRs) threatened species profiles available from the DECCW website were used, and these are considered to satisfy s.110(5) report requirements. Other background information was also utilised, and is detailed in relevant sections of this SIS.

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Appendix A: Director General's Requirements

NSW GOVERNMENT Office of Environment & Heritage

Our reference ED11/1307
Contact Benn Treharne 9995 6807

Mark Ferguson
General Manager
Pittwater Council
PO Box 882
Mona Vale NSW 1660

RE: REQUEST FOR DIRECTOR GENERAL'S REQUIREMENTS FOR THE PREPARATION OF A SPECIES IMPACT STATEMENT FOR ONGOING MANAGEMENT OF THE GREY-HEADED FLYING-FOX COLONY AT CANNES RESERVE, AVALON BY PITTWATER COUNCIL.

Thank you for your letter dated 29 September 2011 (received 5 October 2011) requesting the requirements of the Director-General for a species impact statement (SIS) for the proposal cited above.

As requested, Director-General's Requirements (DGRs) are attached. These DGRs have been compiled on the understanding that the proposal is based on the works described in the *Cannes Reserve and Gunyah Place Reserve Plan of Management*, including (but not necessarily limited to):

- creation of a seven metre buffer around the perimeter of Cannes Reserve to form a buffer between the Grey-headed Flying-fox colony and adjoining residents; and
- upgrade of the walking track from Cannes Drive to Therry Street along the unformed section of Net Road.

Please note that issuing of Director-General's Requirements is a statutory obligation for the Office of Environment and Heritage (OEH) and should not be construed as endorsement of or support for the proposal.

Should you require any further information on these requirements please contact Benn Treharne on 9995 6807 or by email at benn.treharne@environment.nsw.gov.au.

Yours sincerely

26.10.2011

JACINTA HANEMANN
A/Manager Infrastructure & Biodiversity
Environment Protection and Regulation
Office of Environment and Heritage
Department of Premier and Cabinet

The Department of Environment, Climate Change and Water is now known as the Office of Environment and Heritage, Department of Premier and Cabinet

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ATTACHMENT

DIRECTOR-GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR ONGOING MANAGEMENT OF THE GREY-HEADED FLYING-FOX COLONY AT CANNES RESERVE, AVALON BY PITTWATER COUNCIL.

PURPOSE

The purpose of an SIS is to:

- allow the applicant or proponent to identify threatened species issues and provide appropriate amelioration for adverse impacts resulting from the proposal;
- assist consent and determining authorities in the assessment of a development application under Part 4 or request for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- assist the Director-General in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act;
- assist the Director-General or the Minister for the Environment when consulted for the purposes of Parts 4 or 5 of the EP&A Act; and
- assist the Director-General in the assessment of Section 91 Licence applications lodged under the *Threatened Species Conservation Act 1995* (TSC Act).

DEFINITIONS

The definitions given below are relevant to these requirements:

proposal is the development, activity or action proposed
threatened species, populations and ecological communities has the same meaning as in the *Threatened Species Conservation Act 1995*
subject site means the area directly affected by the proposal.
study area means the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account.
locality is the area within a 5 km radius of the subject site.
subject species means those threatened species, populations and ecological communities that are known or considered likely to occur in the study area.

All other definitions are the same as those contained in the TSC Act and the assessment of significance guidelines.

MATTERS WHICH HAVE BEEN LIMITED

The following Section 110 matters need only be addressed where relevant:

- *Threat abatement plans*
  No threat abatement plans have been currently approved in accordance with the TSC Act which are relevant to this proposal.

- *Recovery plans*
  The following Recovery Plans are relevant to this proposal:
  - Grey-headed Flying-fox *Pteropus poliocephalus* Draft National Recovery Plan
  - Koala *Phascolarctos cinereus* Recovery Plan
  - Large Forest Owls Recovery Plan

DIRECTOR-GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR ONGOING MANAGEMENT OF THE GREY-HEADED FLYING-FOX COLONY AT CANNES RESERVE, AVALON BY PITTWATER COUNCIL.

- *Key threatening processes*

The following key threatening processes are relevant to this proposal:

- Clearing of native vegetation
- Infection of native plants by *Phytophthora cinnamomi*
- Invasion and establishment of exotic vines and scramblers
- Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*
- Invasion by native plant communities by exotic perennial grasses
- Invasion, establishment and spread of *Lantana camara*
- Loss of hollow-bearing trees
- Predation by the Feral Cat *Felis catus*

- *Critical habitat*

At this time, no areas of declared critical habitat are relevant to this proposal.

The proponent should be aware that recovery plans may be approved, critical habitat may be declared and key threatening processes may be listed between the issue of these requirements and the granting of consent. Such an occurrence may require additional matters to be addressed in the SIS and considered by the consent, determining or concurrence authority.

MATTERS TO BE ADDRESSED

Except where those matters have been limited above, the TSC Act provides that the SIS **must** meet all the matters specified in Sections 109 and 110 of the Act, as directed by the following sections.

1 FORM OF THE SPECIES IMPACT STATEMENT

*1.1 A species impact statement **must** be in writing (Section 109 (1))*

*1.2 A species impact statement **must** be signed by the principal author of the statement and by:*

(a) the applicant for the licence, or

(b) if the species impact statement is prepared for the purposes of the Environmental Planning and Assessment Act 1979, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires) Section 109(2)).

The applicant must sign the following declaration:
"I…[insert name], of ..[address], being the applicant for the licence…[insert name of proposal, Lot & DP numbers, street, suburb and LGA names] have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions on any licence or certificate provided for the proposal."

2 CONTEXTUAL INFORMATION

The description must include information of the following forms or types:

2.1 Description of proposal, subject site and study area

The following are further requirements related to your obligation under Section 110(1) to address the following:

DIRECTOR-GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR ONGOING MANAGEMENT OF THE GREY-HEADED FLYING-FOX COLONY AT CANNES RESERVE, AVALON BY PITTWATER COUNCIL.

A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout

A comprehensive description of the nature, extent and timing of all components and associated or consequent actions of the proposal must be provided, including actions that have effects both *on and off* the subject land as a result of the proposal.

Detailed justification of the need for the proposal must be provided in the SIS. This must include a clear statement outlining the aims and objectives of the proposal, as well as a detailed assessment of the likely effectiveness of the proposal in achieving the desired outcomes. Evidence to support the assessment of likely effectiveness should be provided where necessary to justify the proposal.

2.2 Land tenure information

A legal description of the land (lot and deposited plan numbers) and information about the land tenure across the study area must be provided.

2.3 Vegetation

Vegetation present within the locality must be mapped and described, including documentation of the areal extent of each vegetation community. Vegetation descriptions should match (or at least refer to) those in the Vegetation Types Database (available at www.environment.nsw.gov.au/resources/nature/BioMetric_Vegetation_Type_CMA.xls). Reference should also be made to the descriptions of endangered or critically endangered ecological communities as determined by the Scientific Committee. Classifications must have regard to both structural and floristic elements.

2.4 Plans and maps

An aerial photograph or reproduction of such a photograph (preferably colour), of the locality, indicating scale and clearly delineating the subject site must be provided.

A map or maps must be provided, showing:

i) in the locality,
- any locally significant areas for threatened biodiversity.
- the locations of any previously known threatened species or endangered populations.
- the locations and types of vegetation and cleared areas (with reference to the description required in section 2.3).

ii) in the study area,
- the location, size and dimensions of the study area.
- the full extent of the proposed works as described in section 2.1 at a scale of not less than 1:1000.
- topography of the site and immediate surrounds at a scale of not less than 1:3000.
- the locations and types of vegetation and cleared areas (with reference to the description required in section 2.3).

All maps must indicate scale and have an explanatory legend of any symbols used.

DIRECTOR-GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR ONGOING MANAGEMENT OF THE GREY-HEADED FLYING-FOX COLONY AT CANNES RESERVE, AVALON BY PITTWATER COUNCIL.

3 INITIAL ASSESSMENT

The following are further requirements related to your obligation under Section 110(2)(a) to address the following:

- *a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action.*

and the requirements under Section 110(3)(a) to address the following:

- *a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action*

3.1 Identifying subject threatened species, populations and ecological communities ('subject species')

3.1.1 Assessment of available information

In determining the subject threatened species, populations and ecological communities likely to be present (the subject species), the applicant should consult relevant databases, including the Atlas of NSW Wildlife. Note the public website version of the Atlas does not contain all records and some are not represented accurately (the location data is denatured). An Atlas report from the OEH Wildlife Data Unit is, therefore, recommended. A full list of threatened species, populations and ecological communities within a 10 km x 10 km area centered on the subject site must first be compiled (and provided in the SIS). Contact the OEH Wildlife Data Unit (gis@environment.nsw.gov.au) to obtain a full Atlas report under licence for this 10 km x 10 km area around the subject site. Use of the BioBanking Credit Calculator is also recommended to supplement the list of threatened species that possibly occur on the site (see guidelines at www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm#4).

Other flora and fauna databases, such as those held by local government, the Australian Museum, CSIRO, Forests NSW and the Botanic Gardens Trust Sydney should also be consulted to assist in compiling the list. Note that the Atlas of NSW Wildlife only holds records for which OEH is the custodian and does not include records held in other databases, where the conditions of data licences or data exchange agreements prevent OEH from distributing such information. In many cases, the Atlas of NSW Wildlife may only contain a small subset of the available data. Hence, other databases should also be consulted to assist in making an adequate determination of subject species.

A list of subject threatened species, populations and ecological communities likely to be present (the subject species) must then be developed from recent records obtained from the data sources above, as well as any other species likely to be present that may not have been recorded locally. In developing the list of subject species, populations and ecological communities, consideration must be given to the habitat types present within the study area and the known distribution of threatened species, populations and ecological communities in the locality. The guidelines at www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm#3 for habitat assessment must be followed. Additionally, the OEH threatened species profiles, any available recovery plans and or draft recovery plans, and vegetation assessment and mapping by State or local government agencies must be consulted.

The following **vulnerable, endangered or critically endangered species** must be considered as a subject species:

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DIRECTOR-GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR ONGOING MANAGEMENT OF THE GREY-HEADED FLYING-FOX COLONY AT CANNES RESERVE, AVALON BY PITTWATER COUNCIL.

Scientific name	Common name	TSC Act legal status
Syzygium paniculatum		Endangered *
Ninox strenua	Powerful Owl	Vulnerable
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable *
Phascolarctos cinereus	Koala	Vulnerable
Petaurus norfolcensis	Squirrel Glider	Vulnerable
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable *

The following **endangered populations** must be considered as a subject species (endangered population):

- Koala *Phascolarctos cinereus* population in the Pittwater Local Government Area
- Squirrel Glider *Petaurus norfolcensis* population on Barrenjoey Peninsula, north of Bushrangers Hill

The following **endangered or critically endangered ecological communities** must be considered as a subject species (ecological community):

Name	TSC Act legal status
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered *
Pittwater Spotted Gum Forest	Endangered

* indicates species, populations or communities that are listed also on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

These lists are not exhaustive. One of the roles of the SIS is to determine which species may be utilising the study area given the limitations of existing databases.

Also be aware that additional species, populations, and ecological communities could be added to the schedules of the TSC Act between the issue of these requirements and the granting of consent. If this occurs, these additional entities will need to be addressed in the SIS and considered by the consent, determining, or concurrence authority.

4 SURVEY

4.1 Requirement to survey

A flora and fauna survey is to be conducted in the study area. Targeted surveys must be conducted for all subject threatened species, populations and ecological communities determined in accordance with section 3.

The techniques and timing of these surveys should be commensurate with the biology/ecology of these species and ecological communities in order to maximise the likelihood and accuracy of detection. Specific survey requirements for certain species are identified in section 4.3. Guidance on appropriate methodologies and level and timing of survey efforts for some other species can be obtained from OEH's *Threatened Species Survey and Assessment Guidelines* (www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm), environmental impact assessment guidelines (see section 9.4), draft or approved recovery plans (see section 9.4), scientific or environmental management journals, previous biodiversity surveys and other sources. The information required to identify the type of impacts and assess their significance on threatened species is the key determinant for the level of survey effort required.

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Any modifications to the recommended or required survey methods or levels of survey effort require justification of their adequacy. This justification should be scientifically valid and refer to relevant scientific literature. Previous surveys (yours or others) can contribute to fulfilling the requirements of section 4, but only if they have been conducted and documented in accordance with the provisions specified in that section, e.g. with respect to the type, location, duration, spacing/density, appropriate season and weather conditions, etc. of the surveys. Documentation and mapping of these attributes, as required by section 4.2, applies equally to any previous surveys used. The currency of any previous surveys used to fulfill these requirements is a matter that will need to be considered by the consent authority in determining the adequacy of the SIS.

Species of taxonomic uncertainty must have their identification confirmed by a recognised authority such as the Australian Museum or National Herbarium at the Royal Botanic Gardens, Sydney.

4.2 Documentation

4.2.1 Description of survey techniques and survey locations

Survey technique(s) must be described and, where possible, a reference supporting the survey technique employed is to be provided.

The size, orientation and dimensions of plots, transects or other sampling units should be clearly documented for each type of survey technique undertaken. Full AMG grid references for the survey site(s) should be noted. Survey site(s) should be shown on a map or maps, which indicate scale and have an explanatory legend of all information shown and symbols used.

4.2.2 Documenting survey effort and results

Each and every survey must be documented.

Name(s) of surveyor(s) and other personnel must be recorded. Other persons who identified records (e.g. by analysis of Anabat recordings, hair tubes, scats) should also be named.

The date and time and environmental conditions experienced during each survey must be documented.

Survey proformas for a range of standard fauna survey techniques can be provided separately by email from the nominated contact officer upon request. These forms have provision for the types of information required to be documented. These or equivalent forms must be used by field staff when undertaking fauna surveys. Completed data sheets are to be included as an appendix to the SIS.

Additionally, the time invested in applying *each* different survey technique – e.g. number of person hours/transect, duration of call playback, number of nights traps set – must be summarised in the SIS. **It is *not* sufficient to document only the aggregate time spent on all survey techniques combined.**

Any limitations (e.g. denied access to private land) to sampling across the study area are to be documented.

DIRECTOR-GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR ONGOING MANAGEMENT OF THE GREY-HEADED FLYING-FOX COLONY AT CANNES RESERVE, AVALON BY PITTWATER COUNCIL.

4.2.3 Description and mapping of results of vegetation, flora and fauna surveys

The locations of any newly recorded threatened species or endangered populations resulting from additional surveys must be mapped and described. The mapping of vegetation required under section 2.3 must reflect any new information resulting from additional surveys.

4.3 Specific survey requirements

Grey-headed Flying-fox *Pteropus poliocephalus*
The SIS must include all available population data for the Cannes Reserve Grey-headed Flying-fox colony based on past and current monitoring. This must include the results of the population monitoring required by the conditions of the Section 95(2) certificate issued by OEH to Pittwater Council on 8 July 2011. The applicable conditions are as follows:

- Camp numbers will be verified by ongoing monitoring by appropriately trained Council staff or volunteers, as agreed by OEH.
- Camp assessment and local population counts of Cannes Reserve must continue on at least a fortnightly basis until immediately prior to the proposed disturbance when a count will be done the day before the works, on the day, on the day after, one week later, and then monthly thereafter until at least June 2012.
- The numbers of Grey-headed Flying-foxes at the Cannes Reserve camp leading up to and after the works and the gender ratio within the camp. If additional information can be sought as to whether there are juveniles in the roost, this information should be included.

5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES AND POPULATIONS

Assessment of impacts must consider the nature, extent and timing of the proposal and all associated actions.

Assessment must include the **direct and indirect** impacts of these activities which may occur both **on or off** the subject site.

The impacts on threatened species and populations from the activities proposed to manage the Grey-headed Flying-fox colony at Cannes Reserve are likely to arise from:

- fragmentation and isolation of habitat and an incremental decline in its quality and extent;
- loss of locally significant vegetation;
- loss of foraging and roosting habitat for threatened fauna and a reduction in their local abundance and distribution;
- increased susceptibility to competition, disease, predation, insect attack and other disturbances due to increased access and a reduction in vegetative cover; and
- indirect effects of urbanisation e.g. vegetation removal, rubbish dumping, soil compaction, erosion, weed invasion and increased nutrient loads from run-off into the Reserve.

5.1 Assessment of species likely to be affected

The following are further requirements related to your obligation under Section 110(2)(b) to address the following:

> *an assessment of which threatened species or population known or likely to be present in the area are likely to be affected by the action.*

This requires you to refine the list of subject threatened species and populations (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or endangered populations may be affected directly or indirectly (including cumulatively), by the

proposal. This is to be done taking account of the requirements outlined previously in section 4 of these requirements and information in any relevant Scientific Committee determinations, OEH threatened species profiles, recovery plans or draft recovery plans, and vegetation assessment and mapping. Detailed rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the species does not occur in the study area, or if not resident, will not utilise habitats on site on occasion, or if off-site, be influenced by off-site impacts of the activity, that species does not have to be considered further. Otherwise all species/populations likely to occur in the study area (based on general species distribution information), and known to utilise those habitat types, should be assessed as if they are present.

The requirements in the remainder of this section need only be addressed for those species that are likely to be affected by the proposal. Subsequently this information should be used in an Assessment of Significance (as required in section 8) for each of those species or populations.

5.2 Discussion of local and regional abundance and distribution

The following are further requirements related to your obligation under Section 110(2)(d) to address the following:

an estimate for the local and regional abundance of those species or populations

5.2.1 Discussion of other known local populations

A discussion of other known populations in the locality must be provided. An estimate of the numbers of individuals of each threatened species or population utilising the area and the relative significance of the population(s) in the study area to the populations in the locality must be included.

5.3 Assessment of habitat

The following are further requirements related to your obligation under Section 110(2)(f) to address the following:

a full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region

5.3.1 Description of habitat values

Specific habitat features must be described (e.g. frequency and location of stags, hollow bearing trees, culverts, rock shelters, rock outcrops, crevices, caves, drainage lines, soaks etc) and the density of understorey vegetation and groundcover.

The condition of the habitat within the study area must be discussed, including the prevalence of introduced species, species of weeds present and an estimate of the total weed cover as a percentage of each vegetation community, whether trampling or grazing is apparent, effects of erosion, prevalence of rubbish dumping, history of resource extraction or logging and proximity to roads.

Details of the subject site's fire history (e.g. frequency, time since last fire, intensity) and the source of fire history (e.g. observation, local records), must be provided.

5.3.2 Discussion of habitat utilisation

A discussion of how individuals use the area (e.g. residents, transients, adults, juveniles, nesting, foraging) and discussion of the significance of the habitat of the study area to the viability of the threatened species or endangered population in the locality must be included.

5.4 Discussion of conservation status

The following are further requirements related to your obligation under Section 110(2)(c) to address the following:

> *for each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it*

and to your obligation under Section 110(2)(e) to address the following:

> *an assessment of whether those species or populations are adequately represented in conservation reserves (or other similar protected areas) in the region*

and to your obligation under Section 110(2)(e1) to address the following:

> *an assessment of whether any of those species or populations is at the limit of its known distribution*

The relative significance of the subject site for threatened species or endangered populations in the locality must be discussed. In particular, discussion of other known populations must be provided. Such an assessment must consider and compare the differences in the type, condition and tenure and long-term security of other areas of known habitats in the *locality* with those in the study area.

The discussion must also relate to the threatening processes (see section 5.5.3) that affect the conservation status of the species or population.

Known occurrences in the locality and region of the extinction or degradation of local populations of each affected threatened species or population and of fragmentation, decrease in extent or degradation of its habitat should be documented.

5.5 Discussion of the likely effect of the proposal at local and regional scales

5.5.1 Significance within a local context

The significance of impacts in the study area for the conservation of affected threatened species or endangered populations in the *locality* must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in the type, condition, and the tenure and long-term security, of other areas of known habitats in the *locality* with those in the study area.

5.5.2 Discussion of connectivity

The potential of the proposal to increase the fragmentation of habitat or decrease the ability for the movement of individuals and/or gene flow between habitats or populations of a threatened species or population must be assessed.

5.5.3 Consideration of threatening processes

The assessment of impacts must not be limited only to threats that are recognised as key threatening processes, but must include other threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or

exacerbated by the proposal. The assessment should also include consideration of information in the Priorities Action Statement and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.

5.6 Description of feasible alternatives

The following are further requirements related to your obligation under Section 110(2)(h) to address the following:

> *a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development.*

The SIS must include a detailed review of all potential alternative and supplementary measures to manage and ameliorate the impacts of the Cannes Reserve Grey-headed Flying-fox colony on local residents (while retaining the colony in-situ as per the *Cannes Reserve and Gunyah Place Reserve Plan of Management*). A discussion as to why these measures (whether combined or in isolation) can or cannot be considered as feasible alternatives to the proposal must also be included.

6 ASSESSMENT OF LIKELY IMPACTS ON THREATENED ECOLOGICAL COMMUNITIES

Assessment of impacts must consider the nature, extent and timing of the proposal and all associated actions.

Assessment must include the **direct and indirect** impacts of these activities which may occur both **on or off** the subject land.

The impacts on threatened ecological communities from the activities proposed to manage the Grey-headed Flying-fox colony at Cannes Reserve are likely to arise from:

- fragmentation and isolation of habitat and an incremental decline in its quality and extent;
- loss of locally significant vegetation;
- loss of foraging and roosting habitat for threatened fauna and a reduction in their local abundance and distribution;
- increased susceptibility to competition, disease, predation, insect attack and other disturbances due to increased access and a reduction in vegetative cover; and
- indirect effects of urbanisation e.g. vegetation removal, rubbish dumping, soil compaction, erosion, weed invasion and increased nutrient loads from run-off into the Reserve.

6.1 Assessment of critically endangered or endangered ecological communities likely to be affected

The following are further requirements related to your obligation under Section 110(3)(a) to address the following:

> *a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action.*

This requires you to refine the list of subject ecological communities (given the outcome of survey and analysis of likely impacts) in order to identify which critically endangered or endangered ecological communities (EECs) may be affected, directly or indirectly (including cumulatively), by the proposal. This must include reference to the ecological community as described by the NSW Scientific Committee, and to the requirements outlined previously in section 4 of these DGRs, and take into account information in any relevant EEC profile, recovery plan or draft recovery plan,

and vegetation assessment and mapping. Adequate rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the EEC does not occur in the study area, or will not utilise habitats on site, or if off-site, be influenced by off-site impacts of the activity, that EEC does not have to be considered further. Otherwise all EECs likely to occur in the study area (based on general distribution information), and known to occupy those habitat types, should be assessed as if present.

The requirements in the remainder of this section need only be addressed for those EECs that are likely to be affected by the proposal. Subsequently this information should be utilised in an Assessment of Significance (as required in section 8) for each of those EECs.

6.2 Description of habitat

The following are further requirements related to your obligation under Section 110(3)(c) to address the following:

a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region.

6.2.1 Study area

An assessment of habitat in the study area is required to include:

- a description of each EEC, including:
  - a description of those areas where the community may only be represented by soil stored seed with no or few above-ground components, and
  - a description of disturbance history and recovery capacity. If the site shows signs of disturbance, details should be provided of the site's disturbance history. An assessment should be made of the ability of the ecological community to recover to a state representative of its pre-disturbance condition. This assessment will include consideration of the site's in-situ and migratory resilience and will be accompanied by a map of the recovery capacity of the ecological community across the site. Consideration should be given to the results (preliminary or otherwise) of restoration projects being undertaken at other sites that contain the ecological community when assessing its recovery capacity.
- comparison of the affected community with the EEC as determined by the NSW Scientific Committee.
- reference to any relevant available recovery plans or draft recovery plans and vegetation assessment and mapping.
- maps, consistent with the descriptions provided, showing of the extent and condition of the EEC.

6.2.2 Locality

A discussion of other occurrences of each EEC in the *locality* must be provided. This must include:

- a comparison of other known occurrences and their habitats with those of the study area in terms of remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances).
- the tenure and long-term security of other occurrences and their habitat.
- the relative significance of the subject site for each EEC in the *locality* and region.

6.3 Discussion of conservation status

The following are further requirements related to your obligation under Section 110(3)(b) to address the following:

for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or any threat abatement plan applying to it

The following are further requirements related to your obligation under Section 110(3)(b1) to address the following:

an assessment of whether those ecological communities are adequately represented in conservation reserves (or other similar protected areas) in the region

The following are further requirements related to your obligation under Section 110(3)(b2) to address the following:

an assessment of whether any of those ecological communities is at the limit of its known distribution

The relative significance of the subject site for each EEC in the locality must be discussed. In particular, discussion of other known occurrences of each affected EEC must be provided. Such an assessment must consider and compare the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the *locality* with those in the study area.

The discussion must also cover the threatening processes (see section 6.4.4) that affect the conservation status of the ecological community.

Known occurrences in the locality and region of increased fragmentation, decrease in extent or degradation of each EEC or its habitat should be documented.

6.4 Discussion of the likely effect of the proposal at local and regional scales

6.4.1 Significance within a local context

Provision of information to allow adequate determination of the significance of the effects of the proposal in accordance with Section 5A of the EP&A Act (see section 8) is required. The significance of impacts in the study area for conservation of affected EEC in the *locality* must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the *locality* with those in the study area.

6.4.2 Extent of habitat removal or modification

The location, nature and extent of habitat removal or modification which may result from the proposed action, and the impacts of this on the viability of the EEC in the locality, must be discussed.

This must include an assessment of the proportion of the EEC to be affected by the proposal, in relation to the total extent of the EEC in both Cannes Reserve and Pittwater Local Government Area, and the impact of this on the viability of the EEC at the local level.

6.4.3 Discussion of connectivity

The potential of the proposal to increase fragmentation of each EEC, in relation to adjoining vegetation, and to exacerbate edge effects or to decrease the ability for the movement of individuals and/or gene flow between habitats must be discussed.

If connectivity between adjacent remnants of EECs is likely to be affected, the impact of the proposal on connectivity must also be discussed.

6.4.4 Consideration of threatening processes

The assessment of impacts must not be limited to threats that are determined to be key threatening processes, but must also include threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or exacerbated by the proposal. Assessment should also include consideration of information in the Priorities Action Statement and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.

6.5 Description of feasible alternatives

The following are further requirements related to your obligation under Section 110(3)(e) to address the following:

> *a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development.*

The SIS must include a detailed review of all potential alternative and supplementary measures to manage and ameliorate the impacts of the Cannes Reserve Grey-headed Flying-fox colony on local residents (while retaining the colony in-situ as per the *Cannes Reserve and Gunyah Place Reserve Plan of Management*). A discussion as to why these measures (whether combined or in isolation) can or cannot be considered as feasible alternatives to the proposal must also be included.

7 AMELIORATIVE AND COMPENSATORY MEASURES

7.1 Description of ameliorative measures

The following are further requirements related to your obligation under Sections 110(2)(i) and 110(3)(f) to address the following:

> *a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations [s.110(2)(i)] [or] ecological community [s.110(3)(f)] including a compilation (in a single section of the statement) of those measures.*

OEH strongly supports the view that proposals should, in order of preference:

i. Avoid any impacts;
ii. Minimise on- and off-site impacts such that a significant impact is not likely.

Generally, ameliorative or compensatory measures proposed to reduce or offset the level of impact should only be considered where it can be shown that they have been successfully applied elsewhere. In instances where these measures have not previously been applied they will need to be fully justified and a comprehensive proposal should be submitted which is scientifically

rigorous and adequately funded. The likely efficacy of such measures with respect to the current proposal should be assessed in detail.

7.1.1 Long term management strategies

Consideration must be given to developing long term management strategies to protect areas within the study area which are of particular importance for the threatened species, populations and ecological communities likely to be affected. This may include proposals to restore or improve habitat on site where possible.

7.1.2 Compensatory strategies

Where the proposal will still result in loss to threatened species, populations and ecological communities (or their habitats), strategies to compensate (offset) for the loss(es) should be considered. These may include other off-site or local area proposals that contribute to long term conservation of the applicable threatened species, populations and ecological communities.

Any offsetting measures should be developed in accordance and be consistent with the "*Principles for the Use of Biodiversity Offsets in NSW*" (www.environment.nsw.gov.au/biocertification/offsets.htm). OEH advocates use of the BioBanking Assessment Methodology (www.environment.nsw.gov.au/biobanking/assessmethodology.htm) which affords a transparent, consistent and scientifically-based method to inform the calculation of sufficient offset areas and appropriate management actions to ensure maintenance or improvement of threatened biota.

Where such proposals involve other lands, or where the involvement of community groups is envisaged in such proposals, such groups are to be consulted and proposals should contain evidence of support from these stakeholders *and* from relevant land managers.

Compensatory benefits likely to result from such measures proposed for alternative sites are to be discussed and evaluated along with a discussion of mechanisms of how they might best occur.

7.1.3 Translocation

OEH does not consider the translocation of threatened species, populations or ecological communities to be an ameliorative measure for the purposes of considering impacts of a particular development/activity. Translocation is usually only supported by OEH in specific conservation programs (e.g. recovery planning), but only as a last resort after *in-situ* conservation options have been exhausted.

Translocation should only be considered following extensive investigation of alternative options to avoid and mitigate the impacts of the development and a demonstrated long term financial commitment by the applicant.

7.1.4 Ongoing monitoring

Any proposed pre- or post-development monitoring plans of the effectiveness of the mitigation or compensatory measures must be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies which have not been proved effective should be undertaken under experimental design conditions and be appropriately monitored.

NSW (available at www.planning.nsw.gov.au/assessingdev/environmentalassessment.asp) and on the SEWPAC website at www.environment.gov.au/epbc/about/index.html.

9.3 Licensing matters relating to conducting surveys

Persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. The relevant legislation and associated licences and approvals that may be required are listed below:

National Parks and Wildlife Act 1974:

- General Licence (Section 120) to harm or obtain protected fauna (this may include threatened fauna).
- Licence to pick protected native plants (Section 131).
- Scientific Licence (Section 132C) to authorise the carrying out of actions for scientific, educational or conservation purposes.

Threatened Species Conservation Act 1995:

- Licence to harm threatened animal species, and/or pick threatened plants and/or damage the habitat of a threatened species (Section 91).

Animal Research Act 1985:

- Animal Research Authority to undertake fauna surveys.

9.4 Section 110 (5) reports

Section 110(5) of the *Threatened Species Conservation Act 1995* has the effect of requiring OEH to provide that information regarding the State-wide conservation status of the subject species as it has available, in order to satisfy s.110(2) & (3) of the Act. To this end, a number of publications have been produced:

i. OEH has produced a set of profiles for a number of threatened species, populations and ecological communities and these are available on the OEH website (www.threatenedspecies.environment.nsw.gov.au). Some of these may be relevant to the subject species for this development.
ii. The Metropolitan Branch Biodiversity Conservation Section has produced a number of profiles and environmental impact assessment guidelines for species, populations and ecological communities. These are also on the OEH Threatened Species website.

Proponents and consultants should note that OEH has no further published information available to satisfy s.110(5) of the Act and that use of the above profiles can be taken to have satisfied the requirements of s.110(2) & (3) in relation to the State-wide conservation status of the listed species, populations and ecological communities.

Appendix B: Likelihood of Occurrence Tables

Searches of the Atlas of NSW Wildlife and EPBC Protected Matters search tool were originally performed for the study area on 10 February 2012 using the latitude -33.626 and longitude 151.324as their centre with a radius of 10 km. A subsequent search of the data from the Atlas of NSW Wildlife Atlas was also performed on the 06 July 2010 covering a 10km radius around the boundaries of the study area. Marine species (including whales, turtles and seals) have been removed from the list as these species were not considered relevant to the current proposal.

The likelihood of occurrence was considered for all listed species, and is provided for each species under the 'likely' column. The terms for likelihood of occurrence are defined below:

Y = yes: the species was observed on the site during survey or has been previously observed (NSW Atlas data)
L = likely: a medium to high probability that a species uses the site
P = potential: suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
U = unlikely: a very low to low probability that a species uses the site
N = no: habitat on site and in the vicinity is unsuitable for the species.

Those species considered as potentially, likely or known to occur (likelihood of potential, likely or yes) are considered ***subject species*** for this project.

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
ENDANGERED ECOLOGICAL COMMUNITIES						
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	EPBC Protected Matters PoM for Cannes Reserve and Gunyah Place Reserve (Pittwater Council 2003)	E	CE	Y	Y

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
Pittwater Spotted Gum Forest	Pittwater Spotted Gum Forest	EPBC Act Protected Matters, (Pittwater Council 2003)	E	–	This community occurs entirely within the Pittwater LGA on the Barrenjoey Peninsula and Western Pittwater Foreshore. This community typical occurs in association with shale derived soils, areas with high rainfall on lower hill slopes.	Y
FLORA						
Acacia bynoeana	Bynoe's Wattle	EPBC Act Protected Matters	E	V	*Acacia bynoeana* is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains, and has recently been found in the Colymea and Parma Creek areas west of Nowra. It is found in heath and dry sclerophyll forest, typically on sand or sandy clay substrates often with ironstone gravels (DEC 2005).	N
Asterolasia elegans	*Asterolasia elegans*	EPBC Act Protected Matters	E	E	*Asterolasia elegans* is restricted to a few localities on the NSW Central Coast north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs. It is found in sheltered forests on mid- to lower slopes and valleys, in or adjacent to gullies (DEC 2005).	N
Astrotricha crassifolia	Thick-leaf Star-hair	EPBC Act Protected Matters	V	V	*Astrotricha crassifolia* occurs near Patonga (Gosford LGA), and in Royal NP and on the Woronora Plateau (Sutherland and Campbelltown LGAs). There is also a record from near Glen Davis (Lithgow LGA). It occurs in dry sclerophyll woodland on sandstone and flowers in spring (DEC 2005).	N
Boronia umbellata	Orara Boronia	EPBC Act Protected Matters	V	V	*Boronia umbellata* is found at only a few locations between Glenreagh and Lower Bucca, north of Coffs Harbour, but it is locally common in the restricted area where it occurs (DEC 2005). It grows as an understorey shrub in and around gullies in wet open forest (DEC 2005). It appears to regenerate well after disturbance, but it is not known whether prolonged or	U

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					repeated disturbance affects long-term persistence (DEC 2005).	
Caladenia tessellata	Thick Lip Spider Orchid	EPBC Act Protected Matters	E	V	*Caladenia tessellata* occurs in grassy sclerophyll woodland, often growing in well-structured clay loams or sandy soils south from Swansea, usually in sheltered moist places and in areas of increased sunlight (DEC 2005). It flowers from September to November (DEC 2005).	N
Callistemon linearifolius	Netted Bottlebrush	Atlas of NSW Wildlife, Biobanking credit Calculator (species specific credit)	V	-	*Callistemon linearifolius* grows in dry sclerophyll forest on the coast and adjacent ranges (DECC 2007a). *C. linearifolius* has been recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (DECC 2007a).	N
Chamaesyce psammogeton	Sand Spurge	Atlas of NSW Wildlife	E	-	*Chamaesyce psammogeton* is a prostrate perennial herb, which grows on foredunes and exposed sites on headlands often with Spinifex (DECC 2007a). Flowers in Summer.	N
Cryptostylis hunteriana	Leafless Tongue Orchid	Atlas of NSW Wildlife, EPBC Act Protected Matters	V	V	*Cryptostylis hunteriana* is known from a range of vegetation communities including swamp-heath and woodland (DEC 2005). The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (E. sieberi), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*). This species prefers open areas in the understorey and is often found in association with the Large Tongue Orchid (C. subulata) and the Tartan Tongue Orchid (C. erecta) (DEC 2005). Bell (2001) has identified Coastal Plains	N

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					Scribbly Gum Woodland and Coastal Plains Smoothed-barked Apple Woodland as potential habitat on the Central Coast. This species flowers between November and February (DEC 2005; Bell 2001).	
Eucalyptus camfieldii	Camfield's Stringybark	EPBC Act Protected Matters	V	V	*Eucalyptus camfieldii* is generally associated with shallow sandy soils bordering coastal heath with other stunted or mallee eucalypts, often in areas with restricted drainage and in areas with laterite influenced soils, thought to be associated with proximity to shale (DEC 2005).	N
Eucalyptus nicholii	Narrow-leaved Black Peppermint	Atlas of NSW Wildlife	V	V	*Eucalyptus nicholii* grows in dry grassy woodland, on shallow and infertile soils, mainly on granite (DECC 2007a). This species is widely planted as an urban street tree and in gardens but is quite rare in the wild. It is confined to the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield (DECC 2007a).	N
Genoplesium baueri	Bauer's Midge Orchid	Atlas of NSW Wildlife	V	-	Grows in sparse sclerophyll forest and moss gardens over sandstone (DECC 2007a).	N
Grevillea caleyi	Caley's Grevillea	EPBC Act Protected Matters	E	E	*Grevillea caleyi* is restricted to an 8 km square area around Terrey Hills, approximately 20 km north of Sydney. It occurs in three major areas of suitable habitat, namely Belrose, Ingleside and Terrey Hills / Duffys Forest within the Ku-Ring-gai, Pittwater and Warringah LGAs. It occurs on ridgetops between elevations of 170 to 240 m asl, on laterite soils in open or low open forests, generally dominated by *Eucalyptus sieberi, Corymbia gummifera and E. haemastoma* (DEC 2005).	N

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
Haloragodendron lucasii	*Haloragodendron lucasii*	EPBC Act Protected Matters	E	E	*Haloragodendron lucasii* is confined to a very narrow distribution on the north shore of Sydney, where it is associated with low woodland on sheltered slopes near creeks on moist loamy sand on bench below small sandstone cliff lines where continuous seepage occurs (Benson and McDougall 1997).	N
Kunzea rupestris	*Kunzea rupestris*	EPBC Act Protected Matters	V	V	Kunzea rupestris is endemic to the Hornsby Plateau, where it grows in heath on exposed sandstone rock platforms (NPWS 1997).	N
Melaleuca biconvexa	Biconvex Paperbark	EPBC Act Protected Matters	V	V	*Melaleuca biconvexa* occurs in coastal districts and adjacent tablelands from Jervis Bay north to the Port Macquarie district. It grows in damp places often near streams (PlantNet 2011).	N
Melaleuca deanei	Deane's Paperbark	EPBC Act Protected Matters	V	V	*Melaleuca deanei* is generally found in heath on sandstone (DEC 2005), and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soils (Benson and McDougall 1998).	N
Microtis angusii	Angus's Onion Orchid	EPBC Act Protected Matters	E	E	*Microtis angusii* is currently only known from one site at Ingleside in the north of Sydney (DEC 2005). The dominant species occurring on the highly disturbed Ingleside site are introduced weeds Hyparrhenia hirta (Coolatai grass) and Acacia saligna (ibid.). Most likely associated with the Duffys Forest vegetation community (ibid.). The species exists as subterranean tubers for most of the year, producing leaves and then flowering stems in late winter and spring and flowers from May to October (ibid.). By summer, the above ground parts have withered leaving no parts above ground (ibid.).	N
Pimelea curviflora var. *curviflora*	*Pimelea curviflora* var. *curviflora*	EPBC Act Protected Matters	V	V	*Pimelea curviflora* var. *curviflora* is confined to the coastal regions of Sydney. It grows on shaley/lateritic soils over sandstone and shale/sandstone transition	N

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					soils on ridgetops and upper slopes amongst woodlands (DEC 2005). Associated with the Duffys Forest Community, shale lenses on ridges in Hawkesbury sandstone geology (Pittwater Council 2000).	
Prostanthera junonis	Somersby Mintbush	EPBC Act Protected Matters	E	E	*Prostanthera junonisis* likely to be restricted to the Somersby Plateau, found on the Somersby and Sydney Town soil landscapes (NPWS 2000a). Occurs predominantly in the low woodland component of the Hawkesbury Sandstone Complex dominated by Eucalyptus haemastoma with *Banksia ericifolia* or *B. serrata* in the understorey (ibid.). Has been found in the ecotone between low woodland and open forest or the open scrub\heath components (ibid.). Not found in sedgelands or *Allocasuarina distyla* open heath (ibid.).	N
Syzygium paniculatum	Magenta Lilly Pilly	EPBC Act Protected Matters	V	V	*Syzygium paniculatum* occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW. On the Central Coast, it occurs on Quaternary gravels, sands, silts and clays, in riparian gallery rainforests and remnant littoral rainforest communities (Payne 1997). Payne (1991) reports that the species appears absent from Terrigal formation shales, on which the gully rainforests occur. *S. paniculatum* is summer flowering (November-February), with the fruits maturing in May (DEC 2005).	P
Tetratheca glandulosa	*Tetratheca glandulosa*	EPBC Act Protected Matters	V	V	*Tetratheca glandulosa* is generally associated with ridgetop woodland habits on yellow earths (Travers Morgan 1991) also in sandy or rocky heath and scrub (NPWS 1997). Often associated with sandstone /	N

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					shale interface where soils have a stronger clay influence (NPWS 1997).	
FRESHWATER FISH						
Macquarie australasica	Macquarie Perch	EPBC Protected Matters		E	The Macquarie Perch has a broad distribution and occurs in riverine and lake habitats. In Sydney basin only known from Cataract and Cordeaux River catchments. It prefers to inhabit upland streams and migrates upstream to gravel beds to spawn.	N
Prototroctes maraena	Australian Grayling	EPBC Protected Matters		V	The Australian Grayling inhabits freshwater streams and rivers that drain to the sea. They prefer clear fast flowing, gravely bottomed streams with estuarine that reach substantial distances inland.	N
FROGS						
Heleioporus australiacus	Giant Burrowing Frog	Atlas of NSW Wildlife, Biobanking Credit Calculator (Species specific credit). EEC (2011)	V	V	Giant Burrowing Frog forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). It is generally associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	U
Litoria aurea	Green and Golden Bell Frog	Atlas of NSW Wildlife and EPBC Protected Matters Tools	E	V	The Green and Golden Bell Frog utilises a variety of natural and man-made waterbodies (Pyke & White 1996) including coastal swamps, marshes, dune swales, lagoons, lakes, estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structures capable of storing water (DECC 2007a). The prefered habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy	N

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					shading (DECC 2007a). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–Typha sp. and spikerushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (Gambusia holbrooki) (DECC 2007a).	
Pseudophryne australis	Red-crowned Toadlet	Atlas of NSW Wildlife, EEC (2011)	V	-	Red-crowned Toadlets are found in steep escarpment areas and plateaus, as well as low undulating ranges with benched outcroppings on Triassic sandstones of the Sydney Basin (DECC 2007a). This species generally occupies the upper parts of ridge lines, usually being restricted to within about 100 metres of the ridgetop. Utilises small ephemeral drainage lines which feed water from the top of the ridge to the perennial creeks below for breeding, and are not usually found in the vicinity of permanent water (Ehmann 1997). Breeding sites are often characterised by clay-derived soils and generally found below the first sandstone escarpment in the talus slope (NPWS 1997).	U
Litoria littlejohni	Littlejohn's Tree Frog, Heath Frog	EPBC Protected Matters	V	V	Littlejohn's Tree Frog Habitats include dams, creeks and lagoons. Favours higher woodland areas	N
Mixophyes balbus	Stuttering Frog, Southern Barred Frog	EPBC Protected Matters	E	V	The Stuttering Frog or Southern Barred Frog generally occurs in mountain rainforest habitats.	N
Mixophyes fasciolatus	Giant Barred Frog	EPBC Protected Matters		V	Found on forested slopes of the escarpment and adjacent ranges in riparian vegetation, subtropical and dry rainforest, wet sclerophyll forests and swamp sclerophyll forest (DECC 2007a; Ehmann 1997). This species is associated with flowing streams with high	N

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					water quality, though habitats may contain weed species (Ehmann 1997). This species is not known from riparian vegetation disturbed by humans (NSW Scientific Committee 1999). During breeding eggs are kicked up onto an overhanging bank or the streams edge (DECC 2007a).	
REPTILES						
Hoplocephalus bungaroides	Broad-headed Snake	EPBC Protected Matters, EEC (2011)	E	V	Broad-headed Snake typical occupies areas with exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin (DECC 2007a). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998b).	N
Varanus rosenbergi	Rosenberg's Goanna	Atlas of NSW Wildlife, EEC (2011), Biobanking Credit Calculator (Species specific credit).	V	-	Rosenberg's Goanna found in heath, open forest and woodland (DECC 2007a). Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component (DECC 2007a).	U
DIURNAL BIRDS						
Anthochaera phrygia *(aka Xanthomyza phrygia)*	Regent Honeyeater	Atlas of NSW Wildlife, EEC (2011)	E	E & M	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (Casuarina cunninghamiana) (Garnett 1993). Areas containing Swamp Mahogany (Eucalyptus robusta) in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on	P

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000).	
Ardenna careippis	Flesh-footed Shearwater	Atlas of NSW Wildlife,	V		The Flesh-footed Shearwater, is a small black shearwater that is an offshore migrant. The species breeds in colonies at main locations, one includes the South-wester Pacific Ocean (Lord Howe Island and northern New Zealand) and along the coast of Western Australia from Cap Leeuwin to the Recherche Archipelago. .	N
Botaurus poiciloptilus	Australasian Bittern	Atlas of NSW Wildlife	V	-	Australasian Bittern occupies terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1993). Reedbeds, swamps, streams, estuaries (Simpson & Day 1999).	N
Burhinus grallarius	Bush Stone-curlew	Atlas of NSW Wildlife,	E	-	Associated with dry open woodland with grassy areas, dune scrubs, in savannah areas, the fringes of mangroves, golf courses and open forest / farmland. Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Environment Australia 2000; Marchant & Higgins 1993). Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed in lightly disturbed.	N
Callocephalon fimbriatum	Gang-gang Cockatoo	Atlas of NSW Wildlife, EEC (2011)	V	-	During summer in dense, tall, wet forests of mountains and gullies, alpine woodlands (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome 1992). They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson & Day 2004).	P
Calyptorhynchus lathami	Glossy Black-	Atlas of NSW Wildlife,	V	-	Associated with a variety of forest types containing	P

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
	Cockatoo	EEC (2011)			Allocasuarina species, usually reflecting the poor nutrient status of underlying soils (Environment Australia 2000; NPWS 1997; DECC 2007a). Intact drier forest types with less rugged landscapes are preferred (DECC 2007a). Nests in large trees with large hollows (Environment Australia 2000).	
Dasyornis brachypterus	Eastern Bristlebird	EPBC Act Protected Matters	E	E	Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone. Age of habitat since fires (fire-age) is of paramount importance to this species; Illawarra and southern populations reach maximum densities in habitat that has not been burnt for at least 15 years; however, in the northern NSW population a lack of fire in grassy forest may be detrimental as grassy tussock nesting habitat becomes unsuitable after long periods without fire; northern NSW birds are usually found in habitats burnt five to 10 years previously.	N
Diomedea exulans amsterdamensis	Amsterdam Albatross	EPBC Act Protected Matters	_	E, Mig, Mar	The Amsterdam Albatross is a marine, pelagic seabird, non-resident visitor to Australia. It nests in open patchy vegetation (among tussocks, ferns or shrubs) near exposed ridges or hillocks on Amsterdam Island (Weimerskirch *et al.* 1985). It sleeps and rests on ocean waters when not breeding.	U
Diomedea exulans antipodensis	Antipodean Albatross	EPBC Act Protected Matters	-	V, Mi, Ma	The species ranges across the southern Pacific Ocean, east to the coast of Chile and west to eastern Australia.	U
Diomedea exulans exulans	Tristan Albatross	EPBC Act Protected Matters	_	E, Mig, Mar	The Tristan Albatross is a marine, pelagic seabird. It forages in open water in the Atlantic Ocean near the Cape of Good Hope, South Africa. It sleeps and rests	U

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					on ocean waters when not breeding. There is currently only one definitive record of the Tristan Albatross from Australian waters. A bird banded as a chick on Gough Island was recaptured four years later off Wollongong (NSW) (Environment Australia 2001f).	
Diomedea exulans gibsoni	Gibson's Albatross	EPBC Act Protected Matters		V, Mig, Mar	Gibson's Albatross is marine, pelagic and aerial. It has been recorded foraging between Coffs Harbour, NSW, and Wilson's Promontory, Victoria (Garnett & Crowley 2000). Males and females appear to use different foraging areas, with females frequenting the Tasman Sea in the vicinity of 40° S, while males either disperse westwards at lower latitudes or north-east towards the mid-Pacific Ocean. The only Australian record of this species is from a recapture off Wollongong, NSW, in September 1997. This albatross visits Australian waters while foraging for squid, fish and crustaceans (Marchant & Higgins 1990) and during the non-breeding season (EA 2001f).	U
Diomedea exulans (sensu lato)	Wandering Albatross	Atlas of NSW Wildlife, EPBC Protected Matters	E1	V, Ma	The Wandering Albatross visits Australian waters extending from Fremantle, Western Australia, across the southern water to the Whitsunday Islands in Queensland between June and September. It has been recorded along the length of the NSW coast. At other times birds roam the southern oceans and commonly follow fishing vessels for several days.	U
Fregetta grallaria grallaria	White-bellied Storm-petrel (Tasman Sea and Australasian)	EPBC Act Protected Matters	V	V	The White-bellied Storm-Petrel (Tasman Sea) breeds on small offshore islets and rocks in the Lord Howe Island group, including Roach Island and Balls Pyramid (Hutton 1991). In the non-breeding season, it reaches and forages over near-shore waters along the continental shelf of mainland Australia (Holmes	U

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					1977; Priddel 1996). The White-bellied Storm-Petrel (Tasman Sea) feeds on small crustaceans and squid (Hutton 1991).	
Glossopsitta pusilla	Little Lorikeet	Atlas of NSW Wildlife, EEC (2011)	V	-	In NSW, are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands where they feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes.	U
Haematopus fuliginosus	Sooty Oystercatcher	Atlas of NSW Wildlife	V	-	A coastal species that inhabits rock coastlines, coral cays, reefs and occasionally sandy beaches and Marchant & Higgins 1993; Simpson & Day 1999).	U
Hieraaetus morphnoides	Little Eagle	Atlas of NSW Wildlife	V	-	Found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. There have two records of the species in Pittwater region, in Ingleside and Church Point in 1995 and 2007 respectively.	U
Lathamus discolor	Swift Parrot	Atlas of NSW Wildlife, EPBC Protected Matters	E1	E	The Swift Parrot breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts during autumn and winter (Blakers *et al.* 1984; Forshaw and Cooper 1981). Favoured feed trees include species such as Swamp Mahogany	P

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					(Eucalyptus robusta), Spotted Gum (Corymbia maculata), Red Bloodwood (C. gummifera), Mugga Ironbark (E. sideroxylon), and White Box (E. albens) (DECC 2007a).	
Macronectes giganteus	Southern Giant Petrel	Atlas of NSW Wildlife, EPBC Protected Matters	E	E	Southern Giant Petrel nests in small colonies amongst open vegetation on Antarctic and subantarctic islands, including Macquarie and Heard Islands and in Australian Antarctic territory. Has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the coast of NSW.	N
Macronectes halli	Northern Giant-Petrel	Atlas of NSW Wildlife, EPBC Protected Matters	V	V	Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer. Adults usually remain near the breeding colonies while immature birds make circumpolar and trans-oceanic movements.	N
Onychoprion fuscata	Sooty Tern	Atlas of NSW Wildlife	V		Sooty Terns are regarded as migratory and dispersive seabird of the tropical oceans. It breeds on equatorial rocky or coral islands. This species rarely comes on land, except to breed and is generally only found over land following tropical storms.	N
Pandion haliaetus	Osprey	Atlas of NSW Wildlife	V	-	Associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995). Osprey may nest on the ground, on sea cliffs or in trees (Olsen 1995). Ospreys generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995).	U
Pterodroma leucoptera leucoptera	Gould's Petrel	Atlas of NSW Wildlife, EPBC Protected Matters	V	E	Gould's Petrel breeds on both Cabbage Tree Island and Boondelbah island, 1.4 km offshore from Port	N

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					Stephens. The range and feeding areas of non-breeding Petrels are unknown.	
Pterodroma neglecta neglecta	Kermadec Petrel (western)	Atlas of NSW Wildlife	V	V	Generally oceani	N
Ptilinopus superbus	Superb Fruit-Dove	Atlas of NSW Wildlife	V		Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms (DECC 2007a). It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (ibid.). Part of the population is migratory or nomadic (ibid.). At least some of the population, particularly young birds, moves south through Sydney, especially in autumn (ibid.). Breeding takes place from September to January (ibid.). Will feed in adjacent mangroves or eucalypt forests (Blakers *et al.* 1984).	P
Puffinus carneipes	Flesh-footed Shearwater	Atlas of NSW Wildlife	V	-	Ranges throughout the Pacific and Indian Oceans. There are two main breeding areas in the world: one in the South West Pacific includes Lord Howe Island and New Zealand; the other along the coast of Western Australia.	N
Rostratula benghalensis australis	Painted Snipe (Australian subspecies)	EPBC Protected Matters	E	E	The Painted Snipe prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 200a). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (ibid.). This species roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECC 2007a). Feeds on worms, molluscs, insects and some plant-matter (ibid.).	N
Thalassarche bulleri	Buller's Albatross	EPBC Protected Matters		V	Species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New	N

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					Zealand provide breeding habitat.	
Thalassarche cauta cauta	Shy Albatross, Tasmanian Shy Albatross	Atlas of NSW Wildlife, EPBC Protected Matters	V	V	Species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat.	N
Thalassarche cauta salvini	Salvin's Albatross	Atlas of NSW Wildlife, EPBC Protected Matters		V	Species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat.	N
Thalassarche cauta steadi	White-capped Albatross	Atlas of NSW Wildlife, EPBC Protected Matters		V	Species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat.	N
Thalassarche melanophris	Black-browed Albatross	Atlas of NSW Wildlife, EPBC Protected Matters	V	V	Has a circumpolar range over the southern oceans, and are seen off the southern Australian coast mainly during winter. This species migrates to waters off the continental shelf from approximately May to November and is regularly recorded off the NSW coast during this period.	N
Thalassarche melanophris impavida	Campbells Albatross	Atlas of NSW Wildlife, EPBC Protected Matters		V	Species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat.	N
NOCTURNAL BIRDS						

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
Ninox connivens	Barking Owl	Atlas of NSW Wildlife, EEC (2011)	V	-	The Barking Owl is generally associated with a variety of habitats such as savannah woodland, open eucalypt forests, wetland and riverine forest. They prefer habitat that are dominated by Eucalypts (often Redgum species), however often dominated by Melaleuca species in the tropics (DECC 2007a). Barking Owls roosts in dense foliage in large trees such as River She-oak (*Allocasuarina cunninghamiana*), other Casuarina and Allocasuarina, eucalypts, Angophora, Acacia and rainforest species from streamside gallery forests (NPWS 2003). It usually nests near watercourses or wetlands (NPWS 2003) in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997). According to the EEC 2011, this species has not been recorded in any of the reserves within the Pittwater LGA.	U
Ninox strenua	Powerful Owl	Atlas of NSW Wildlife, EEC (2011), Biobanking credit Calculator (ecosystem credit)	V	-	Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Environment Australia 2000, Debus & Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Environment Australia 2000).	Y
MAMMALS (EXCLUDING BATS)						
Cercartetus nanus	Eastern Pygmy-possum	Atlas of NSW Wildlife,	V	-	Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2010). Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat	U

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					insects, seeds and fruit (Turner & Ward 1995). The presence of Banksia sp. and Leptospermum sp. are an important habitat feature (DECC 2007a). Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old bird nests and in the branch forks of tea-trees (Turner & Ward 1995).	
Dasyurus maculatus	Spotted-tailed Quoll	Atlas of NSW Wildlife, EPBC Protected Matters,	V	E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECC 2007a), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007a). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).	U
Isoodon obesulus obesulus	Southern Brown Bandicoot	Atlas of NSW Wildlife, EPBC Protected Matters	E	E	This species is associated with heath, coastal scrub, heathy forests (Menkhorst & Knight 2010), shrubland and woodland on well drained soils. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire (Menkhorst & Seebeck 1990).	U
Phascolarctos cinereus	Koala	Atlas of NSW Wildlife, EEC (2011),	V	-	Koalas are generally found in association with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed *et al.* 1990), with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: *Eucalyptus tereticornis*, *E. punctata*, *E. cypellocarpa*, *E. viminalis.*	U
Petaurus norfolcensis	Squirrel Glider		V	-	Squirrel Glider is generally found in association with	P

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					dry hardwood forest and woodlands (Menkhorst *et al.* 1988; Quin 1995). Habitats typically include gum barked and high nectar producing species, including winter flower species (Menkhorst *et al.* 1988). The presence of hollow bearing eucalypts is a critical habitat value (Quin 1995).	
MAMMALS (BATS)						
Falsistrellus tasmaniensis	Eastern False Pipistrelle	EEC (2011)	V	-		U
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	Atlas of NSW Wildlife, Biobanking credit Calculator (ecosystem and species specific credit)	V	-	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). It forages above and below the tree canopy on small insects (AMBS 1995, Dwyer 1995, Dwyer 1981). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000, Dwyer 1995).	Y
Miniopterus australis	Little Bent-winged Bat	EEC 2011	V		Recorded across a number of reserves in the Pittwater region and in has also been recorded in the Littoral Rainforest and Pittwater Spotted Gum Forest.	P
Mormopterus norfolkensis	Eastern Free-tail Bat	Atlas of NSW Wildlife, Biobanking credit Calculator (ecosystem credit)	V	-	Found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	Y
Pteropus poliocephalus	GHFF	Atlas of NSW Wildlife, EPBC Protected Matters, Biobanking credit	V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops (DECC 2007b;). Roosting camps are generally	Y

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
		Calculator (ecosystem credit)			located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (DECC 2007b; DECCW 2009).	
Scoteanax rueppellii	Greater Broad-nosed Bat	Atlas of NSW Wildlife, Biobanking credit Calculator (ecosystem credit)	V	-	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 1998). Within denser vegetation type's use is made of natural and manmade openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 1998). This species has only been previously recorded from Deep Creek Reserve (EEC 2011).	U
ENDANGERED Populations						
Phascolarctos cinereus	Koala in the Pittwater Local Government Area	Atlas of NSW Wildlife, EEC (2011),	E2	-	No – Koalas were once widespread and common throughout the Barrenjoey Peninsula. The Koala population on the Barrenjoey Peninsula was considered the largest and best known in Sydney (Smith and Smith 2000). In the 1970's, it was estimated that more than 120 individuals were present within this population. By the end of the 1990's fewer than 10 individuals were present (Smith and Smith 2000). Since 2000, no Koalas have been recorded in the region and are possibly extinct in the area (Smith and Smith 2000).	U
Petaurus norfolcensis	Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill	Atlas of NSW Wildlife, EEc (2011).	E2	-	The Squirrel Gliders occurs in range of habitats including low scrubby eucalypts woodlands, banksia thickets and tall wet eucalyptus forest that border onto rainforest. In Pittwater, important food sources are likely to be	P

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					the winter flowering Coast Banksia (Banksia integrifolia) and Spotted Gum (*Corymbia maculata*) and the summer flowering Old Man Banksia (B. serrata) and Grey Ironbark (*Eucalyptus paniculata*). Other likely food sources include *Angophora costata*, *Banksia spinulosa, Corymbia gummifera, Eucalyptus botryoides, E. punctata, E. robusta, Melaleuca quinquernervia*, mistletoes and *Xanthorrhoea* species (Source: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10603)	
MIGRATORY TERRESTRIAL SPECIES LISTED UNDER EPBC ACT						
Haliaeetus leucogaster	White-bellied Sea-Eagle	EPBC Protected Matters	—	M	White-bellied Sea-Eagle forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	U
irundapus caudacutus	White-throated Needletail	EPBC Protected Matters	—	M	White-throated Needletail forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	P
Merops ornatus	Rainbow Bee-eater	EPBC Protected Matters	—	M	Rainbow Bee-eater is a resident of coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some	U

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					occasionally present April to May (Pizzey and Doyle 1988). This species prefers open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (ibid). Nest is a chamber a the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (ibid).	
Monarcha melanopsis	Black-faced Monarch	EPBC Protected Matters	—	M	The Black-faced Monarch occurs in the middle structural layers of the rainforest, gullies, dense wet coastal forest. During the migration periods it prefers more open country (Simpson and Day 2004).	P
Myiagra cyanoleuca	Satin Flycatcher	EPBC Protected Matters	—	M	Satin Flycatchers are generally associated with drier eucalypt forests, absent from rainforests open forests, often at height (Simpson & Day 1999).	U
Rhipidura rufifrons	Rufous Fantail	EPBC Protected Matters	—	M	The Rufous Fantail is a summer breeding migrant to south eastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	P
MIGRATORY WETLAND SPECIES LISTED UNDER EPBC ACT						
Ardea alba	Great Egret	EPBC Protected Matters	—	M	The Great Egret is common and widespread in Australia. It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (Morcombe, 2004).	N
Ardea ibis	Cattle Egret	EPBC Protected Matters	—	M	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (Simpson and Day 1999). Some	N

SCIENTIFIC NAME	COMMON NAME	DATA SOURCE	CONSERVATION SIGNIFICANCE		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
			TSC ACT	EPBC ACT		
					individuals stay close to the natal heronry from one nesting season to the next, but the majority leave the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range (Simpson and Day 1999).	
Gallinago hardwickii	Latham's Snipe	EPBC Protected Matters	—	M	Latham's Snipe occurs in a variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1999). Occupies a variety of vegetation around wetlands (Marchant and Higgins 1999) including wetland grasses and open wooded swamps (Simpson and Day 1999).	N
Rostratula benghalensis s. lat.	Painted Snipe	EPBC Protected Matters	—	V, M	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007a). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (*ibid.*). Breeding is often in response to local conditions; generally occurs from September to December (DECC 2007a). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECC 2007a). Feeds on worms, molluscs, insects and some plant-matter (*ibid.*).	N

Appendix C: Fauna Species Recorded in Study Area during February 2012 survey

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	OBSERVATION TYPE
Amphibians				
Amphibian	Myobatrachidae	*Limnodynastes peronii*	Striped Marsh Frog	Heard
Reptiles				
Reptilia	Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	Seen
Birds				
Aves	Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	Seen
Aves	Apodidae	*Dacelo novaeguineae*	Laughing Kookaburra	Seen/heard
Aves	Artamidae	*Strepera graculina*	Pied Currawong	Seen/heard
Aves	Artamidae	*Strepera versicolor*	Grey Currawong	heard
Aves	Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	Seen/heard
Aves	Cisticolidae	*Manorina melanocephala*	Noisy Miner	Seen/heard

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	OBSERVATION TYPE
Aves	Corvidae	*Corvus coronoides*	Australian Raven	Seen/heard
Aves	Corvidae	*Corvus mellori*	Little Raven	Heard
Aves	Eupetidae	*Psophodes nigrogularis*	Western Whipbird	Heard
Aves	Falconidae	*Falco berigora*	Brown Falcon	Seen
Aves	Megapodiidae	*Alectura lathami*	Australian Brush-turkey	Seen/heard
Aves	Pachycephalidae	*Gymnorhina tibicen*	Australian Magpie	Seen/heard
Aves	Phalacrocoracidae	*Anthochaera carunculata*	Red Wattlebird	Seen/heard
Aves	Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	Seen/heard
Aves	Strigidae	*Ninox strenua*	Powerful Owl	Seen/heard
Mammals (non Bats)				
Mammalia	Acrobatidae	*Acrobates pygmaeus*	Feathertail Glider	Recorded – during spotlight surveys
Mammalia	Dasyuridae	*Antechinus stuartii*	Brown Antechinus	Recorded on remote camara
Mammalia*	Felidae	*Felis catus*	Cat	Recorded on remote camara

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	OBSERVATION TYPE
Mammalia	Muridae	*Hydromys chrysogaster*	Water-rat	Tracks beside drainage line
Mammalia	Phalangeridae	*Trichosurus vulpecula*	Common Brush-tail Possum	Seen/recorded on remote camara
Mammalia	Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	Seen/recorded on remote camara
Mammals (bats)				
Mammalia	Molossidae	*Mormopterus norfolkensis*	Eastern Free-tail Bat	Anabat Survey
Mammalia	Pteropodidae	*Pteropus poliocephalus*	GHFF	Seen/heard
Mammalia	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	Anabat Survey
Mammalia	Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	Anabat Survey
Mammalia	Vespertilionidae	*Miniopterus schreibersii oceanensis*	Common Bent-wing Bat	Anabat Survey

Appendix D: Flora Species Recorded in Study Area

Key: '●' indicates and introduced species (both native and exotic);
'▲' indicates a species which is threatened (*TSC Act*, *EPBC Act,* or RoTAP (Briggs and Leigh 1995).

FAMILY	SPECIES NAME	Q1 - LR	INCIDENTALS LR	Q2 - PWSGF	INCIDENTALS PWSGF	PREVIOUS STUDIES[1]
Acanthaceae	*Hypoestes phyllostachya* ●				✓	✓
	Thunbergia alata ●				✓	
Adiantaceae	*Adiantum formosum*				✓	✓
Alliaceae	*Agapanthus praecox* subsp. *orientalis* ●			✓	✓	
Apiaceae	*Cyclospermum leptophyllum* ●				✓	
	Hydrocotyle laxiflora				✓	
Apocynaceae	*Araujia sericifera* ●			✓	✓	✓
	Nerium oleander ●				✓	
Araceae	*Calocasia esculenta* ●				✓	✓
	Monstera deliciosa ●			✓	✓	✓
	Philodendron sp. ●				✓	
Araliaceae	*Hedera helix* ●				✓	
	Schefflera actinophylla ●					✓
Arecaceae	*Archontophoenix cunninghamiana*				✓	
	Arecastrum romanzoffianum ●				✓	

[1] Pittwater Council 2010

FAMILY	SPECIES NAME	Q1 - LR	INCIDENTALS LR	Q2 - PWSGF	INCIDENTALS PWSGF	PREVIOUS STUDIES[1]
	Livistona australis	✓	✓	✓	✓	✓
Aristolochiaceae	*Aristolochia elegans* ●				✓	
Asparagaceae	*Asparagus aethiopicus* ●				✓	
	Dracaena sp. ●			✓	✓	✓
Asteraceae	*Ageratina adenophora* ●				✓	✓
	Ageratina riparia ●				✓	✓
	Bidens pilosa ●				✓	
	Conyza canadensis ●				✓	
	Conyza sp. ●					✓
	Crassocephalum crepidioides ●				✓	✓
	Delairea odorata ●					✓
	Galinsoga parviflora ●				✓	
	Gamochaeta sp.●				✓	
	Sigesbeckia orientalis				✓	
	Sonchus oleraceous ●				✓	
	Taraxacum officinale ●				✓	
Balsaminaceae	*Impatiens* sp. ●	✓				
Basellaceae	*Anredera cordifolia* ●				✓	✓
Bignoniaceae	*Jacaranda mimosifolia* ●	✓		✓	✓	✓
Blechnaceae	*Blechnum cartilagineum*		✓			✓
	Doodia aspera	✓	✓	✓	✓	✓
Brassicaceae	*Cardamine* sp. ●				✓	
Cannaceae	*Canna indica* ●		✓		✓	✓
Commenlinaceae	*Commelina cyanea*				✓	✓
	Tradescantia fluminensis ●	✓	✓	✓	✓	✓

FAMILY	SPECIES NAME	Q1 - LR	INCIDENTALS LR	Q2 - PWSGF	INCIDENTALS PWSGF	PREVIOUS STUDIES[1]
Convolvulaceae	*Dichondra repens*				✓	
	Ipomoea cairica ●				✓	✓
	Ipomoea indica ●	✓	✓		✓	✓
Cyatheaceae	*Cyathea australis*	✓				✓
	Cyathea cooperi ●				✓	✓
Cyperaceae	*Cyperus eragrostis* ●				✓	✓
	Cyperus sesquiflorus ●				✓	
	Gahnia aspera		✓			
	Gahnia sp.		✓			✓
Davalliaceae	*Nephrolepis cordifolia* ●	✓		✓	✓	
Dennstaedtiaceae	*Hypolepis muelleri*		✓			✓
Dryopteridaceae	*Lastreopsis decomposita*	✓	✓		✓	✓
Euphorbiaceae	*Euphorbia peplus* ●				✓	
	Glochidion ferdinandi	✓	✓	✓	✓	✓
	Homalanthus populifolius	✓				✓
	Ricinus communis ●			✓	✓	✓
Eupomatiaceae	*Eupomatia laurina*		✓			
Fabaceae - Caesalpinioideae	*Senna pendula* ●	✓		✓		✓
Fabaceae - Faboideae	*Glycine tabacina*				✓	
	Erythrina x sykesii ●				✓	
	Trifolium repens ●				✓	
Fabaceae - Mimosoideae	*Acacia elata* ●				✓	✓
Geraniaceae	*Geranium homeanum*					✓
	Geranium sp.				✓	

FAMILY	SPECIES NAME	Q1 - LR	INCIDENTALS LR	Q2 - PWSGF	INCIDENTALS PWSGF	PREVIOUS STUDIES[1]
Iridaceae	*Crocosmia x crocosmiifolia* ●				✓	✓
Lamiaceae	*Clerodendrum tomentosum*				✓	✓
	Plectranthus parvifolius				✓	
Lauraceae	*Endiandra sieberi*					✓
	Persea Americana ●	✓				✓
Lobeliaceae	*Pratia purpurascens*				✓	
Lomandraceae	*Lomandra longifolia*				✓	✓
Luzuriagaceae	*Eustrephus latifolius*			✓	✓	
	Geitonoplesium cymosum			✓	✓	✓
Malvaceae	*Hibiscus* sp. (cultivar) ●				✓	
	Modiola caroliniana. ●				✓	✓
	Sida rhombifolia ●			✓	✓	
Marantaceae	*Calathea* sp. ●				✓	✓
Menispermaceae	*Sarcopetalum harveyanum*					✓
	Stephania japonica var. *discolor*	✓	✓			✓
Monimiaceae	*Wilkiea huegliana*			✓	✓	✓
Moraceae	*Ficus benjamina* ●				✓	✓
	Ficus coronata	✓	✓	✓	✓	✓
	Morus sp. ●	✓				
Musaceae	*Musa* sp. ●	✓			✓	✓
Myrtaceae	*Acmena smithii*		✓			✓
	Angophora costata				✓	✓
	Corymbia maculata			✓	✓	✓
	Eucalyptus botryoides				✓	
	Eucalyptus ?paniculata				✓	✓

FAMILY	SPECIES NAME	Q1 - LR	INCIDENTALS LR	Q2 - PWSGF	INCIDENTALS PWSGF	PREVIOUS STUDIES[1]
	Eucalyptus punctata				✓	
	Eucalyptus sp.				✓	✓
	Lophostemon confertus ●		✓			
	Rhodamnia rubescens			✓		✓
	Syncarpia glomulifera			✓	✓	✓
	Syzygium sp. (cultivar) ●				✓	
Ochnaceae	*Ochna serrulata* ●		✓	✓	✓	
Oleaceae	*Jasminum polyanthum* ●			✓	✓	✓
	Ligustrum lucidum ●	✓	✓	✓	✓	✓
	Ligustrum sinense ●	✓	✓	✓	✓	✓
	Notelea longfolia			✓	✓	✓
	Olea europaea subsp. *cuspidate* ●					✓
	Olea (?) *europaea* ● (non-hairy, to be confirmed)			✓		
Oxalidaceae	*Oxalis latifolia* ●				✓	
	Oxalis sp.				✓	
Passifloraceae	*Passiflora caerulea* ●					✓
	Passiflora edulis ●			✓	✓	
Pittosporaceae	*Pittosporum undulatum*		✓			
Plantaginaceae	*Plantago lanceolata* ●				✓	
Poaceae	*Axonopus fissifolius* ●				✓	
	Dactylis glomerata ●				✓	
	Digitaria ciliaris ●	✓		✓	✓	✓
	Ehrharta erecta ●				✓	✓
	Eleusine indica ●					✓

FAMILY	SPECIES NAME	Q1 - LR	INCIDENTALS LR	Q2 - PWSGF	INCIDENTALS PWSGF	PREVIOUS STUDIES[1]
	Entolasia marginata				✓	
	Oplismenus aemulus	✓			✓	✓
	Oplismenus imbecillis		✓			✓
	Microlaena stipoides				✓	
	Microlaena stipoides (var. B? – rare)[2]					✓
	Paspalum dilatatum ●				✓	
	Pennisetum clandestinum ●				✓	
	Phyllostachys aurea ●				✓	
	Phyllostachys edulis ●				✓	
	Poa annua ●				✓	
	Setaria palmifolia ●			✓	✓	✓
	Stenotaphrum secundatum ●			✓	✓	
Polygonaceae	*Acetosa sagittata* ●				✓	✓
	Persicaria decipiens					✓
	Rumex brownii				✓	
	Rumex sp. ●					✓
Proteaceae	*Grevillea robusta* ●				✓	
Rhamnaceae	*Alphitonia excelsa*				✓	✓
Rosaceae	*Rubus moluccanus* var. *trilobus*	✓				
Rubiaceae	*Ixora coccinea* (?)●					✓
Sapindaceae	*Cardiospermum grandiflorum* ●		✓		✓	✓
Smilacaceae	*Smilax australis*			✓	✓	✓

[2] Taxon not recognized by Jacobs *et al.* 2004 or Flora Online (2012)

FAMILY	SPECIES NAME	Q1 - LR	INCIDENTALS LR	Q2 - PWSGF	INCIDENTALS PWSGF	PREVIOUS STUDIES[1]
Solanaceae	*Cestrum parqui* ●					✓
	Cestrum nocturnum ●	✓	✓		✓	
	Solanum mauritianum ●			✓	✓	
	Solanum nigrum ●			✓	✓	
Sterculiaceae	*Brachychiton acerifolius*	✓	✓	✓	✓	✓
Thelypteridaceae	*Christella dentata*	✓	✓	✓		✓
Tropaeolaceae	*Tropaeolum majus* ●				✓	✓
Urticaceae	*Parietaria judaica* ●					✓
Verbenaceae	*Lantana camara*●	✓	✓	✓	✓	✓
	Verbena bonariensis ●					✓
Violaceae	*Viola hederacea*				✓	✓
Vitaceae	*Cayratia clematidea*		✓	✓	✓	✓
	Cissus antarctica		✓		✓	✓
	Cissus hypoglauca	✓	✓	✓	✓	✓
Zamiaceae	*Macrozamia communis*				✓	
Strelitziaceae	*Strelitzia nicholai* ●					✓

Anabat Results – Cannes Reserve, 7 Anabat nights over 4 nights 14, 15, 16 & 22 February 2012.

Anabat sites 1 and 2 were conducted for a period of 3 consecutive nights (14, 15, & 16th) and 1 additional anabat night at site No.3 on the 22 February.

Bat calls were analysed using the program AnalookW (Version 3.7w 31 December 2009, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay *et al.* 2004); and south-east Queensland and north-east New South Wales (Reinhold *et al.* 2001) and the accompanying reference library of over 200 calls from north-eastern NSW (http://www.forest.nsw.gov.au/research/bats/default.asp).

Bat calls are analysed using species-specific parameters of the call profile such as call shape, characteristic frequency, initial slope and time between calls (Rinehold *et al.* 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et. al. 2006) were followed:

1. Recordings containing less than three pulses were not analysed (Law *et al.* 1999) and are labelled as short.
2. Only search phase calls were analysed (McKenzie *et al.* 2002).
3. Four categories of confidence in species identification were used (Mills *et al.* 1996):
   a. definite – identity not in doubt
   b. probable – low probability of confusion with species of similar calls
   c. possible – medium to high probability of confusion with species with similar calls; and
   d. unidentifiable – calls made by bats which cannot be identified to even a species group.
4. *Nyctophilus* spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay *et al.* 2004).
5. Calls not attributed to micro-chipertan bat echolocation calls are labelled as junk or non Bat calls and don't represent micro-chipertan bat activity at the site. Calls labelled as low are of poor quality and therefore not able to be identified to any micro-chipertan bat species, they can however be used as an indicator of micro-chipertan bat activity at a site.

Anabat results were variable between nights and across all sites, for example data for Site 1 totalled 7 identifiable bat calls only over 3 nights representing very low activity but 3 threatened species were recorded. Site 2 recorded the most micro-chipertan bat activity over all nights and the greatest species diversity (**Table 16**).

Overall from all sites including stag watches 5 species were identified including **2 vulnerable** species listed under the NSW TSC Act 1987. They were **Eastern Bent-wing (*Miniopterus schreibersii oceanensis)*** and **East coast Free-tail Bat *(Mormopterus norfolkensis*)** identified from 4 calls each again representing very low occurrence. By far the most common species was Gould's Wattled bat (*Chalinolobus gouldii)* represented from the majority of sites and over most nights (**Table 16**) .

Table 16: Anabat results all nights, Cannes Reserve February 2012.

SITE	NIGHT	LABEL	NUMBER	DEFINITE	PROBABLE	POSSIBLE
No.1						

SITE	NIGHT	LABEL	NUMBER	DEFINITE	PROBABLE	POSSIBLE
(Sues place)	14/02/2012	*Chalinolobus gouldii*	1	1	0	0
	16/02/2012	*Chalinolobus morio*	1	0	1	0
	14/02/2012	*Miniopterus schreibersii oceanensis*	4	2	2	0
	14/02/2012	short	2			
	14/02/2012	Junk	35			
	15/02/2012	short	1			
	16/02/2012	Junk	27			
	16/02/2012	short	1			
No.2						
(Malcolm's)	14/02/2012	*Chalinolobus gouldii*	40	15	7	18
	14/02/2012	*Chalinolobus morio*	1	0	1	0
	14/02/2012	low	5			
	14/02/2012	short	68			
	14/02/2012	Junk	19			
	15/02/2012	*Chalinolobus gouldii*	51	28	7	16
	15/02/2012	*Chalinolobus morio*	3	2	1	0
	15/02/2012	*Mormopterus norfolkensis*	4	2	2	0
	15/02/2012	low	17			
	15/02/2012	short	76			
	15/02/2012	Junk	17			
	16/02/2012	*Chalinolobus gouldii*	28	18	4	6
	16/02/2012	*Chalinolobus morio*	2	0	2	0
	16/02/2012	low	6			
	16/02/2012	Junk	8			
	16/02/2012	short	45			

SITE	NIGHT	LABEL	NUMBER	DEFINITE	PROBABLE	POSSIBLE
No.3						
(Weedy area)	22/02/2012	*Chalinolobus gouldii*	1	0	0	1
	22/02/2012	Junk	3			
	22/02/2012	short	2			
Stag watch						
No.1	14/02/2012	*Chalinolobus gouldii*	1	0	0	1
	14/02/2012	Junk	11			
	14/02/2012	short	6			
No.2	22/02/2012	Junk	65			

HAIR SAMPLE ANALYSES

Hair tube analysis was conducted by Dr. Hans Brunner. Dr. Hans Brunner is a world renown expert in hair identification and forensic science.

Hans Brunner,
9, Cooinda Court,
Frankston, Vic. 3199\

28/02/12

Rodney Armistead,
Eco Logical Australia Pty Ltd,
PO Box 12
Sutherland, NSW 1499

Dear Rodney,

I have examined the 10 hair tube samples from Cannes Reserve with the following results:

Nos. 1, 2,3,4,5,7,8,9,10 had hairs of T. vulpecula. Number 6 had no hair. No hairs of P. norfolcensis.

Kind regards,

Hans Brunner

Appendix E: Residential survey responses

Table 17: Break down of survey results of survey and subsequent submissions.

SURVEY QUESTION	SUB QUESTION	ANSWERS/REPONSES	ADDITIONAL COMMENTS
1. How long have your lived at your current residency		Four months to 43 years.	
2. How far is your house from Cannes Reserve?			The survey was restricted to those house immediate adjacent or in close proximity to the reserve.
3. What do value about Cannes Reserve?		The most common answers were Views. The natural beauty of the reserve. Peacefulness and tranquil subtropical environment. The vegetation. Privacy. Wildlife. Concern for the weeds.	Several responses stated that reserve is important to the life style and welling being of those that live there. However, GHFF are impacting on the lifestyle and e enjoyment of most residents.
4. When did you first notice Grey-headed Flying-fox at Cannes Reserve?		Answered varied between up to Twelve years	Several residents were unaware of the colony when they moved to the area.
5. How do you rate your experiences living near the Cannes Reserve Grey-headed Flying-fox colony?	Positive and pleasant Interesting and enjoyable	2 1	Negative responses include: Impacts on wellbeing and health.

SURVEY QUESTION	SUB QUESTION	ANSWERS/REPONSES	ADDITIONAL COMMENTS
	Unpleasant experience	4	Woken regularly between 3.30 and 5.30am
	Very Negative	2	Smell, stench,
	Neutral, neither positive or negative	1	Excrement dropping on cars, building and clothing. Cost involved in repair or massive drops in re-sale value.
			Impacts of income.
			Need to take medication
			Subsequent impacts on work the following day Occupation Health and Safety issue.
			Disappointment at the reduced diversity of native wildlife, especially birds.
			Having to close windows and doors on warm nights.
			Impact on trees in reserve.
			Positive responses include:
			Enjoying having a endangered species living nearby
6. Are you affected or do you have any concerns with the Cannes Reserve Grey-headed Flying-Fox Colony?	No concerns	2	Lost lifestyle, sleep and impacts on health.
	Noise	6	Frustration at being unable to enjoy the lifestyle associated with living in the area.
	Smell	11	
	Droppings	7	Impact, costs to clean and lost re-sale value associated with GHFF defecating on houses and cars.
	Impacts on property - car and	5	Spoil the view and trees.

SURVEY QUESTION	SUB QUESTION	ANSWERS/REPONSES	ADDITIONAL COMMENTS
	house Impacts of property value	 5	Causing declines in the other wildlife Landlord put clause in lease that makes it difficult to break and move away.
7. Do you have any health and/or disease concerns with the Grey-headed Flying Fox,	No. Yes.	2. 11	The most commonly stated concerns included: Stress related issues. Potential for children to come in contact with excrement or dead individual GHFF. Occupation Health and Safety issues from lack of sleep and stress. Diseases that may be caused by the GHFF –ABL, Hendra Ebola and Nipah. Ear plugs and subsequent bleeding from ear and severe recurring ear infections. Have greater concerns with snakes, spiders and sharks.
8. Do you have any suggestions for the management of Cannes Reserve and the Grey-headed Flying-fox colony?		Clearing all of the vegetation to make the GHFF move away. Move or relocate the colony Pruning the vegetation from edge to reduce roost potential. Remove weeds, rehabilitate and maintain the site. Eradication.	Several residents suggest relocating the colony to Warriewood. Removal of all tall trees to encourage the camp to move towards the centre of Cannes Reserve.

SURVEY QUESTION	SUB QUESTION	ANSWERS/REPONSES	ADDITIONAL COMMENTS
9. Would you like further information concerning the ecology, biology and conservation status of Grey-headed Flying-foxes	No Yes	6 6	
10. Would you attend further community meetings and information nights? ***If so, is there anything that you feel should be discussed or considered relating to the Cannes Reserve Grey-headed Flying-fox colony?***	No Yes	2 6	Comments from the second part of the question. Revision of PoM Restoration and weed removal Change of laws regarding the protection of GHFF to avoid conflicts with residents. Existing costs associated with managing the camp.
Additional comments to the surveys or from other correspondence.	The additional comments that were made by the local residents generally focused on: Economic factors. Massive decreases in the resale value of property, mostly on cars and residential dwellings. Cleaning and re-painting external walls of residential dwellings covered in excrement. Re-mortgaging Health and stress. ○ Rheumatoid arthritis ○ Stress ○ Occupational Health and Safety Issues in work place due to a lack of sleep. ○ Well-being and health of children who play in parks. ○ Doctors certificates and other information are provided in Appendix F. • Weed removal and restoration of native plant species.		

SURVEY QUESTION	SUB QUESTION	ANSWERS/REPONSES	ADDITIONAL COMMENTS
	• Loss of amenity and enjoyment of living near park.		

Appendix F: Doctors certificates

50 AVALON PDE. MEDICAL CLINIC
Drs. John Eccles, Peter Saxon-Williams, Harriett Webb, Erin Noonan.

Dr. Erin Noonan ,BMED SCI, MBBS(HONS), FRACGP
50 Avalon Pde
AVALON NSW 2107
Phone: 9918 3716
Fax: 9973 2503

30/03/2012

This is to certify that

[redacted]
Cannes Drive
AVALON NSW 2107 .

is a patient of this practice. Her sleep has been disturbed as a result of the noise created by the bat colony and as a result has continued to require medication for sleep

Dr. Erin Noonan

AVALON FAMILY MEDICAL PRACTICE

54 AVALON PARADE AVALON BEACH 2107
Postal Address: PO Box 174 AVALON BEACH 2107
Telephone: (02) 9918 3586: (02) 9918 3463 Facsimile: (02) 9973 1465
J.D. Cavanaugh Pty Ltd ABN 95 003

DR. JEFF CAVANAUGH M.B., B.S. (N.S.W.) Provider No 369676Y
DR JAN MAEHL M.B., B.S. Provider No 0459534X
DR PAUL KLEMES M.B., B.S. FRACGP Provider No 060310DX
DR SHARRON DAVIS M.D., B.S. (Syd) FRACGP Provider No 2457056T

29/3/2012

Attn Mark Beharrell
Manager of Natural Environment and Vegetation
Pittwater Council.

Re: [redacted] Therry Street
AVALON 2107
My record no.: 89284

This is to certify that [redacted], age 71 yrs, is my patient and has been suffering stress related gastritis due to the flying foxes that inhabit the reserve adjacent to her property (Cannes Reserve off Therry Street). Also, for over one year now she has been suffering from insomnia due to the noisy flying foxes.

Past History:

Date	Condition

Allergies:
ERYTHROMYCIN, PETHIDINE

Current Medications:

Drug Name	Strength	Dosage	Reason	Last script
GAVISCON DUAL ACTION PEPPERMINT LIQUID Liquid	500mg-213mg-325mg/10mL	5mls t.i.d. after meals and at bedtime		29/03/2012
OSTELIN VITAMIN D & CALCIUM Tablet (Cholecalciferol/Calcium (as Carbonate))	12.5mcg (equivalent to 500 Units Vitamin D)/600mg	2 daily		14/12/2010

Yours sincerely,

Dr. Paul Klemes.

Appendix H: Authors Qualifications

CURRICULUM VITAE

Dr Rodney Armistead

ECOLOGIST

QUALIFICATIONS

- PhD in Conservation Biology from Murdoch University, Perth Western Australia. The impact of Phytophthora Dieback on the Mardo or Yellow Footed Antechinus (*Antechinus flavipes leucogaster*). – 2008
- Bachelor of Advanced Science (Honours), Deakin University, Geelong. A phylo-genetic assessment of Swamp Antechinus *Antechinus minimus*. - 2001

Rodney is an ecologist with a Doctor of Philosophy in Conservation Biology with 10 years' experience in environmental research and consulting. Rodney has been fortunate to have been able to gather considerable experience conducting flora, Phytophthora Dieback, terrestrial and aquatic fauna assessments through a variety of desert, alpine, coastal and woodland habitats in Western Australia, Victoria, Tasmania and New South Wales. He has particular experience in establishing and conducting mark, recapture and release population, biodiversity and presence-absence surveys for native mammals, lizards, frogs and bird surveys. Rodney has undertaken assessments of how threatening ecological processes impact upon Australia's native fauna. He has had the pleasure of researching, monitored and surveying the ecology and biology of several threatened and iconic native fauna species, including Western Quolls, Brush-tailed Bettongs, Platypus and Mountain Pygmy Possums.

RELEVANT PROJECT EXPERIENCE

Phytophthora Dieback related assessments

- The distribution of Phytophthora Dieback in the Angahook State Park. Parks Victoria.
- The distribution of Phytophthora Dieback in Alcoa's Anglesea Mining Lease. (Alcoa World Alumina).
- The distribution of Phytophthora Dieback along the proposed alignment for the Great Otway Walk. (Parks Victoria).
- The cause of a large expansion of Phytophthora Dieback in the Fitzgerald National Park, Western Australia. (Murdoch University DEC).
- Field methods to eliminating Phytophthora Dieback from the affected soil in the south west of Western Australia and northern Tasmania. (Murdoch University, DEC, Parks Tasmania)

Impact assessments

- Busselton Flora and Fauna Assessment, Western Australia. (Coffey Environments)

- Pinjarra urban growth Flora and Fauna Assessment, Western Australia. (Coffey Environments)
- Flora and Fauna Assessment at Mount Gibson, Western Australia. (Coffey Environments)
- Pilbara Fauna Assessment, Western Australia. (Coffey Environments for Fortescue Metals)
- Murchison Flora and Fauna Assessment, Western Australia. (ecologia)
- Great Victoria Desert Flora and Fauna Assessment, Western Australia. (ecologia)
- Impact of fibrinol baiting for yellow-crazy ants on Christmas Island's native invertebrates and waterways. (CESAR Consultants and Christmas Island National Parks).
- Manor Lakes Flora and Fauna Assessment, Victoria. (Biosis Research and Urban Growth Authority)
- Stella Property Flora and Fauna Assessment, Victoria. (Biosis Research and Urban Growth Authority)
- Rye Flora and Fauna Assessment, Victoria. (Biosis Research and Urban Growth Authority)
- Flinders St, Rye Flora and Fauna Assessment, Victoria. (Biosis Research and Department of Education)
- Preliminary Flora, Fauna and geomorphic Assessment at Grantville, Victoria. (Biosis Research and Melbourne Water)
- Rockbank Golden Grass Frog and Golden Sun Moth Surveys, Victoria. (Biosis Research and Urban Growth Authority)
- Port Campbell gas pipeline alignment Flora and Fauna Assessment, Victoria. (Biosis Research)
- Melbourne/Geelong water pipeline Fauna Assessments, Victoria (Biosis Research, Melbourne Water and Barwon Water)

Ecological Monitoring

- The distribution of Swamp Antechinus in the eastern Otway Ranges. (Deakin University)
- The distribution and status of Mountain Pygmy-possums on Mount Buller, Mount Hotham and Bogong High Plains. (Dean Heinze Environmental Consulting, ARMB and Parks Victoria).
- Spotted Tree Frog surveys in north-eastern Victoria ((Dean Heinze Environmental Consulting and Parks Victoria).
- Dibbler surveys on Whitlock Island. (University of Western Australia)
- Woylies or Brush-tail Bettong surveys in the Dryandra Woodlands. (Murdoch University)
- Spring vegetation surveys in rehabilitated bauxite mine pits. (Alcoa World Alumina)
- Seasonal hydrological changes in areas where bauxite mining and habitat rehabilitation has occurred. (Alcoa World Alumina)
- Stream monitoring in areas where bauxite mining and habitat rehabilitation has occurred. (Alcoa World Alumina)
- Habitat use by small mammals, reptiles and frogs in rehabilitated bauxite mine pits. (Murdoch University and Alcoa World Alumina)
- Southern Brown Bandicoot and Brush-tail Phascogale surveys in urban Busselton. (Coffey Environments)
- Platypus surveys in Melbourne's urban streams. (CESAR Consultants and Melbourne Water)
- Modified gill net platypus surveys in the Wimmera region. (CESAR Consultants and Project Platypus)
- Platypus surveys in the Mackenzie River, Grampians National Park. (CESAR Consultants and Wimmera Catchment Management Authority)
- Golden Grass Frog surveys in the urban growth areas of Melbourne. (Biosis Research)
- Plains Wanderer surveys in the urban growth areas of Melbourne. (Biosis Research)
- Golden Sun Moth surveys in the urban growth areas of Melbourne. (Biosis Research)
- Striped Legless Lizard surveys in the urban growth areas of Melbourne. (Biosis Research)
- Dwarf Galaxias surveys in urban Melbourne. (Biosis Research)
- Dwarf Galaxias relocation surveys in urban Melbourne. (Biosis Research)
- Broad Toothed Rat surveys in areas impacted by the Black Saturday Fires. (Biosis Research and DSE)

Ecological Reviews

- Cahill, D. M., Wilson, B. A., and Armsitead, R. J. (2001). Dieback assessment at Fairhaven Ridge, Ganghook – Lorne State Park, Victoria. A report to Parks Victoria.

- Cahill, D. M, Wilson, B. A., and Armistead, R. J. (2001). Assessment of Phytophthora cinnamomi (cinnamon fungus) at Coalmine Road, Anglesea Alcoa lease, Victoria. As report for Alcoa World Alumina, Anglesea.
- Cahill, D. M., Wilson, B. A., and Armistead, R. J. (2001). Assessment of Phytophthora dieback, Phytophthora cinnamomi in the Otway National Park, Victoria. A report for Parks Victoria for the Great Ocean Walk.
- Dunstan, W. A., Rudman, T. Shearer, B. L., Moore, N. A., Paap, T., Calver, M. C., Armistead, R. Dobrowolski, M. P., Morrison, B., Howard, K., O'Gara, E., Crane, C., Dell, B., O'Brien, P., McComb, J. A., and Hardy, G. E. St J. (2008) Research into natural and induced resistance in Australian native vegetation of Phytophthora cinnamomi and innovative methods to contain and/or eradicate within localised incursions in areas of high biodiversity in Australia. Eradication of Phytophthora cinnamomi from spot infections in native plant communities in Western Australia and Tasmania. Prepared by the Centre for Phytophthora Science and Management for the Australia Government Department of the Environement, Water, Heritage and the Arts.
- The distribution of platypus in waterways from greater Melbourne: spring 2008 and autumn 2009 survey results. A report prepared by Dr. R. Armistead and Dr. A Weeks for Melbourne Water (2009).
- The Mount Hotham Mountain Pygmy Possum Recovery Plan (Biosis Research for Mount Buller and Mount Stirling Alpine Resort Management Board and Parks Victoria)

CURRICULUM VITAE

Elizabeth Norris

SENIOR ECOLOGIST

QUALIFICATIONS

- Bachelor of Science, Macquarie University, Sydney. Biology/Ecology and Palaeontology major, 1983.
- Post Certificate in Electron Microscopy, Sydney Technical College, Transmission and Scanning Microscopy, 1986.
- Master of Science, Macquarie University, Sydney. Thesis entitled: *'A study of the soil and vegetation patterns within part of the Pilliga Forests, and an evaluation of the impact of European settlement on the vegetation'*, 1997.

Liz has 20 years botanical and ecological research in the New South Wales: Sydney Basin, Coastal New South Wales, Hunter Valley, North and South Western Slopes and Plains, often to remote areas. She has a Bachelor of Science, a post graduate certificate in electron microscopy and a Master of Science (Thesis) "*A study of the soil and vegetation patterns within part of the Pilliga Forests, and an evaluation of the impact of European settlement on the vegetation*".

Liz is a senior botanist/ecologist at Eco Logical Australia (permanent part time). During this time, she has been involved in a large number of systematic floristic surveys, targeted flora surveys, vegetation monitoring, the development of strategic conservation plans, other ecological assessments and an ecological expert to the NSW Land and Environment Court. She has been an employee at the National Herbarium, Royal Botanical Gardens from 1982 – 2009 and has undertaken a range of duties including various research projects and curation of the herbarium collection. Liz has extensive experience as a field botanist, has written species descriptions for the Flora of NSW, and provided technical advice at flora workshops.

RELEVANT PROJECT EXPERIENCE

Ecological Constraints / Impact Assessment

- Ingleside Biodiversity Strategy
- Pre-clearing Assessment for APZ dvelopment
- Calderwood Urban Development Ecological Survey
- South Cecil Hills Ecological Constraints Analysis
- Crudine Ridge Wind Farm Ecological Assessment (Wind Prospect)
- Ecological Impact Assessments – various (Integral Energy)
- Biobanking Pilot Assessments (DECC)
- El Caballo Blanco and Gledswood Rezoning Ecological and Bushfire Assessment (Landcom)
- Ballanagamang Biobanking Assessment (Ecotrades)
- Blacktown Olympic Park Site Expansion Flora and Fauna Impact Assessment (Blacktown City Council)
- Marsden Park Industrial Precinct Ecological Assessment & EPBC Surveys (APP)
- Alex Avenue Ecological Assessment (Landcom)
- Area 20 Ecological Assessment (GCC)
- Shoalhaven LGA Rural Residential property Flora survey
- Vegetation survey and targeted orchid survey for SEPP 5 development in Wyong LGA.
- Vegetation surveys for Integral Energy and the NSW Road & Traffic Authority and other authorities
- Raymond Terrace and Medowie Wastewater Transportation System, Hunter Water.

- Flora survey and assessment for proposed water pipeline - fennel Bay to Toronto, Hunter Water.
- Flora survey and report including assessment under EPBC and TSC Acts, Kiama LGA.

Targeted threatened species survey

- Targeted orchid survey, Buckingbong State Forest
- Various targeted flora surveys, Cumberland Plain
- Targeted flora surveys, Maroota State Conservation Area (DECCW)
- Hawkesbury City Council's Council and Crown Reserves Vegetation survey

Vegetation Survey and Mapping

- Vegetation Survey for South-east Corner Biometric Benchmark Project
- Systematic Vegetation Surveys, Upper Hunter Regional Environmental Management Strategy
- Marra Marra NP and Muogomarra NR NPWS flora surveys
- Wetland Vegetation Surveys for LiDAR, Lowbidgee and Gwydir wetlands (DECC)
- Vegetation Survey, Durness Station, Tea Gardens, Great Lakes LGA
- Vegetation Survey, Camerons Gorge Nature Reserve, DECCW
- Vegetation Survey, Maroota State Conservation Area, DECCW
- Wingecarribee LGA Flora survey and targeted threatened species survey
- Baulkham Hills Shire Natural Assets Mapping
- Hawkesbury City Council's Council and Crown Reserves Vegetation survey

Ecological Monitoring

- Systematic surveys of long term monitoring plots within Upland Swamps, Newnes Plateau
- Metropolitan Colliery Vegetation Monitoring Program

Ecological Reviews

- EPBC Conservation Advice (DEWHA)
- Review of Threatened Species Nominations (DECCW)

Other

- Vegetation Condition Assessment, South West Slopes, DEWHA
- EPBC Referral - Cumberland Plain Woodland, Wivenhoe

CURRICULUM VITAE

Lucas McKinnon

SENIOR ECOLOGIST

QUALIFICATIONS

- Bachelor of Environmental Science (Honours), University of Wollongong
  Thesis topic: *Validation and Field Assessment of Endangered Ecological Communities on Community Lands within the Wollongong LGA*
- BioBanking Accredited Assessor (No. 0076), *Threatened Species Conservation Act 1995*, TAFE NSW and DECCW
- Aboriginal Cultural Awareness Training, TAFE NSW
- Forest Soil and Water Protection, TAFE NSW

Lucas is an Environmental Scientist / Ecologist with 8 years' post graduate experience working in both the private and public sectors. After completing an honours thesis studying endangered ecological communities (EECs) in the Wollongong LGA, he went onto to further studies in vegetation at the University of Wollongong and with the Australian Museum. In 2005, he began work in native vegetation policy with the former NSW Department of Natural Resources, working on the implementation of the *Native Vegetation Regulation 2005*, and with the co-ordination of threatened species policy, and went on to work in biodiversity conservation policy at the former NSW Department of Environment and Climate, Change (DECC). Whilst with DECC, Lucas also worked with the on-ground regulation of native forestry on private land on the north coast of NSW.

Lucas has worked with property scale vegetation planning with qualifications in the assessment of broadscale clearing and farmscale private native forestry under the *Native Vegetation Act, 2003*, and is an accredited BioBanking Assessor under the *Threatened Species Conservation Act, 1995*, qualified to undertake and prepare surveys and assessments for the NSW Biodiversity Banking and Offset Scheme.

Lucas has highly developed skills in research, policy development and project management, and these skills are complemented by his field skills with flora and fauna survey. Since starting ELA in October 2009, he has worked as a Project Manager and Field Ecologist on a variety of small and large scale projects, including vegetation mapping, impact assessment, biodiversity offset strategies, flora and fauna monitoring, Biobanking approvals and targeted threatened species surveys.

RELEVANT PROJECT EXPERIENCE

- West Dapto and Adjacent Growth Areas: Lead Ecologist for Part 3A flora, fauna and ecological assessment of West Dapto Urban Release Area and Adjacent Growth Areas, including the Yallah and Marshall Mount area
- Bronlow Hill: Biobanking Assessor for 60ha Cumberland Plain Woodland Biobank site
- Tharbogang BOS: Project Manager and Lead Ecologist for Biodiversity Offset Strategy for landfill and quarry, Griffith LGA
- Spring Farm: Project Manager and Lead Ecologist for Elderslie Banksia Scrub Forest Species

Impact Statement

- ARTC: Project Manager and Lead Ecologist for Purple Copper Butterfly habitat assessment
- Pine Dale Coal Mine: Project Manager and Lead Ecologist for vegetation mapping project and Purple Copper Butterfly survey
- Werris Creek Coal Mine: Project Manager and Lead Ecologist for monitoring program of offset lands including collection of baseline data for flora and fauna
- West Pymble: Lead ecologist for peer review and field validation of threatened ecological communities, Blue Gum High Forest and Sydney Turpentine Ironbark Forest
- Marsden Park; Eastern Creek; Camden: Ecologist for flora assessment of potential threatened ecological community, Cumberland Plain Woodlands and Derived Native Grasslands, including additional threatened species survey for Grevillea juniperina and Cumberland Plain Snail
- Werris Creek Coal mine: Project Manager and Lead Ecologist for flora and fauna assessment of Part 3A development proposal for Life of Mine Extension Project in Box-Gum Woodland Critically Endangered Ecological Community (CEEC) on the Liverpool Plains, NSW.
- Thornton Park TOD: Lead Ecologist for flora, fauna and riparian assessment of proposed 1200 lot Transit Oriented Development (TOD) at North Penrith.
- Grasmere: Lead Ecologist for flora, fauna and riparian assessment of proposed 30 lot sub-division of rural land containing Cumberland Plain Woodland (CEEC), at Grasmere, Camden LGA, south west of Sydney.
- Yellow Rock: Project Manager for Management Plan of Deerubbin Local Aboriginal Land Council lands at Yellow Rock, Blue Mountains LGA.
- Molongolo: vegetation survey – determination of the presence and extent of EPBC Box-Gum Woodland CEEC on the outskirts in Molongolo growth area of Canberra.
- Tralee Station: Invertebrate survey for the threatened Golden Sun Moth (Synemon plana) near Queanbeyan.
- Metropolitan Colliery: vegetation survey and monitoring for Metropolitan Colliery, west of Helensburgh in Sydney Catchment Area lands
- Warringah Council: Impact Assessment of infrastructure development adjacent to a sandstone community at Belrose, northern Sydney.
- Penrith Lakes Development Corporation: preliminary ecological advice on future development adjacent to the Nepean River.
- Integral Energy: Impact assessment for the proposed re-establishment of access tracks to infrastructure managed by Integral Energy off Mount Ousley Road and Appin Road
- NSW Natural Resource Commission: strategic input and background research for review of White Cypress Pine forestry in NSW.
- NSW Natural Resources Commission: strategic input and review into a review of River Red Gum forestry practices.
- Private Native Forestry (PNF): operational administration of regulatory activities under the Native Vegetation Act 2003 and PNF Code of Practice (NSW Dept. of Environment, Climate Change & Water).
- EEC Recovery Project: development and implementation of identification package for endangered ecological communities (EECs), including simple I.D. Guidelines and Indicative EEC Mapping Series for coastal floodplain EECs (NSW Dept. of Environment and Climate Change).
- Native Vegetation Act 2003, Implementation Committee Secretariat (NSW Dept. of Natural Resources).

CURRICULUM VITAE

Bruce Mullins

MANAGER, ECOLOGY AND ASSESSMENT, SENIOR ECOLOGIST

QUALIFICATIONS

- Master of Science, University of Technology, Sydney. Factors affecting the vegetation of mined and unmined areas in a montane forest.
- Bachelor of Science, University of Technology, Sydney

Bruce is an ecologist with nineteen years post-graduate experience and is Eco Logical Australia's Senior Ecologist and Manager of the Ecology and Assessment team. Following the completion of a Master of Science thesis examining patch dynamics and plant ecophysiology at an abandoned mine site in the central tablelands of NSW, Bruce has been working as a researcher and environmental consultant. For seven years he managed the environmental consulting activities of Charles Sturt University, principally through the Johnstone Centre, after which time he joined Eco Logical Australia.

Bruce has highly developed skills in research and consulting. He is experienced in the design and execution of ecological surveys, environmental impact assessment, the development of management plans, literature reviews and all aspects of project management.

RELEVANT PROJECT EXPERIENCE

- Towra Point Artificial Bird Roosts REF, DECCW
- Southern Highlands Transfer, Identification of Flora and Fauna Constraints, Dept Commerce
- Shoalhaven Water Transfers, Terrestrial Ecology and Wetlands, Dept Commerce
- Metropolitan Colliery Vegetation Monitoring Program
- Ecological Assessment, Proposed Hume Highway Duplication, RTA
- Flora and Fauna Impact Assessment, Roadside Vegetation Maintenance, Old Princes Highway, Bulli Tops to Waterfall, Wollongong City Council
- Ecological Assessment, Proposed Hume Highway Duplication, RTA
- Goodnight Island Ecological Assessment, Studio Internationale
- Research and Monitoring Program, DEFCOMMSTA Morundah, Dept of Defence
- Wetland Vegetation Surveys for LiDAR comprising the Gwydir Wetlands, DECCW
- Wetland Characterisation and Management, Port Stephens Council
- EPBC Box Gum woodland survey and mapping, Molonglo region, ACT
- Tallawarra Local Environment Study, TRUenergy
- Shellharbour Hardrock Extraction Flora and Fauna Assessment, NSW Dept of Planning
- Campbelltown Biodiversity Study, Campbelltown City Council
- Native Vegetation Guide for the Riverina, Greening Australia
- Buckingbong State Forest Environmental Assessment, Dept of Defence
- Wagga Wagga Planning Studies, Willana Associates
- Historical distribution of Native Grasses through Parkes, Forbes and Lachlan Shires, Western

Research Institute
- A review of the ecological health of the Murrumbidgee River, Living Murray
- Systematic Vegetation Surveys, Upper Hunter Valley
- Environmental investigations and vegetation mapping, DEFCOMMSTA properties, Dept of Defence
- Vegetation Condition Assessment, Woodlands Historic Park, Melbourne, Parks Victoria
- Flora survey, Riverine Plain (62 sites), DLWC
- Flora survey, Jingellic, Bogandyera and Clarkes Hill Nature Reserves, NPWS
- Flora survey, Wagga Wagga LGA, DEC
- Googong Environmental Investigations for Local Environment Study, Willana Associates
- Gum Swamp Management Plan and Operation and Maintenance Manual, Gum Swamp, DLWC
- Evaluation of 1750 mapping of vegetation by the Riverina Vegetation Committee, NPWS
- Edwin Land Parkway, Queanbeyan, GHD
- Vegetation validation - Narrandera, Ardlethan, Barmedman and Coolamon 1:100,000 Map Sheets, DECCW
- Scoping Report for the Development of a Biodiversity Strategy and Plan for the Rice Industry, Rice Growers Association
- Council Appointed Expert, terrestrial ecology, Proposed Subdivision Hampton Cres Blacktown
- Council Appointed Expert, terrestrial and aquatic ecology, Rooty Hill
- Box-Gum Woodland Mapping and Monitoring Plan for Kapooka Military Area, Dept of Defence
- Monitoring the Impacts of Kangaroo Grazing in the Kapooka Military Area, Dept of Defence
- Monitoring the Impacts of Kangaroo Grazing in Latchford Barracks, Dept of Defence
- North Bandiana Landscape Management Plan, Dept of Defence
- South Bandiana Landscape Management Plan, Dept of Defence
- Vegetation Condition Assessment, South West Slopes, DEWHA
- Flora and Fauna Assessment, Proposed Bayswater 2 Powerstation, Part 3A, AECOM
- Hargraves to Windeyer Powerline Ecological Assessment, Barnson Pty Ltd
- Moolarben Coal Mine Preclearing Survey, Moolarben Coal Operations
- Vegetation Mapping, Mulwala Explosives Facility, Mulwala, Dept of Defence
- Native Grassland Condition Assessment, Tubbo Station, Tubbo Farming.
- Wagga Wagga Linepack Extention, Environmental Licencing Professionals
- Ecological Assessment, Cooktown, QLD, Airservices Australia
- Assessment of Irongrass Natural Temperate Grassland, Tailem Bend, SA, Airservices Australia
- Moorlaben Coal, Flora and Fauna Monitoring 2010-2011, Moolarben Coal Operations
- Superb Parrot Surveys, selected sites in ACT.
- Eastern Highlands Vegetation Surveys, (Kosciusko NP and ACT), DECCW and ACT government.
- West Dapto and Adjacent Growth Areas, Part 3A Assessment, Sydney Water Corporation
- Tharbogang Landfill Biodiversity Offset Strategy, Griffith City Council
- Tralee Station proposed rezoning, environmental assessment and constraints analysis, Queanbeyan, Urbis.

CURRICULUM VITAE

Peter Knock

SENIOR GIS OFFICER

QUALIFICATIONS

- Bachelor of Applied Science, University of Canberra, 1990.
- Associate Diploma of Environmental Control, Mitchell College of advanced Education 1988.

Peter has 19 years' experience in applied Geographic Information Systems and Remote Sensing particularly within the fields of conservation and natural resource management. He has professional experience in threatened species, habitat assessment and vegetation management from a, Local, State and Federal Government perspective. Peter has been involved in numerous landscape scale conservation assessment projects both from field level to the project management level including Comprehensive Regional Assessments (CRAs), Regional Wilderness assessments and Land cover change projects.

Peter has applied these skills at property level targeted Fauna and Flora surveys to catchment-wide ecological assessment s for local and regional environmental planning outcomes. He has the ability to collect and collate field based data to produce map and spatial analysis products utilising his GIS skills.

Peter has an excellent working knowledge of threatened species and ecological community processes and legislation on the North Coast of NSW.

RELEVANT PROJECT EXPERIENCE

- MDBC Basin Wide Vegetation Mapping Project (M305).
- Australian Agricultural Land-cover Change Mapping Project for Bureau Resource Sciences.
- Australian wide Digital Topographic database for Australian Bureau of Statistics.
- NSW NPWS Upper and Lower Nth East CRA Wilderness Assessment process.
- NSW NPWS Nandewar Bioregion Vegetation Mapping Project.
- Vegetation mapping of the Naomi catchment using Spot imagery interpretation for Namoi Catchment Management Authority:
- Vegetation Mapping For Coffs Harbour City Council Vegetation Strategy
- Vegetation mapping for the extension to Coffs Harbour LGA: Red rock –Corindi area.
- Strategic Planning environmental inputs for Monee, Hearns Lake and South Coffs Development Control Plans.
- Targeted Remote Sensing Mapping for Montane heaths and wetlands Endangered Ecological Community for Northern Rivers CMA
- Curracubundi Wilderness Assessment Process
- Role out of Biodiversity Conservation Lands Layer for Mid North Coast Councils for incorporation and defining standard LEP's
- GIS and Remote Sensing for Lower Clarence floodplain Biolinks study.

- Construction of River and Floodplain wide model for Goulburn river Valley, Victoria for the Murray Darling Basin Authority as part of the Sustainable Rivers Audit.
- Volume Estimates for on farm Storages using LiDAR derived DEM's Darling River Floodplain, DECCW.

CURRICULUM VITAE

Joanne Daly

GIS OFFICER AND ENVIRONMENTAL SCIENTIST

QUALIFICATIONS

- Bachelor of Environmental Science (Honours)
- Attended the BioBanking Assessor Accreditation training Course, TAFE NSW and DECCW

Joanne joined the Eco Logical Australia team full-time in September 2008 after completing a Bachelor of Environmental Science (Honours) at the University of Wollongong. Jo has worked on mapping wetlands in the Namoi catchment, refining the Mitchell Landscapes data layer and other projects that have required GIS for analysis and mapping.

Jo has a multidisciplinary background with focuses in GIS and geomorphology. She has a range of GIS skills including: map production; vectorisation; and digitizing. She is also able to utilize GIS to determine the inputs for the BioBanking Credit Calculator for a BioBanking Assessment.

RELEVANT PROJECT EXPERIENCE

GIS Editing and Analysis:

- Natural Asset Management for Urban Waterways Baulkham Hills Shire Council
- Namoi CMA Wetland mapping Namoi Catchment Management Authority
- Liverpool Plains Biodiversity Strategy
- Mainland Islands Conservation Status Prioritisation
- Hunter Councils API Vectorisation
- Regionally Significant Riparian Corridors Assessment
- Species Habitat Modelling for Gold Coast City Council
- Strathfield Local Environmental Plan and Zoning Update
- Sydney Metro CMA Land Use Mapping
- Whitehaven Regional Biodiversity Offset

BioBanking Assessments and Biodiversity Offset Calculations:

- Strategic Biodiversity Offsets Overview for Cockatoo Coal Ltd
- Brownlow Hill Biobank Site
- Darkinjung Land Council Biobank Agreement Assessment
- Liddell Colliery Expansion

Plans of Management and Masterplans:

- Queanbeyan River Corridor Plan of Management
- Wongawallan Management Plan
- Bonogin Conservation Reserves Management Plan
- Bidjigal Reserve Plan of Management
- Middle Creek Management Plan
- Dunbar Park Plan of Management
- Warriewood and Nareen Wetlands Plans of Management
- Crest to Lansdowne Final Masterplan

- Yeramba Lagoon Catchment Masterplan

CURRICULUM VITAE

Robert Humphries

MANAGER, BIOBANKING AND OFFSETS PROGRAMS

QUALIFICATIONS

- Bachelor of Applied Science, Ballarat C.A.E 1983-85.
- Master of Applied Science (Research) University of Ballarat 1986-89.

Robert is an ecologist, environmental planner and project manager with 25 years experience. Since graduating with Bachelors and Masters Degrees in wildlife management in 1985, Robert has worked mainly in the public sector with the Department of Environment and Conservation (Victoria) 1988-1996 and NSW National Parks and Wildlife Service, now NSW Office of the Environment & Heritage 1996-2006. Robert joined Eco Logical Australia in March 2008.

Robert was the Manager of the Threatened Species Section of the NSW Department of Conservation and Environment for over 10 years and has extensive experience of the NSW Threatened Species and Environmental Planning legislation, Government policy, the biodiversity of the Greater Sydney and Hunter Regions and the new biodiversity certification and biobanking provisions.

Robert is a member of the Biobanking Ministerial Reference Group representing the NSW Urban task Force.

RELEVANT PROJECT EXPERIENCE

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Environmental Impact Assessment Projects (traditional impact assessment)

- LOM Part 3A Assessment for Werris Creek Coal Mine (Werris Creek Coal Pty Ltd, 2010)
- Threatened Species Impact Statement for proposed retirement village at Beacon Hill, Warringah LGA, NSW (Beacon Hill Retirement Pty Ltd, 2010).
- Threatened Species Impact Statement for proposed residential subdivision at Menai, Sutherland LGA, NSW (Landcom, 2009/10).
- Part 3A Environmental Assessment of the Boco Rock Wind Farm, Nimmitabel, NSW (Wind Prospect CWP Pty Ltd, 2009)
- Part 3A Environmental Assessment of the Sapphire Wind Farm, Glenn Innes, NSW (Wind Prospect CWP Pty Ltd, 2010)
- Part 3A Environmental Assessment of the Crudine Wind Farm, Sofala, NSW (Wind Prospect CWP Pty Ltd, 2011)
- Native Grassland Assessment of proposed residential rezoning application at Beveridge, Victoria

(2008 Nick Baldi Constructions)
- Threatened species review and advice for proposed rezoning at Ashtonfield, Maitland LGA, NSW (Ashtonfield Developments Pty L:td), 2008
- Threatened Species review and advice for proposed rezoning at Taylors Beach, Port Stephens LGA, NSW (North Arm Cove Joint Venture Pty Ltd, 2008)

Threatened Species Recovery Programs
- Review of 13 EPBC Act Threatened Species Recovery Plans (DECC, 2008)

- As Manager of Threatened Species Unit, NSW Department of Environment and Conservation 1996-2005, Project Manager, prepared and/or supervised preparation of over 40 threatened species recovery plans under the NSW Threatened Species Conservation Act 1995 and Commonwealth Environmental Protection & Biodiversity Conservation Act including the following species Wollemi Pine (1998 & 2006), *Allocasuarina portuensis* (2000), *Prostanthera junonsis* (2000), *Persoonia mollis* sub.spp. Maxima (2000), Manly Endangered Population of Little Penguins (2000), *Epacris hamiltonii* (2001), *Leionema lachnaeoides* (2001), *Grevillea obtusiflora* (2001), *Pterostylis gibbosa* (2001), *Pterostylis* sp. 15 (2001), Blue Mountains Water Skink (2001), Bathurst Copperwing Butterfly (2001), *Acacia pubescens* (2003), *Darwinia biflora* (2003), *Irenepharsus trypherus* (2004), *Daphnandra* sp. C (2004), *Zieria granulata* (2004), Eastern Suburbs Banksia Scrub (2004), Gould's Petrel (2000), *Grevillea caleyi* (2001), Green and Golden Bell Frog (2003), Long-nosed Bandicoot (2003), *Microtis angusii* (2002), Southern Brown Bandicoot (2005), *Pimelea spicata* (2004), *Persoonia nutans* (2005), *Prostanthera askania* (2005), *Zieria involucrata* (2005), Large Forest Owls, Brush-tailed Rock-wallaby, Bush Stone Curlew, Critical Weight Range Mammals

- As Flora and Fauna Guarantee Officer, Victorian Department of Environment and Conservation (now Dept Sustainability and Environment (1988-1995), prepared or had significant input to FFG Action Statements for the following species:- Button Wrinklewort, *Rutidosis leptorrhynchoides*, Hairy Anchor Plant, *Discaria* pubescens, Brush-tailed Phascogale, *Phascogale tapoatafa*, Powerful Owl, *Ninox strenua*, Western (Basalt) Plains Grassland Community, Eastern Barred Bandicoot, Striped Legless Lizard, Plains Wanderer, Large -fruit Groundsel *Senecio macrocarpus*, Hairy-tails *Ptilotus erubescens*, Brolga

Research Areas
- Threatened Species Recovery Programs
- Population Viability Analysis
- Ecological impacts of fire (Master Applied Science Thesis)
- Native Grassland management
- Predator control techniques including the use of cyanide baiting for Red Foxes
- Silvicultural systems and flora and fauna impacts
- Biology and ecology of threatened bandicoot species

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