total earth care

Flora and Fauna Assessment

2 McPherson Street, Warriewood

Total Earth Care Pty Ltd
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1 INTRODUCTION

A Flora and Fauna Assessment is required for the Development Application to Pittwater Council.

A Flora and Fauna assessment has been prepared by TEC in 2014 to address the potential environmental impacts of the proposal on flora and fauna, and their habitats that may occur on and/or utilise the subject site and study area. Based on new development drawings, the TEC (2014) report has been updated and amended (present report) to take into account the new plans and re-assess potential impacts and recommendations. The findings of the assessment will be utilised to ensure that the proposed design maximises the restoration, retention and preservation of indigenous trees, shrubs and groundcovers, fauna habitats, as well as natural features, including rock features and watercourses. The report will consider any Council mapped creekline/wetland corridors and associated buffer strips, and make recommendations for rehabilitation/landscaping works in line with Council requirements.

1.1 Background

Total Earth Care (TEC) was engaged by Karimbla Properties Pty Ltd/Meriton Apartments in June 2013 to carry out a preliminary biodiversity assessment on site. The assessment was undertaken in response to discussions with Pittwater Council which outlined the following Ecological information requirements;

- An inventory of native and exotic species present within the vegetated areas of each property. Species information was gathered during a site visit on 30 May 2013.
- An assessment of the vegetation communities present on site, based on species recorded and with reference to recent mapping methodologies (SMCMA Mapping – DECCW 2009).
- An assessment of the conservation significance of the vegetation communities based on the communities listing on the NSW Threatened Species Conservation Act and the Commonwealth Environmental Protection and Biodiversity Conservation Act.
- Timing of further ecological assessment information and reasons why it is not required at this stage.
- Mitigation measures to be employed to minimise impacts to these communities.

The assessment found remnant Swamp Sclerophyll Forest (SSF) vegetation exists around the boundary of the Foleys Nursery site associated with the creekline along the northern and eastern boundaries and the wetland area to the west. The majority of the threatened vegetation exists either within the creekline itself or on the adjacent creekbank from the main nursery property, closer to the Lot boundary. The vegetation is generally in low/moderate condition with exotic species dominating the understorey and creek banks. The Macpherson Street road frontage supports SSF from the south-western Lot boundary to the junction with Narrabeen Creek. Within the nursery property two stands of regrowth SSF vegetation occur as regrowing swamp oak trees characteristic of the threatened vegetation.

This present report provides an update of the TEC (2004) report which includes an assessment of new threatened species records on the OEH BioNet Atlas of NSW Wildlife and EPBC database, and provides amendments to reflect the updated proposal design.

2 AIMS

The aims of the current report are to update the previous flora and fauna and biodiversity assessments (TEC 2013, 2014) in order to submit an updated and complete Flora and Fauna Assessment for the purposes of submission of the DA proposal to Pittwater Council. This Flora and Fauna Assessment will consider the requirements outlined in the Pittwater Council DA submission requirements, Pittwater 21 Development Control Plan (DCP), Pittwater Local Environment Plan (LEP) 2014 and Warriewood Valley Strategic Review. The report will aim to:

- Confirm the presence or likely occurrence of threatened species, populations and ecological communities (or their habitats), as listed under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act* 1999 and *NSW Threatened Species Conservation (TSC) Act* 1995;
- Address the significance of potential direct and indirect impacts on flora and fauna, including threatened species, populations or endangered ecological communities or their habitats;
- Make recommendations to avoid-mitigate-compensate (offset) the identified impacts;
- Clearly set out environmental management measures that are to be implemented before, during and after construction. This includes the implementation of measures to protect and rehabilitate the Vegetated Riparian Zone (VRZ).

3 METHODS

3.1 Desktop Research

Records of all threatened species, populations and endangered ecological communities previously recorded within 5 kilometres of the subject site (10km locality search) were obtained from the Office of Environment & Heritage (OEH) Wildlife Atlas database, and the Federal Environment Department of Environment Protected Matters search tool. All previous reports and plans relating to the site were reviewed including the Flora and Fauna Assessment Reports (TEC 2013) for consistency with the updated database searches. Additionally, a review of all updated plans and reports relating to the site, relevant legislation, recent vegetation mapping and other documentation were reviewed, including:

- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (V.2) (OEH 2013);
- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (DECC, 2009)
- Broad-scale mapping of the Sydney 1:100,000 map sheet by Benson and Howell (1994).
- *Arboricultural Assessment* (TALC 2014);
- Landscape Concept Plan (Noble 2014);
- *Controlled Activities: Guidelines for Riparian Corridors* (DECCW 2012);
- *NSW State Rivers and Estuaries Policy (*NSW WRC 1993);
- *Warriewood Wetlands Plan of Management* (Pittwater Council 2004).
- *NSW Wetlands Management Policy (DLWC 2010);* and
- *NSW Groundwater Dependent Ecosystems Policy (DLWC 2002).*

3.2 Flora

General botanical survey of the area was conducted on the site on 29th October 2014. The entire subject site was surveyed using random meander methods. This involved

- the identification of native and exotic plant species according to *Field Guide to the Native Plants of Sydney* (Robinson 2003) and the *Flora of NSW* (Harden 1992, 1993, 2000, 2002), with reference to recent taxonomic changes;
- the identification and mapping of plant communities (where present) according to the structural definitions of Specht & Specht (1999), and reference to previous broad-scale mapping of the Sydney 1:100,000 map sheet by Benson & Howell (1994), the *Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (Draft) (DECCW 2009a) vegetation mapping, and *Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* V2.0 (OEH 2013); and
- targeted searches for plant species of conservation significance according to the "random meander" method (Cropper 1993).

The conservation significance of plant species and plant communities was determined according to:

- TSC Act for significance within NSW; and
- EPBC Act for significance within Australia.

3.3 Fauna

A general fauna survey, involving diurnal and nocturnal survey techniques, was conducted over one day and two nights on the site on the 29th and 30th October, 2014. Weather conditions during the day were warm (around 26°C) with light winds and a clear blue sky, the nights were clear with temperatures around 18°C and no wind.

The diurnal survey involved observations of animal activity, habitat identification and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings). Surveys for avifauna and amphibians involved visual detection and aural recognition of bird and frog calls.

Nocturnal fauna surveys effort involved:

- spotlighting by foot for nocturnal birds, koala and amphibian species over two nights;
- call playback for forest owls, koalas, and amphibians over two nights; and
- placement of an ultrasonic bat recording device (Anabat) over two nights.

Targeted searches were also undertaken for the habitat types of threatened fauna previously recorded in the area, as identified on the OEH Wildlife Atlas database.

All records of fauna, including habitats types, sightings and evidence of activity, in particular diggings and scats, were maintained throughout the survey period, and an inventory of species was compiled. The conservation significance of fauna species and populations was determined at a state level according to the TSC Act and at a national level according to the EPBC Act.

3.4 Limitations

Field surveys were conducted over 1 day and 2 evenings during spring 2014. In addition to the surveys undertaken, the full spectrum of flora and fauna species and ecological processes likely to occur on the site were considered by identifying potential habitats for such species and assessing the potential for these species to occur on the site based on previous records, the type and condition of habitats present, the land use of the site and its landscape context. As stated by the DEC (2004a) '*The absence of a species from survey data does not necessarily mean it does not inhabit the survey area. It may simply*

mean that the species was not detected at that time with the survey method adopted and the prevailing seasonal or climatic conditions.' Accordingly, the brevity of the survey and its timing mean that the full spectrum of flora and fauna species, as well as ecological processes, likely to occur on the subject site cannot be fully quantified or described in the TEC (2014) report.
No further survey and site visit were requested and nor done since the report provided in 2014. The 7-part tests, recommendations and conclusions are based on information collected in the field in 2014 and the most recent information found on search databases (threatened species list).

4 LANDSCAPE

4.1 Site Description

4.1.1 Soils

The site lies within land mapped on the Sydney 1:100,000 soil landscape sheet as "disturbed terrain", "Warriewood" and "Erina" (Chapman *et al*., 1989),

The western boundary area is mapped as "disturbed terrain" which is described as "level to plain hummocky terrain, extensively disturbed by human activity" (Chapman & Murphy 1989). The original soils are likely to have been subject to complete burial or removal from previous agricultural and silvicultural land use. This description is consistent with the surface conditions observed during field surveys, which indicate that major levelling and filling has occurring over the majority of the site, with extensive removal of vegetation in some areas, and changes to surface and subsurface drainage, through the construction of irrigation channels and the surrounding road and drainage systems.

The majority of the land throughout the remainder of the subject site is mapped as the "Warriewood Soil Landscape Group" (Chapman *et al*., 1989) which occurs on "level to gently undulating swales, depressions and infilled lagoons on Quaternary sands". The Warriewood landscape group contains soils described as "deep, well sorted, sandy humus podzols and dark, mottled siliceous sands, overlying acid peats in depressions, and deep podzols and pale siliceous sands on sandy rises". Soils within the Warriewood landscape are highly permeable and subject to localised flooding, waterlogging, and high water tables. Most of these areas mapped as "Warriewood Soil Landscape Group" on the subject site contains limited locally native vegetation, with the majority of native vegetation generally restricted to the southern and eastern boundaries.

A narrow band of the "Erina Soil Landscape" is mapped principally in the northern part of the Eastern Boundary (Chapman & Murphy 1989). This soil landscape occurs on "undulating to rolling rises and low hills on fine-grained sandstones and claystones of the Narrabeen Group. The Erina Group contains soils of moderately deep to deep yellow podzolic soild on sandstone crests and slopes; moderately deep red podzolic soils on shale crests and steeper slopes as well as yellow earths." Soils within the Erina Soil Landscape are impermeable and of a very high erodibility. This soil landscape shows some development of native vegetation to the east of the subject site.

4.1.2 Topography and Aspect

The site is located within the Warriewood Valley, with Narrabeen Creek passing through the northern and eastern extents. The site is characterised by a largely flat topography incised by the often steep banks of Narrabeen creek. The site has low relief, with an east to southerly aspect.

The water table is located close to the surface across most of the site and some areas, particularly in the west, are subject to waterlogging and periodic inundation. Surface runoff drains mainly into the eastern and western parts of the site, as well into artificial drainage channels constructed in various locations. The site drains into Narrabeen Creek.

4.1.3 Vegetation

The site contains a mixture of disturbed land currently used as a plant nursery, with associated structures such as a house/office, and storage and production/potting sheds. Internal roads, and levelled growing areas dominate the central parts of the site with the native plant community Swamp Sclerophyll Forest dominating the edges and northern parts of the site.

While much of the original vegetation of the site has been removed, there is still resilient native vegetation of various age classes. The native vegetation is dominated by *Casuarina glauca*, *Eucalyptus robusta* and *Melaleuca* spp. Localised infestations of common herbaceous and woody weeds are present in many parts of the site, including the areas mapped as native vegetation. Common weed species include *Cestrum parqui, Ligustrum lucidum, Lucidum sinense, Erythrina spp, Senna pendula* var. *glabrata, Tradescentia fluminensis* and *Lantana camara.*

4.1.4 Habitat Corridors

Portions of the site are mapped as being part of a wildlife corridor as per the Pittwater Council mapping, given the class C03 “Residential areas with some tree cover but requiring supplementary planting to aid fauna movements”. The site is nearby to Warriewood Wetlands which is mapped as a ‘major habitat area’.

Areas along the southern and western boundary of the site also show similar qualities of local native tree canopy intactness and show good connectivity to large areas of adjacent native vegetation such as the Warriewood Wastewater Treatment Plant. In the current study these western and southern parts of the subject site are identified as native vegetation (the threatened community Swamp Sclerophyll Forest), but are not listed as a wildlife corridor by Pittwater Council Mapping.

5 FLORA

5.1 Plant Species

A flora inventory for the site is provided in Appendix A that includes species and abundances. The methodology of a random meander within the study site included the subject site and the immediate surrounding contiguous vegetation. Characteristic species for the endangered ecological communities (EEC) Swamp Sclerophyll Forest (SSF) are also marked in this inventory.

A total of 44 plant species have been recorded on the site during the previous flora field surveys (TEC 2014), including 17 native species and 27 exotic species (Appendix A). Noxious weeds were noted on the site, and those listed under the *NSW Noxious Weeds Act 1993* for the Pittwater LGA are listed (Appendix A).

5.2 Vegetation Communities

Previous broad-scale mapping of the Sydney 1:100,000 map sheet (Benson & Howell, 1994) has identified the area immediately to the north of the study area as supporting Coastal Swamp Forest Complex. Mapping of the native vegetation of Pittwater has identified the subject site as supporting the ‘Lowland’ plant community Pittwater Council (2008).

In 2009, The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area, a vegetation community mapping project conducted by Department of Environment, Climate Change & Water (DECCW 2009a) was released. The SMCMA project has mapped and Coastal Flats Swamp Mahogany Forest occurring on the subject site. The remainder of the site is either unmapped, or considered to be weeds and exotic vegetation. Coastal Flats Swamp Mahogany Forest is considered a component of the EEC Swamp Sclerophyll Forest by DECCW (2009a).

In October 2013, The Native Vegetation of the Sydney Metropolitan Area version 2.0 (OEH 2013) was made available. This new version included mapping that revised and integrated local government data,

including the Pittwater LGA. For the study area, where DECCW (2009a) had previously mapped Coastal Flats Swamp Mahogany Forest (a component of the EEC Swamp Sclerophyll Forest), OEH (2013) had mapped the community Coastal Freshwater Swamp Forest, of which OEH (2013) offers inconsistent opinion as to whether it is an EEC or not. In the technical document it includes Coastal Freshwater Swamp Forest as a component of the EEC, though elsewhere it neglects to note it as such. This failure to note it as an EEC elsewhere is deemed by the current report to be an oversight. Thus is assumed to be a component of the EEC Swamp Sclerophyll Forest as described in the principal technical document. Bangalay/Eastcoast (2012) looks at the same methodology but considers, presumably erroneously, that Coastal Freshwater Swamp Forest is part of the EEC Sydney Freshwater Swamp Forest.

The current study considers the native vegetation on site to be a depauperate remnant of the EEC Swamp Sclerophyll Forest.

Three plant communities were identified within the study area during the current survey:

- Swamp Sclerophyll Forest;
- Exotic Riparian Forest; and
- Cleared and Disturbed.

The distribution of plant communities within the study site is shown in Figure 5 (Appendix B) and they are described below.

Swamp Sclerophyll Forest

Swamp Sclerophyll Forest is located over most of the boundaries of the subject site with the exception of the southern extent of the eastern boundary. It was also identified as isolated patches in the central north as well as in the south-west. The canopy of this native plant community is dominated by Swamp Oak *Casuarina glauca* along the western, northern and north-eastern parts of the subject site, and dominated by Swamp Mahogany *Eucalyptus robusta* and *Casuarina glauca* along the southern boundary. The canopy is commonly to a height of between 15 and 20 metres, with Foliage Projective Cover (FPC) of approximately 60–70%. Regrowth Swamp Oak dominates the mid canopy with the understorey to 5 metres dominated by woody weeds including Giant Reed *Arundo donax*, Lantana, Senna *Senna pendula* var. *glabrata,* Green Poisonberry *Cestrum parqui, Large Leaved Privet Ligustrum lucidum* and Small Leaved Privet *Ligustrum sinense* with native species such as *Melaleuca linariifolia*, *Melaleuca quinquinervia* and Cheese Tree *Glochidion ferdinandi* var. *ferdinandi* occurring occasionally; FPC is up to 80%. The groundcover stratum is sparse away from the lit edges. Weed species generally dominate and commonly include Wandering Jew *Tradescantia fluminensis*, Asthma Weed *Parietaria judaica* and *Rumex* sp.. Native species present in the groundcover stratum include *Hypolepis muelleri*, *Calochlaena dubia* and *Christella dentella*.

The Swamp Sclerophyll Forest also occupies the majority of the Narrabeen Creek banks that occur along the northern and eastern boundaries of the site. Additionally the diversion channel/backwater formed along the western edge supports Swamp Sclerophyll Forest.

Ecological condition and functioning of the Swamp Sclerophyll Forest of the subject site exhibits various degrees of intactness from moderate to low, dependent upon the species and ecological process involved. One of the two dominant tree species, *Casuarina glauca*, is exhibiting localised recruitment along the edges of many parts of the Swamp Sclerophyll Forest, through its ability to sucker, tolerate root and above ground plant disturbance, tolerate changes to soil physics and chemistry and exhibit strong allelopathy. These factors have resulted in persistence and even regrowth of this dominant species in some areas of the subject site, despite weed completion, clearing and soil changes. The other dominant native tree on the subject site is *Eucalyptus robusta* which displays reduced resilience, being restricted to areas of more stable soil profiles and reduced weed competition. Very few seedlings of this species were observed and most trees were large and mature.

Two isolated areas have been mapped as Swamp Sclerophyll Forest within the north and south-east of the site, away from the more extensive areas of Swamp Sclerophyll Forest on the edges of the subject

site. These areas are dense stands of *Casuarina glauca*, with plants possible suckers from previous disturbance or from abandoned nursery batches that have taken root, Elsewhere, outside of any areas mapped as Swamp Sclerophyll Forest, there is evidence of *Casuarina glauca* rooting through the drainage holes of plastic pots and establishing as immature plants.

This community contains characteristic species of Swamp Sclerophyll Floodplain Forest, and these species are highlighted in green in Table A, Appendix A

Exotic Riparian Forest

The southern part of the eastern border has been mapped as Exotic Riparian Forest, which is not considered to represent a remnant of any native vegetation community listed under either the TSC Act (1995) or EPBC Act (1999). The community is largely exotic with uncommon *Casuarina glauca* and *Melalueca quinquinervia* on the edges. Many of these appear to be planted. The dominant species include *Ficus macrophylla, Arundo donax, Ligustrum lucidum, Ligustrum sinense* and *Ipomoea indica*. Natural ecological functioning of the plant community is very limited.

Cleared and Disturbed

This area corresponds to the area largely associated with the production of nursery plants, including sheds and offices, cleared nursery growing areas and unsealed roads. Plant species include naturalised annual and perennial weeds. Some specimens of *Casuarina glauca* have naturalised from abandoned nursery stock but have not been mapped as Swamp Sclerophyll Forest.

5.3 Threatened Plant Species

No threatened plant species listed under the TSC Act or EBPC Act were recorded on the subject site during the previous investigations.

A search of the OEH Wildlife Atlas and EPBC database identified 26 threatened plant species occurring within 10 kilometres of the site (Table 1).

Table 1 Threatened flora species previously recorded within the locality (5km of the site) on the OEH and EPBC databases.

Scientific Name	TSC Act Status[1]	EPBC Act Status[2]
Acacia bynoeana	E	V
Acacia terminalis ssp *terminalis*	V	V
Asterolasia elegans	E1	E
Caladenia tessellata	E	V
Callistemon linearifolius	V	
Chamaesyce psammogeton	E1	
Cryptostylis hunterinana	V	V

[1] CE - critically endangered (Schedule 1A of the TSC Act); E1 – endangered (Schedule 1 of the TSC Act); V – vulnerable (Schedule 2 of the TSC Act).

[2] CE – critically endangered, E – endangered, V – vulnerable

Scientific Name	TSC Act Status[1]	EPBC Act Status[2]
Epacris purpurascens var. purpurascens	V	
Eucalyptus camfieldii	V	V
Eucalyptus nicholii	V	V
Genoplesium baueri	E1	E
Grammitis stenophylla	E1	
Haloragodendron lucasii	E	E
Kunzea rupestris	V	V
Melaleuca biconvexa	V	V
Melaleuca deanei	V	V
Grevillea caleyi	E4A	E
Microtis angusii	E1	E
Pelargonium sp. *striatellum*	E	E
Persoonia hirsuta	E1	E
Persoonia laxa	E4	X
Pimelea curviflora var. *curviflora*	V	V
Prostanthera marifolia	CE	CE
Syzygium paniculatum	E1	V
Thesium australe	V	V
Tetratheca glandulosa	V	V

5.4 Endangered Ecological Communities

The vegetation community Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions is recorded on the subject site by the previous survey and OEH (2013).

The endangered ecological communities Bangaly Sand Forest and Sydney Freshwater Wetlands are also mapped within the locality, with Swamp Oak Floodplain Forest mapped further to the south in areas with increased estuarine influences. Bangalay Sand Forest is previously mapped in the locality (DECCW 2009), and OEH (2013) although the nearest extent has since been extirpated.

6 FAUNA

6.1 Fauna Species

A total of 21 vertebrate fauna species were recorded during the field survey in October 2014, including nine bird species, and four amphibians. A list of species recorded during the surveys can be found in Appendix B.

The majority of species recorded on the site are generally typical of urban fringe or semi-rural areas within the Sydney Basin region and are widespread in distribution and common to abundant within their ranges.

Three species listed as Vulnerable under the *Threatened Species Conservation Act* 1995, Grey-headed Flying-fox *Pteropus poliocephalus,* Eastern Bentwing-bat *Miniopterus schreibersii oceanensis,* Little Bentwing-bat *Miniopterus australis* was observed during the survey.

6.2 Fauna Habitats

The main habitat types occurring within the study area are:

- Swamp Sclerophyll Forest;
- Exotic Riparian Forest; and
- Cleared and Disturbed

Swamp Sclerophyll Forest

The canopy and understorey vegetation of the Swamp Sclerophyll Forest provides shelter, nectar, blossom and seed for birds and arboreal mammals. The main habitats include an intact native canopy, shrubs and woody weed thickets in the understorey, as well as a somewhat sparse native/exotic groundcover stratum. Very few hollows were observed in the canopy suitable for roosting and nesting. Habitat features such as fallen branches, leaf litter, logs and rotting stumps are present and provide additional foraging and sheltering habitat for native ground dwelling mammals, invertebrates and reptiles. Lantana thickets smothered in exotic vine species along the margins are likely to provide good nesting and sheltering habitat for arboreal mammals such as Common Brushtail Possums *Trichosurus vulpecular* and small birds. This community onsite is unlike to support native ground-dwelling mammals such as Long-nosed Bandicoot *Perameles nasuta* and Brown Antechinus *Antechinus stuartii*. Large Forest Owls, such as Powerful Owl *Ninox strenua* and Barking Owl *Ninnox connivens* would also utilise this community as part of its wider foraging habitat in the locality,

Exotic Riparian Forest

The dense Lantana and Arundo within Exotic Riparian Forest provides suitable nesting and foraging habitat for small bird species such as the Superb Fairy Wren *Malurus cyaneus*; although this species was not observed onsite during the survey is it commonly seen throughout the locality. Small bird species are often lost in urban landscapes through loss of suitable midstorey and understorey habitat, and competition by larger, more territorial birds.

This community also contains suitable aquatic and semi-aquatic habitats that are likely to be used by water fowl and other birds, reptiles, amphibians and mammals for foraging, sheltering. Dusky Moorhen *Gallinula tenebrosa* and Australian Wood Duck *Chenonetta jubata*, have been observed utilising ponds in Warriewood Wetlands and these and other native fauna such as Eastern Snake-necked Turtle *Chelodina longicollis*, Longfinned Eel *Anguilla reinhardtii*, Common Eastern Froglet *Crinia signifera* and Green-tree Snake *Dendrelaphis punctulatus* potentially may use this habitat type of the subject site.

Cleared and Disturbed

The cleared and disturbed habitat is composed of open foraging areas between naturalised *Casuarina glauca*, exotic species, occasional buildings, sheds, and piles of building debris. It represents a highly modified landscape that lacks many of the natural habitat features and resources that are important in the maintenance of native fauna diversity and life cycles, including fully structured vegetation, a diverse shrub layer for food sources and protection, leaf litter and rocks and logs.

The cleared and disturbed habitat type favours ecological generalist species that are capable of utilising a wide range of habitats for foraging, as well as disturbance-tolerant species that are ubiquitous in modified urban and rural habitats throughout the region. An example of a generalist bird species that were recorded within this habitat is the Australian Magpie *Gynorhina tibicen*. Furthermore, common introduced and native mammal or reptile species such as Rabbit *Oryctolagus cuniculus*, and Bluetongue Lizard *Tiliqua scincoides* are likely to forage over the cleared parts of the site and throughout the locality in general.

Warriewood Wetlands

Whilst not occurring onsite, Warriewood Wetlands is a regionally significant vegetation community for local and international fauna species that is located less than 2km away from site. The wetlands are considered the largest remaining sandplain wetlands in Northern Sydney, at 26 hectares, (Pittwater Council 2004) and are utilised by several threatened species. Migratory birds from China and Japan have been known to visit the wetlands, and are protected under the China-Australia Migratory Bird Agreement (CAMBA) and Japan-Australia Migratory Bird Agreement (JAMBA). Warriewood wetlands are an important habitat for many bird and animal species, and the wetland and surrounding natural areas comprise an important wildlife corridor in the catchment. Over 80 bird species have been recorded including threatened bird species as well as several migratory birds protected under international migratory bird treaties (JAMBA, CAMBA), reptile, frog and mammal species (Pittwater Council 2004). It is possible that these protected species periodically utilise the subject site.

6.3 Threatened Fauna Species

Three threatened fauna species were recorded on the subject site during the investigation. Grey-headed Flying-foxes *Pteropus poliocephalus* was observed foraging on the edges of the subject site. Furthermore, analysis of ultrasonic bats calls have determined that Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* and Little Bentwing-bat *Miniopterus australis* occur on the subject site.

Eastern Bentwing-bat and Little Bentwing-bat are listed as Vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. Grey-headed Flying-foxes are listed as Vulnerable under both the *Threatened Species Conservation Act 1995* and Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.*

6.4 Endangered Populations

No endangered fauna populations listed under the TSC Act were recorded on the subject site in the current investigation.

Table 2 Threatened fauna species previously recorded within the locality (10km search) on the OEH and EPBC databases.

Scientific Name	Common Name	TSC Act Status[3]	EPBC Act Status[4]
Botaurus poiciloptilus	Australasian Bittern	E1	E
Ninox connivens	Barking Owl	V	
Rostratula australis	Australian Painted Snipe	E1	E
Ixobrychus flavicollis	Black Bittern	V	
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	
Burhinus grallarius	Bush Stone-curlew	E1	
Miniopterus schreibersii	Eastern Bentwing-bat	V	
Artamus cyanopterus	Dusky Woodswallow	V	
Mormopterus norfolkensis	Eastern Freetail-bat	V	
Cercartetus nanus	Eastern Pygmy-possum	V	
Pandion cristatus	Eastern Osprey	V	
Callocephalon fimbriatum	Gang-gang Cockatoo	V	
Heleioporus australiacus	Giant Burrowing Frog	V	V
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	
Scoteanax rueppellii	Greater Broad-nosed Bat	V	
Litoria aurea	Green and Golden Bell Frog	E1	V
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Phascolarctos cinereus	Koala population	E2	V
Phascolarctos cinereus	Koala	V	V
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Tyto novaehollandiae	Masked Owl	V	
Pseudomys novaehollandiae	New Holland Mouse	P	V
Myotis macropus	Southern Myotis	V	
Miniopterus australis	Little Bentwing Bat	V	
Hieraaetus morphnoides	Little Eagle	V	
Glossopsitta pusilla	Little Lorikeet	V	
Pandion haliaetus	Osprey	V	M
Ninox strenua	Powerful Owl	V	
Pseudophryne australis	Red-crowned Toadlet	V	
Xanthomyza phrygia	Regent Honeyeater	E4A	CE
Varanus rosenbergi	Rosenberg's Goanna	V	
Haematopus fuliginosus	Sooty Oystercatcher	V	
Isoodon obesulus obesulus	Southern Brown Bandicoot	E1	E
Dasyurus maculatus	Spotted-tailed Quoll	V	E
Lophoictinia isura	Square-tailed Kite	V	
Ptilinopus superbus	Superb Fruit-Dove	V	
Lathamus discolour	Swift Parrot	E1	CE
Petaurus norfolcensis	Squirrel Glider	V	
Petaurus norfolcensis	Squirrel Glider on Barrenjoey	E2	
Neophema pulchella	Turquoise Parrot	V	
Daphoenositta chrysoptera	Varied Sittella	V	

[3] CE critically endangered (Schedule 1A of the TSC Act); E1 & E2 – endangered (Schedule 1 of the TSC Act); V – vulnerable (Schedule 2 of the TSC Act).

[4] CE - critically endangered, E – endangered, V – vulnerable, M - Migratory, X - Extinct

7 HABITAT POTENTIAL FOR THREATENED SPECIES

7.1 Flora

Table 3 summarises the habitat potential of the subject site for the threatened flora species previously recorded as occurring within 10 km search on the OEH Wildlife Atlas and Department of Environment's Protected Matters Search Tool.

Table 3 Habitat potential for threatened flora species previously recorded within the locality (10km of the site) on the OEH Wildlife Atlas and Department of Environment's Protected Matters Search Tool

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Acacia bynoeana	Bynoe's wattle is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at most locations being very small (1-5 plants). It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Prefers open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	Nil to low. The subject site does not support the preferred habitat.
Acacia terminalis ssp *terminalis*	Very limited distribution, mainly in near-coastal areas from the northern shores of Sydney Harbour south to Botany Bay, with most records from the Port Jackson area and the eastern suburbs of Sydney. Recent collections have mainly been made from the Quarantine Station, Clifton Gardens, Dover Heights, Parsely Bay, Nielson Park, Cooper Park, Chifley and Watsons Bays. Occurs in coastal scrub and dry sclerophyll woodland on sandy soils. Habitat is generally sparse and scattered. Most areas of habitat or potential habitat are small and isolated. Most sites are highly modified or disturbed due to surrounding urban development. This species flowers in autumn. Small birds and bees are natural pollinators. Seeds mature in November and are dispersed by ants. Seed viability is high and recruitment occurs mainly after fire. A fire temperature of 60 degrees is required for optimum germination. Although plants are killed by fire, they have been recorded sprouting from the base	Nil to low. Know populations have very limited distribution and the species was not identified on site

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Asterolasia elegans	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone. Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine (*Syncarpia glomulifera subsp. glomulifera*), Smooth-barked Apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*), Forest Oak (*Allocasuarina torulosa*) and Christmas Bush (*Ceratopetalum gummiferum*). Ecological knowledge about this species is very limited.	Nil to low. Subject site soil type not consistent with soil type or vegetation type of preferred habitat.
Calistemon linearifolius	Netted Bottle Brush 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. *C. linearifolius* grows in dry sclerophyll forest on the coast and adjacent ranges and flowers during spring-summer.	Nil to low. Subject site soil type not consistent with soil type of preferred habitat.
Caladenia tessellata	The Tessellated Spider Orchid is known in Wyong, Ulladulla and Braidwood in NSW. There are no recent records of the species occurring in the Sydney region. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The single leaf regrows each year. Flowers appear between September and November (but apparently generally late September or early October in extant southern populations).	Nil to low. This species is highly restricted in its range with a few fragmented populations, none of which are in close proximity to the subject site.
Chamaesyce psammogeton	Sand Spurge is a herb that forms mats to 1 m across and is found sparsely along the coast from south of Jervis Bay (at Currarong, Culburra and Seven Mile Beach National Park) to Queensland (and Lord Howe Island). Grows on fore-dunes and exposed headlands, often with Spinifex.	Low. Subject site habitat is not foredune or exposed headland.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Cryptostylis hunterinana	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Also recorded at Nelson Bay, Wyee, Washpool National Park, Nowendoc State Forest, Ku-Ring-Gai Chase National Park and Ben Boyd National Park. Known from a range of communities, including swamp-heath and woodland. Often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*). The Leafless Tongue-orchid has been reported to occur in a wide variety of habitats including heathlands, heathy woodlands, sedgelands, *Xanthorrheoa* spp. plains, dry sclerophyll forests (shrub/grass sub-formation and shrubby sub-formation), forested wetlands, freshwater wetlands, grasslands, grassy woodlands, rainforests and wet sclerophyll forests (grassy sub-formation. Soils are generally considered to be moist and sandy, however, this species is also known to grow in dry or peaty soils. Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (E. *sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community. Little is known about the ecology or habitat preferences of the species.	Low Marginal suitable habitat on site. Species is cryptic and has a wide habitat range. No local recent records in similar habitat within the locality.
Epacris purpurascens var. *purpurascens*	An erect shrub, 50 - 180 cm high with white or sometimes pinkish flowers. Recorded from Gosford in the north, to Narrabeen in the east and other districts. Found in a range of habitat types, most of which have a strong shale soil influence.	Nil to low. Subject site soil type not consistent with soil type of preferred habitat.
Eucalyptus camfieldii	Mostly a mallee to 4 m tall though can grow to a straggly tree to 9 m high. Bark is rough, fibrous and stringy, red or dark grey-brown and flowers creamy-white. Distribution restricted to a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park. Occurs in coastal areas in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas.	Low. Subject site soil type not consistent with soil type of preferred habitat.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Eucalyptus nicholii	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, largely on private property. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Nil - Low. The subject site is outside the known range of this species.
Genoplesium baueri	A terrestrial orchid with yellowish-green or reddish inflorescence 6-15 cm high, recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. Grows in sparse sclerophyll forest and moss gardens over sandstone.	Nil to low. Subject site soil type not consistent with soil type or vegetation type of preferred habitat.
Grevillea caleyi	A medium to tall shrub, with long spreading branches, growing to a height of up to 4 m. Restricted to an 8km square area around Terry Hills. All natural remnant sites occur within a habitat that is both characteristic and consistent between sites. All sites occur on the ridgetop between elevations of 170 to 240m asl, in association with laterite soils and a vegetation community of open forest, generally dominated by *Eucalyptus sieberi* and *Corymbia. Gummifera* and commonly found in the endangered Duffys Forest ecological community.	Nil to low. Subject site soil type not consistent with soil type or topography of preferred habitat.
Grammitis stenophylla	Narrow Leaf Finger Fern grows lithophytically in rainforest and wet schlerophyll forest and has a wide distribution in eastern NSW. It prefers moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest.	Nil to low. Subject site not consistent with preferred habitat.
Haloragodendron lucasii	The known locations of this species are confined to a very narrow distribution on the north shore of Sydney. It is associated with dry sclerophyll forest and with high soil moisture and relatively high soil-phosphorus levels. This species is reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland. It is highly clonal, which implies the true population size may be considerably smaller than expected. Flowering occurs from August to November with fruits appearing from October to December. Has demonstrated an ability to resprout from its rootstock.	Low. Appropriate vegetation communities are not found on the subject site

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Kunzea rupestris	The species distribution is restricted, with most locations in the Maroota - Sackville - Glenorie area and one outlier in Ku-ring-gai Chase National Park, all within the Central Coast botanical subdivision of NSW. Currently known to exist in 20 populations, 6 of which are reserved. It grows in shallow depressions on large flat sandstone rock outcrops and is characteristically found in short to tall shrubland or heathland. Flowering occurs in spring. It has indehiscent fruits which resist soil entrapment and so may disperse many metres per week. Resprouts from the base after fire or mechanical damage. Seedlings have also been observed after fire.	Nil to low. The subject site does not contain the appropriate vegetation community and is not located close to the restricted known populations of this species.
Melaleuca biconvexa	This species is only found in NSW, with scattered and dispersed populations in Jervis Bay area and the Gosford-Wyong area in the north. Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Resprouts following fire. This species flowers in September and October.	Low. the subject site is not close to any known occurrences of this species
Melaleuca deanei	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. *Melaleuca deanei* mostly occupies broad flat ridgetops, dry ridges and slopes. Melaleuca deanei is strongly associated with sandy loam soils that are low in nutrients, sometimes with ironstone present (Benson & McDougall 1998). Or on deep and well developed lateritic soils. M. deanei occurs in a wide range of vegetation communities, but is most often found in Coastal Sandstone Ridgetop Woodland (Tindall et al. 2004). The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone. Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate.	Low. The subject site does not support the correct known habitat of this species.
Microtis angusii	A terrestrial "onion orchid" grows to 25 to 60 cm tall with green, linear cylindrical and tapering leaves. Currently only known from one site at Ingleside in the north of Sydney with habitat preference poorly defined due to the disturbed nature (modified soils and degree of weed infestation) of the only know site of occurrence.	Unkown. Little is known about the species preferred habitat. The conditions onsite are similar to those of the known occurrence in Ingleside.
Pelargonium sp. *striatellum*	It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, which the subject site does not support.	Nil. The subject site is outside the known range of this species.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Persoonia hirsuta	The Hairy Geebung is best distinguished by its hairiness - long coarse hairs on flowers and branchlets and short stiff ones on the leaves. The Hairy Geebung has been recorded in the Sydney coastal area (subsp. hirsuta - Gosford to Berowra to Manly to Royal National Park), the Blue Mountains area (subsp. evoluta - Springwood, Lithgow, Putty) and the Southern Highlands (subsp. evoluta - Balmoral, Buxton, Yanderra and Hill Top areas). The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations. It is probably killed by fire (as other Persoonia species are) but will regenerate from seed.	Low - Medium. Subject site supports preferred soils for this species however most native vegetation has been highly modified and was not recorded on site.
Pimelea curviflora var. *curviflora*	A much-branched shrub 20 to 120cm high with hairy stems and flowers are red to yellow. Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes in woodlands amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing.	Nil to low. Subject site soil type not consistent with soil type, vegetation type or topography of preferred habitat.
Prostanthera marifolia	Prostanthera marifolia is currently only known from the northern Sydney suburb near Seaforth and has a very highly restricted distribution within the Sydney Basin Bioregion. The total number of populations may be as few as one and fragmented by urbanisation into as few as three small sites. Occurs in localised patches in or in close proximity to the endangered Duffys Forest ecological community. Some plants are located on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses, a soil type which only occurs on ridge tops and has been extensively urbanised.	Nil to low. The subject site does not contain suitable habitat for this species.
Syzygium paniculatum	The Magenta Lilly Pilly is a small to medium sized rainforest tree that grows to 8 m tall. The bark is flaky and the leaves are shiny, dark-green above and paler underneath. Plants produce white flower-clusters at the end of each branch fruits develop to a deep magenta and may be spherical or egg-shaped. The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Bulahdelah south to Conjola State Forest. Occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low to medium. Subject site provides suitable soil and habitat nearby.
Thesium australe	*Thesium australe* is a root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass, which is not present on the site. It occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast.	Nil to low. The subject site does not contain suitable habitat for this species.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Tetratheca glandulosa	A small spreading shrub which grows 20 - 50cm in height. Stems often become entwined among other small shrubs, sedges and grasses. Flowers are pink with the flower stalk and sepals covered with dark-red gland-tipped hairs, which distinguishes T. glandulosa from other Tetratheca species. Restricted to the Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah and Wyong LGA's the eastern limit is at Ingleside and the western limit is at East Kurrajong. Occurs in shale-sandstone transition habitat where shale-cappings occur over sandstone, and the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam. Stony lateritic fragments are also common in the soil profile on many of these ridgetops. Vegetation structure varies from heaths and scrub to woodlands/open woodlands, and open forest. Vegetation communities correspond broadly to Sydney Sandstone Ridgetop Woodland.	Nil to low. Subject site soil type not consistent with soil type or vegetation type of preferred habitat.

7.2 Fauna

Table 4 summarises the habitat potential of the subject site for the threatened fauna species previously recorded as occurring within 10 km search the OEH Wildlife Atlas.

Table 4 Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the OEH Wildlife Atlas.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Artamus cyanopterus cyanopterus	The Dusky Woodswallow is widespread in eastern, southern and southwestern Australia. In New South Wales it is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. It is sparsely scattered in, or largely absent from, much of the Upper Western region. The Dusky Woodswallow is often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. At sites where Dusky Woodswallows are recorded the understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, including heath. The ground cover may consist of grasses, sedges or open ground, often with coarse woody debris. Birds are also often observed in farm land, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber.	Low. Minimal suitable foraging or sheltering habitat on site or in Warriewood Wetlands.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Botaurus poiciloptilus	The Australasian Bittern occurs from southern Queensland through south-eastern Australia to Tasmania and is recorded in south western, Western Australia. In NSW the species has been observed along the east coast and in wetlands of the Murrumbidgee and Lachlan Rivers and the Murray Darling Basin. Generally sedentary, inhabiting terrestrial and estuarine wetlands with permanent water, preferring dense fringing emergent vegetation of sedges and reeds. Nests are created from trampled reeds and rushes over shallow water with a clutch consisting of 4 – 5 eggs. Feeds at dusk foraging over shallow water for frogs, fish, invertebrates and vegetation or fruit (NPWS 1999).	Low. Suitable foraging and nesting habitat nearby in Warriewood Wetlands.
Burhinus grallarius	Bush Stone-curlews are found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Bush Stone-curlews inhabit open forests and woodlands with a sparse grassy groundlayer and fallen timber feeding on insects and small vertebrates such as frogs, lizards, and snakes. They are largely nocturnal and are especially active on moonlit nights.	Low. Nil to minimal suitable foraging and nesting habitat on site or nearby in Warriewood Wetlands.
Callocephalon fimbriatum	The Gang Gang Cockatoo is a relatively small, dark grey cockatoo. Feathers are distinctively squarish on the ends. Males have a bright red head and crest. Females have a grey head and crest and the females breast feathers are reddish – pink. The species is listed as Vulnerable in NSW and the population found in the Ku-ring-gai and Hornsby LGA's is listed as Endangered. This population is believed to be largely confined to an area bounded by Thornleigh and Wahroonga in the north, Epping and North Epping in the south, Beecroft and Cheltenham in the west and Turramurra/South Turramurra to the east. It is known to inhabit areas of Lane Cove National Park, Pennant Hills Park and other forested gullies in the area. It occurs within a variety of forest and woodland types and usually frequents forested areas with old growth attributes required for nesting and roosting purposes. Also utilises less heavily timbered woodlands and urban fringe areas to forage, but appears to favour well timbered country through which it habitually flies as it moves about. Individuals of this population are likely to move outside the 'defined' population boundary in the general area and should still be considered of this population.	Low. Minimal suitable foraging and nesting habitat on site or nearby in Warriewood Wetlands.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Calyptorhynchus lathami	The Glossy Black-cockatoo is a dusky brown to black cockatoo with a massive, bulbous bill and a broad, red band through the tail and are usually seen in pairs or small groups feeding in she-oaks. The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW. Inhabits open forest and woodlands of the coast and the Great Dividing Range. Feeds almost exclusively on the seeds of several species of she-oak particularly Black She-oak, Forest She-oak and Drooping She-oak. Is dependent on large hollow-bearing eucalypts for nest sites.	Medium. Suitable foraging habitat on site and nearby in Warriewood Wetlands. Minimal nesting habitat.
Cercartetus nanus	Adult Eastern Pygmy-possums have a head and body length of between 70 - 110 mm and are active climbers with prehensile tails. The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pillaga and to Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes and insects. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation, (eg. grass-tree skirts) and are generally nocturnal.	Low. Minimal suitable foraging and nesting habitat on site or nearby in Warriewood Wetlands.
Daphoenositta chrysoptera	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. This bird builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years. Generation length is estimated to be 5 years.	Low to medium. Some suitable foraging and sheltering habitat on site or in Warriewood Wetlands.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Dasyurus maculatus	The Spotted-tailed Quoll is about the size of a domestic cat with rust to dark-brown fur above, with irregular white spots on the back and tail, and a pale belly. The range has contracted and is now found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Mostly nocturnal, it spends most of the time on the ground, but may also climb to raid possum and glider dens and prey on roosting birds. Prey includes gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects and also eats carrion and takes domestic fowl. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares and usually traverse their ranges along densely vegetated creek lines.	Low. Minimal suitable foraging and potential den site habitat on subject site or nearby in Warriewood Wetlands.
Glossopsitta pusilla	The Little Lorikeet is the smallest of the Australian Lorikeets. The species is distributed from Cairns in QLD to Adelaide in SA. In New South Wales Little Lorikeets are occur in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending west to Albury, Parkes, Dubbo and Narrabri. The species predominately forages for nectar and pollen in the tree canopy as well as melaleucas and mistletoes.	Low. Minimal suitable foraging habitat on subject site or nearby in Warriewood Wetlands.
Haematopus fuliginosus	The Sooty Oystercatcher is a large wader, reaching 50 cm in length with a bright orange-red bill, eye-ring and iris, and coral pink legs and feet and entirely black plumage. Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small numbers of the species are evenly distributed along the NSW coast. The availability of suitable nesting sites may limit populations. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels. Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories. The nest is a shallow scrape on the ground, or small mounds of pebbles, shells or seaweed when nesting among rocks.	Low. Nil to minimal suitable foraging and nesting habitat on site or nearby in Warriewood Wetlands.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Heleioporus australiacus	The Giant Burrowing Frog is a large, slow-moving frog that grows to about 10 cm long. It occurs from the NSW Central Coast to eastern Victoria, but is most common on the Sydney sandstone geology from the coast to the Great Dividing Range. Found in heath, woodland and open forest with sandy soils the species generally lives in heath or forest and will travel several hundred metres to creeks to breed. Burrows into deep litter or loose soil, emerging to feed or breed after rain. Diet includes ground-dwelling invertebrates such as ants, beetles and spiders.	Low. Minimal suitable vegetation or soil type on site. However marginal habitat provided in Warriewood Wetlands, and species previously recorded nearby.
Hieraaetus morphnoides	The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment.	Low. Minimal suitable foraging or sheltering habitat on site or in Warriewood Wetlands.
Isoodon obesulus obesulus	Southern Brown Bandicoots have a relatively short nose and ears, dark grey or yellowish brown fur on its upper body, tail and feet and a creamy white belly. The species has a patchy distribution. It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, to coastal Victoria, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. Southern Brown Bandicoots are largely crepuscular and are generally only found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogenous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil. Nesting during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees Xanthorrhoea sp. and other shrubs, or in rabbit burrows. The upper surface of the nest may be mixed with earth to waterproof the inside of the nest.	Low to medium. Subject site supports some potential foraging or nesting habitat on site and in Warriewood Wetlands.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Ixobrychus flavicollis	The Black Bittern is a species of heron, dark grey to black in colour, with buff streaks on the throat and a characteristic yellow streak on the sides of the head and down the neck. The Black Bittern has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region and in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, roosts in trees or on the ground amongst dense reeds. Nests, built in spring are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks.	Medium. Some suitable foraging and nesting within riparian zones on site and nearby in Warriewood Wetlands.
Lathamus discolor	Migrating from breeding grounds in Tasmania to the Australian mainland in winter Swift Parrot ranges from south-eastern South Australia across inland and coastal areas to southeast Queensland. The preferred habitat on mainland Australia is woodlands and riparian vegetation where there are winter flowering eucalypts such as the Swamp Mahogany, *Eucalyptus robusta* in coastal areas (NPWS 2002a). Breeding in Tasmania between September and February sometimes in small colonies the nest is an unlined tree hollow with three to five eggs laid. The species feeds mainly on nectar but also pollen and insects (NPWS 2003).	Medium. Suitable foraging habitat, including preferred tree species on site and nearby in Warriewood Wetlands.
Litoria aurea	The Green and Golden Bell Frog inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). The optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas. The species is active by day and usually breeds in summer when conditions are warm and wet.	Medium. Suitable habitat on site nearby in Warriewood Wetlands, Only 2 sightings recorded within the locality.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Lophoictinia isura	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. The Square-tailed Kite is found in a variety of timbered habitats including dry woodlands and open forests, with a particular preference for timbered watercourses. It has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland in arid north-western NSW. A specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage.	Low to medium. Suitable foraging habitat and preys on site or in Warriewood Wetlands.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies) is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond and Clarence River areas. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions, though it is very rare in the latter. The species occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (E. *albens*), Inland Grey Box (E. *microcarpa*), Yellow Box (E. *melliodora*) and Forest Red Gum (E. *tereticornis*) as well as open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.A gregarious species usually seen in pairs and small groups of up to 12 birds. Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares.	Low. Minimal suitable foraging or sheltering habitat on site or in Warriewood Wetlands.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Miniopterus australis	Little Bentwing-bats occur through the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. They prefer moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, *Melaleuca* swamps, dense coastal forests and banksia scrub, and are generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Species was recorded during nocturnal surveying.
Miniopterus schreibersii oceanensis	The Eastern Bent-wing Bat has chocolate to reddish-brown fur on its back and slightly lighter coloured fur on its belly. The species occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat but also use man-made structures. Form discrete populations centered on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes and cold caves are used for hibernation in southern Australia. At other times of the year, populations disperse within about 300 km range of maternity caves. Forage in forested areas, catching moths and other flying insects above the tree tops.	Species was recorded during nocturnal surveying.
Mormopterus norfolkensis	The Eastern Freetail-bat has dark brown to reddish brown fur on the back and is slightly paler below and is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range and roost mainly in tree hollows but will also roost under bark or in man-made structures. Solitary and probably insectivorous.	Medium. Potential foraging and roosting habitat on site and in Warriewood Wetlands.
Myotis macropus (formally *Myotis adversus*)	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December.	Low to medium. Potential foraging and roosting habitat on site and in Warriewood Wetlands.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Neophema pulchella	Turquoise Parrots are a highly distinctive bird with bright green upperparts and a turquoise-blue crown and face. Its shoulders are turquoise-blue, grading to deep blue at the flight-feathers. It has a chestnut-red patch on the upper-wing. Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. It lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter.	Low to medium. Potential foraging and roosting habitat on site and in Warriewood Wetlands.
Ninox connivens	The Barking Owl is a typical hawk-owl with no facial-disc and males may be up to 45 cm. The Barking Owl is found throughout Australia except for the central arid regions and Tasmania. It is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution across NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains. It is rarely recorded in the far west or in coastal and escarpment forests. Inhabits eucalypt woodland, open forest, swamp woodlands and timber along watercourses. Denser vegetation is used occasionally for roosting. Roost during the day they roost along creek lines, usually in tall understorey trees with dense foliage. Feeds on a variety of prey including insects, birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. Territories range from 30 to 200 hectares and birds are present all year. Nests are made in hollows of large, old eucalypts.	Medium. Potential foraging and roosting habitat on site and over Warriewood Wetlands. Some prey species recorded in survey.
Ninox strenua	The Powerful Owl is the largest owl in Australasia. It is a typical hawk-owl with no facial-disc. Adults reach 60 cm in length. The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands. Now uncommon throughout its range where it occurs at low densities. Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest and requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally in open habitats. It roosts by day in dense. Preys on medium-sized arboreal mammals particularly the Greater Glider, Common Ringtail Possum, Sugar Glider and flying foxes. Have high fidelity to a small number of hollow-bearing nest trees.	High. Species occupies a large home range, potential foraging and roosting habitat on site and over Warriewood Wetlands. Some prey species recorded in survey. Species located on-site roosting.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Pandion cristatus and haliaetus	The Osprey has a global distribution with four subspecies previously recognised throughout its range. However, recent studies have identified that there are two species of Osprey - the Western Osprey (*P. halietus*) with three susbpecies occurring in Europe, Asia and the Americas and the Eastern Osprey (*P. cristatus*) occurring between Sulawesi (in Indonesia), Australia and New Caledonia. Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	Low. Minimal suitable foraging or nesting habitat on site or in Warriewood Wetlands.
Petaurus norfolcensis	Adult Squirrel Gliders have a head and body length of about 20 cm. They have blue-grey to brown-grey fur above, white on the belly and the end third of the tail is black. Squirrel Gliders inhabit mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. They require abundant tree hollows for refuge and nest sites, as well as prefer a mix species stands with Acacia or shub understorey.	Low. Minimal suitable foraging or nesting habitat on site or in Warriewood Wetlands.
Phascolarctos cinereus	The Koala is an arboreal marsupial with fur ranging from grey to brown above, and is white below. The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the western region and in sparse and possibly disjunct populations along the south coast. Inhabit eucalypt woodlands and forests and feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Spend most of their time in trees, but will descend and traverse open ground to move between trees.	Nil to low. Although previously recorded nearby to the subject site.
Pseudomys novaehollandiae	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range, the total population size of mature individuals estimated to be less than 10,000 individuals (Menkhorst et al., 2008). The species is known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes (Lazenby et al., 2008). The species peaks in abundance during early to mid stages of vegetation succession typically induced by fire (Fox and Mckay, 1981). It is a social animal, living predominantly in burrows shared with other individuals.	Low. Minimal suitable vegetation or other habitat on site or in Warriewood Wetlands.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Pseudophryne australis	The Red-crowned Toadlet is an unmistakable small frog, usually measuring less than 30 mm long with distinctive reddish-orange patches, one between the eyes and one along the rump. The species has a restricted distribution and it is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones inhabiting periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Disperses outside the breeding period, when they are found under rocks and logs on sandstone ridges and forage amongst leaf-litter.	Low. Minimal suitable vegetation or other habitat on site or in Warriewood Wetlands.
Pteropus poliocephalus	The Grey-headed Flying-fox is the largest Australian bat. Grey-headed Flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Travel up to 50 km to forage and feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksias, and fruits of rainforest trees and vines.	Species was observed during nocturnal surveying.
Ptilinopus superbus	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. There are records of vagrants as far south as eastern Victoria and Tasmania. 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. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. The nest is a structure of fine interlocked forked twigs, giving a stronger structure than its flimsy appearance would suggest, and is usually 5-30 metres up in rainforest and rainforest edge tree and shrub species.	Low. Minimal suitable vegetation or other habitat on site or in Warriewood Wetlands.

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Scoteanax rueppellii	The Greater Broad-nosed Bat is a large powerful micro bat. The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. The species usually roosts in tree hollows, but it has also been found in buildings. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Females congregate at maternity sites located in suitable trees.	Medium. Potential foraging habitat on site and over Warriewood Wetlands. Medium roosting habitat potential and low maternity camp habitat.
Tyto novaehollandiae	The Masked Owl occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. There is no seasonal variation in its distribution. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (*Pseudocheirus peregrinus*) or Sugar Glider (*Petaurus breviceps*). Nests in very large tree-hollows.	Medium. Potential foraging and roosting habitat on site and over Warriewood Wetlands. .
Varanus rosenbergi	Rosenberg's Goanna reaches up to 1.5 metres in length. Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south and also occurs in South Australia and Western Australia. Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component and individuals require large areas of habitat. Feeds on carrion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens. Lays up to 14 eggs in a termite mound; the hatchlings dig themselves out of the mounds.	Nil to low. Minimal suitable foraging, sheltering or nesting habitat on site or in Warriewood Wetlands

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Xanthomyza phrygia	The Regent Honeyeater is a medium-sized, black and yellow honeyeater with a curved bill and mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. Its range has contracted to between north-eastern Victoria and south-eastern Queensland and in NSW the distribution is very patchy and mainly confined to the two main breeding areas although in some years non-breeding flocks converge on flowering coastal woodlands and forests. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak with large numbers of mature trees, high canopy cover and abundance of mistletoes. Non-breeding flocks are known to forage in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast. The species is a generalist forager and mainly feeds on the nectar from a wide range of eucalypts and mistletoes.	Low to medium. Potential foraging habitat and preferred feed trees on site and in Warriewood Wetlands.

8 LEGISLATION

8.1 *Environment Protection and Biodiversity Conservation Act* 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) would only become relevant if it was considered that an impact on a 'matter of National Environmental Significance (NES)' were likely, thus providing a trigger for referral of the proposal to the Department of Environment and Heritage.

Matters of national environmental significance identified in the Act are:

- world heritage properties;
- national heritage places;
- Ramsar wetlands;
- nationally threatened species and communities;
- migratory species protected under international agreements;
- the Commonwealth marine environment; and
- nuclear actions.

The Commonwealth Government has published *Administrative Guidelines* (Environment Australia 2000) to assist in the determination of whether an action is likely to have a significant impact on a matter of NES.

One nationally threatened species, Grey headed Flying Fox, was observed in the study area. No other nationally threatened populations or ecological communities were noted. The matters of NES of potential relevance to the site include several “threatened species” and “migratory species” that have been recorded within 5 kilometres of the study area. These species include:

- Swift Parrot, Spotted-tailed Quoll, Broad-headed Snake, Giant Burrowing frog, Regent Honeyeater, Southern Brown bandicoot, Australian Painted Snipe and Swift Parrot.

Several significant migratory species are also identified within this area include:

- Lesser Sand Plover, Flesh-footed Shearwater, Osprey and Regent Honeyeater. These species are nomadic to migratory and whilst individuals of these species could occur on or over the site on occasion, they are not likely to nest on the site or permanently inhabit the site, owing to a lack of suitable quality nesting sites and their nomadic habit.

The consideration of the proposed activities on the threatened species identified within the 5km of the subject site is detailed within the fauna habitat table and the *Test of Significance* (Appendix D). A list of key threatening processes relevant to the subject site is as follows;

- Land clearance;
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants;
- Predation by European red fox; and
- Predation by feral cats.

8.2 *Environmental Planning and Assessment Act* 1979 (EP&A Act) and *Threatened Species Conservation Act* 1995 (TSC Act)

Any proposal for the site should be assessed in accordance with the *Environmental Planning and Assessment Act 1979* and the *Environmental Planning and Assessment Regulation 2000*. The Act institutes a system for environmental planning and assessment, including approvals and environmental

impact assessment. The site is located within the Pittwater local government area and the relevant local government control is the Pittwater Local Environmental Plan 2014.

The *Threatened Species Conservation Act 1995* provides for the protection of all threatened plants and animals native to NSW and their habitats (including endangered populations and ecological communities, and their habitats). The TSC Act provides for the listing of species, populations and ecological communities considered to be threatened in NSW. Schedule 1 of the TSC Act contains listings of endangered species, populations and ecological communities, and Schedule 2 of the TSC Act contains listings of vulnerable species.

Section 5A (s.5A) of the *Environmental Planning & Assessment Act 1979* (the so called '7-part test') lists seven factors that "must be taken into account" by a determining authority in the administration of Sections 79C of the Act when considering a development. The aim of s.5A is to determine "whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats", as listed under Schedules 1 and 2 of the TSC Act, and hence whether a *Species Impact Statement* (SIS) is required for the action. As three species and one EEC listed under the TSC Act, the Swamp Sclerophyll Forest, s.5A assessments have been completed for the current proposal and are attached in Appendix C. One of the species were also listed as nationally threatened species under the *Environmental Protection and Biodiversity Conservation Act*.

A list of key threatening processes under the TSC Act relevant to the subject site;

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- Clearing of native vegetation;
- Competition from feral honey bees (*Apis mellifera*);
- Invasion and establishment of exotic vines and scramblers;
- Invasion and establishment and spread of *Lantana camara;*
- Loss of hollow-bearing trees;
- Predation by the European red fox (*Vulpes vulpes*) & feral cat (*Felis catus*);
- Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*); and
- Removal of dead wood and dead trees.

8.3 Water Management Act 2000

The former *River and Foreshore Improvements Act* 1948 has been repealed and replaced by the *Water Management Act* 2000 (The WMA) in NSW. The WMA aims to provide for sustainable and integrated management of water sources within NSW for the benefit of present and future generations.

As part of the development, construction works will be carried out within 40m of the top of the bank of Narrabeen Creek. To carry out works in, on or under waterfront land a 'controlled activity' approval is required from the NSW Office of Water under Part 3 Section 91 of the WMA. The definition for a 'controlled activity' includes the "erection of a building or the carrying out of work" in, on or under waterfront land.

8.4 SEPP 19 – Bushland in Urban Areas

State Environmental Planning Policy No.19 - Bushland in Urban Areas (SEPP 19) aims to, amongst other things, "protect and preserve bushland" within the urban areas of Sydney (Department of Planning 1986). The policy applies where natural vegetation remains or vegetation representative of the structure and floristics of natural vegetation exists.

As the proposed development within the subject site does not adjoin bushland zoned or reserved for public open space purposes, the clearing of vegetation does not need to consider the objectives of SEPP 19.

8.5 SEPP 44 – Koala Habitat Protection

State Environmental Planning Policy No.44 - Koala Habitat Protection (SEPP 44) aims to protect the Koala and its habitat by incorporating prescriptions for consent authorities to consider during the assessment of development applications. SEPP 44 contains prescriptions for the consideration of "potential koala habitat" and "core koala habitat" for developments within Local Government Areas listed on Schedule 1 of the Policy. Pittwater LGA is listed on Schedule 1 as an area to which SEPP 44 applies.

"Potential koala habitat" is defined by SEPP 44 as "areas of native vegetation where the trees of types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component". Two tree species listed under Schedule 2 of the Policy as Koala "feed tree species", Swamp Mahogany *Eucalyptus robusta*, and Tallowwood *Eucalyptus microcorys* were recorded on the subject site during previous field surveys. These species occurred very rarely (one *Eucalyptus microcorys*) to occasionally (nine *Eucalyptus robusta*) on the site, out of a total 80 trees mapped in the Arboricultural Assessment Report (TALC 2014). As such, 12.5% of trees in the upper or lower strata are listed as koalas feed trees. As such, the total number of trees in the canopy stratum of the subject site are "feed tree species" and hence the site does not contain "potential koala habitat", as defined under SEPP 44.

In further consideration of the SEPP 44, "Core koala habitat" is defined as areas of land that contain "a resident population of koalas, evidenced by attributes such as breeding females and recent sightings of and historical records of a population". There is no evidence (such as sightings, calls, scats and fur) that the study area supports a resident population of the Koala and there is no evidence in general of koala activity. Hence, the site does not constitute "core koala habitat", within the meaning of SEPP 44.

On this basis, the provisions of Clause 9 of SEPP 44 do not apply to the proposed activity. A *Koala Plan of Management* is not required to be prepared as part of the proposal.

8.6 Pittwater LEP 2014

Pittwater Local Environmental Plan 2014 (also referred to as Pittwater LEP 2014) is the statutory planning instrument that establishes what forms of development and landuse are permissible and/or prohibited on all land within the Pittwater Local Government Area.

8.6.1 Pittwater 21 DCP

Development Control Plans (DCPs) set the standards, controls and regulations that apply when carrying out development or building work within Pittwater. They support Pittwater Local Environmental Plan 2014, which regulates the uses that are permissible on the land.

The Pittwater 21 Development Control Plan (P21 DCP) describes development controls for land within the Pittwater LGA. Part B4 describes various controls which apply to land which has been classified as Category 1, 2 or 3 and/or wildlife corridor.

The land within the subject site is classified as containing a Flora and Fauna Enhancement Area (Category 2). As such, section B4.4 controls apply to this land.

Outcomes include:

- Conservation, enhancement and/or creation of habitats for locally native flora and fauna to ensure the long term viability of locally native flora and fauna and their habitats.

Controls include:

- Development shall retain and enhance habitat for threatened species, endangered populations, endangered ecological communities and other locally native species.
- Development shall provide an adequate buffer to wildlife corridors.
- Development shall provide flora and fauna habitat and wildlife corridors by active restoration, regeneration, and/or creation.
- Development shall result in no significant onsite loss of canopy cover or net loss in native canopy trees.
- Development shall ensure that at least 60% of any new planting incorporates native vegetation (as per species listed in Native Plants for Your Garden available on the council web page). Landscaping is to be outside areas of existing bushland and should not include environmental weeds.
- Planting is to maximise linkage to the wildlife corridor.
- Development shall not negatively impact on threatened species, endangered populations or endangered ecological communities.
- Caretakers of domestic animals shall prevent them from entering bushland.
- Fencing, where permitted, shall be passable by native wildlife.

The land within the subject site is also classified as containing a Wildlife Corridor, but this land is covered in the Natural Environment Controls Category 2 (above) so section B4.6 controls do not apply to this land**.**

The land within the subject site is also found by the current report as containing Swamp Sclerophyll Forest, a component of Sydney Coastal Estuarine Swamp Forest Complex (as described by Tozer *et al.,* 2010). OEH (2013) had mapped the community Coastal Freshwater Swamp Forest, a component of the EEC Swamp Sclerophyll Forest as described in the principal technical document. DCP 21, in section B4.8, states that controls apply to this land as the land containing or adjoining, Sydney Coastal Estuarine Swamp Forest Complex. The current report considers the wording *'Land to which this control applies – Land containing or adjoining, Sydney Coastal Swamp Forest Complex'* to be not compatible with the presumed intent of Section B4.8 (Freshwater Wetland Endangered Ecological Communities) as Sydney Coastal Estuarine Swamp Forest Complex (Tozer et al. 2010) encompasses different communities to Freshwater Wetland Endangered Ecological Communities, which includes the EEC Sydney Freshwater Wetlands.

The land within the subject site is found by the current report as containing Swamp Sclerophyll Forest. OEH (2013) had mapped the community Coastal Freshwater Swamp Forest, a component of the EEC Swamp Sclerophyll Forest as described in the principal technical document. As such, section B4.14 controls apply to this land as the land contains and adjoins wetlands such as Swamp Sclerophyll Forest.

Outcomes include:

- Development in the catchment of a wetland is to result in wetland conditions being maintained or enhanced
- The physical, chemical and biological processes of wetland habitats in Pittwater are improved, maintained or restored.
- The social and cultural values of wetland areas are conserved and enhanced
- Biodiversity, ecological processes and other wetland values are conserved.

Controls

- Development in a wetlands catchment shall not adversely impact on the wetlands.
- Development shall dispose of stormwater, wastewater and other drainage in a manner that will not adversely impact on wetlands.
- Development must minimise changes to the following:

1. local surface runoff, groundwater flows and water flow regimes to the wetland;
2. temperature, salinity, chemical makeup and sediment loads

- Stormwater is to mimic natural conditions.
- Development shall provide adequate buffering to wetlands
- Existing wildlife corridors are to be maintained and functional habitat links provided wherever possible.
- Development shall ensure that at least 60% of any new planting incorporates native vegetation (as per species found on the site or those listed in 'Native Plants for your Garden' on council webpage).

9 IMPACT ASSESSMENT

The potential direct and indirect impact of the proposal on any threatened species, populations, endangered ecological communities is provided below. This includes consideration of any critical habitat and any relevant recovery plan related to threatened biodiversity. In order to assess the potential impacts the extent, nature and timing of the construction works is considered as well as any maintenance activities and the ongoing occupation of the site. Activities that need to be considered include the construction of buildings, provision of utilities, site access, drainage and stormwater management structures. The proposed landscaping works, asset protection zone treatments and riparian zone's Vegetation Management Plan requirements will also be assessed, with assumptions of adherence to prescribed guidelines.

Potential impacts to threatened biodiversity may occur due to clearing, modification and long term degradation of habitat, from impacts associated with future residential areas adjacent to habitat (trampling, pollution, rubbish dumping, spread of weeds, increased predation by domestic animals) overshadowing, and from increased susceptibility associated with edge effects and urbanisation (weeds, pests, competition, disease, insect attack).

As previously described the majority of the remnant rural/semi-rural site displays a history of anthropogenic disturbance, with large areas previously cleared and disturbed. Evidence of this is visible on site in the form of previous nursery plantings and associated drainage channels and soil level modifications. The vegetation and habitats present have been substantially altered by human occupation and land use over a number of decades. As a consequence, the majority of the site contains some variably limited natural resources and supports a reduced diversity of native flora, fauna and their habitats.

However, the remnant native vegetation located along the boundaries, north and south west of the site consists of endangered ecological communities of high conservation value. The nearby Warriewood Wetland contains vegetation communities that are part of endangered ecological communities as well and is of regional significance.

Other potential direct and indirect impacts from the proposal include habitat fragmentation, weed infestation, alteration of surface and ground water flows, overshadowing, and edge effects. These issues are further discussed below, and impact mitigation measures have been proposed where there is a potential risk to the flora and fauna, and their habitats, occurring within the study area.

Impacts of Construction

The proposed residential development requires the clearance of the Endangered Ecological Community Swamp Sclerophyll Forest (SSF). This community is modified and has a weedy component that will also be removed as part of these direct impacts of construction. Impacts to the Swamp Sclerophyll Forest will very similar to the 2014 proposal and will be isolated to the area around the proposed entry points on McPherson St. and two isolated patches of *Casuarina glauca* regrowth in the north and south-west of the site (Appendix B, Map 6). The area to be impacted at the entrances also includes a section of the Asset Protection Zone (APZ). An area of APZ also affects the SSF in the northern part of the western boundary. **The impact of the current (2016) proposal (Appendix B, Map 7) is significantly less than the impact of the 2014 proposal in that the proposed impact is reduced by approximately 20m^2 of clearing of SSF in one area and increased by approximately 20m^2 of SSF in another area. Additionally the riparian area set aside for the 2016 proposal is approximately 1/3rd larger than the 2014 Plan. None of the specific trees that are to be removed under the 2016 proposal have significant habitat value. So in light of these changes it can be reasonably assumed that impact of the new proposal is less than the 2014 proposal. The 2014 proposal was assessed as having a minimal impact on biodiversity and so it can also be reasonably assume that the new proposal will also have minimal impact on biodiversity.**

The *Arboricultural Assessment/Vegetation Management Report* (TALC 2014, 2016) identifies additional trees to be removed on site in both the Swamp Sclerophyll Forest and the Exotic Riparian Forest that are not local natives. Almost all non-locally native trees mapped for the site occur within the Swamp Sclerophyll Forest or Exotic Riparian Forest. Very few occur outside these two communities as mapped. As all areas of Swamp Sclerophyll Forest retained, and all areas of Swamp Sclerophyll Forest/Exotic

Riparian Forest/Cleared and Disturbed within the Riparian Area must be regenerated or revegetated, the removal of all non-local trees within these areas is supported.

No threatened flora species or populations listed under the TSC Act were recorded on the site during field investigations. Given the highly altered state of the site, no threatened plant species are likely to be adversely affected by the proposal. Local native tree species located within the development footprint requiring removal include specimens of *Casuarina glauca* Swamp Oaks, and one specimen of *Eucalyptus robusta* Swamp Mahogany. (TALC 2014). These trees occur within the area mapped as a Swamp Sclerophyll Forest.

The subject site currently supports 10,684m² of Swamp Sclerophyll Forest. The proposal (2016) will clear approximately 2,796m^2 of Swamp Sclerophyll Forest, including Asset Protection Zones and construction footprint.

The clearing of native vegetation is listed as a key threatening process for the decline in many fauna and flora species. The significance of the impact of the development on the Swamp Sclerophyll Forest has been assessed via a 7-part test (Appendix C) which has concluded that the clearing of 2,796 m^2 of vegetation is unlikely to result in a significant effect on the Swamp Sclerophyll Forest EEC in the locality.

The vegetation retained off MacPherson Street is at risk of degradation subsequent to the reduction in the size of the stand. Greater exposure to fragmentation, weed infestation and edge effect conditions is expected, despite proposed revegetation works. Edge effects currently operate across the site to some extent at the interface between the nursery edges, existing roads and weedy areas and the Swamp Sclerophyll forest. Edge effects tend to occur within a transitional zone between two opposing habitats, and impacts may include changes in light exposure, rain and wind exposure on core vegetation, influx of weeds, pests and disease. The creation of a new 'edge effect' that will impact on the retained SSF is likely following the clearing of the remnant vegetation for the construction of roads, paths and residential dwellings.

The proposed residential buildings also have the potential to alter the vegetation retained due to overshadowing. Overshadowing reduces the likelihood of plants establishing and suppresses of plant growth through the obstruction of the sunlight by buildings. This risk has been considered by review of the shadow diagrams, and is assessed as not of likely negative impact.

The proposed development of the site will reduce the availability of fauna lifecycle resources and habitats that are commonly associated with rural and semi-rural landscapes. This will have minor adverse effects on some of the locally occurring fauna, including the three threatened fauna species recorded onsite, that utilise the rural-urban land interface. The majority of these species are unlikely to be substantially affected by the proposal, as they are considered common within their range, widespread in distribution and tolerant of urban development and disturbance. Assessments of significance for the Grey-headed Flying-fox, Eastern Bentwing-bat, and Little Bentwing-bat found that the proposal is unlikely to cause a significant impact to these species. Currently available habitats within the locality such as Warriewood Wetlands and native vegetation of the escarpment, the Sydney Water site to the south and national parks further away will not be significantly impacted by the proposal. It is likely that for many species the increasing of the quality of intactness of Swamp Sclerophyll Forest retained and improved on site through the VMP associated with the Riparian Area and the restricted development area associated with the west and south of the site will assist the recovery of habitat values on the subject site.

Impacts to the Swamp Sclerophyll Forest cannot be avoided due to the footprint of the current proposal. This will initially reduce the extent of habitat available for fauna species, and this is an area of the site where the Powerful Owl *Ninox strenua* species was located during March 2008 survey. Additional planting will occur within the riparian zones to offset this vegetation removal.

No trees were identified on site as supporting potential fauna habitat features such as hollows, cavities and cracks. Consequently, potential adverse effects on potential fauna species as a result of development of the site are not expected to be significant, and these species should recolonise parts of the site once native vegetation has established within planted areas. Habitat feature may be present within the built structures on site, including the building cavities, particularly for threatened species of bats recorded onsite, as well as other fauna species.

The current overland flow of the site extends away from the proposed building plan in all directions to varying degrees. Areas of standing water accumulate directly to the west and south of the site during adequate rain events. It should be noted that the semi-permanent narrow body of water in the southern extents of the western boundary have not been mapped as a waterbody in published 1:25,000 mapping. The western part of the area immediately south of the subject site along MacPherson Street regularly floods after adequate rainfall.

At this stage it is unclear what the extent of cut and fill will be required as part of flood management works; thus any impacts of this process on SSF has not been assessed within this report.

Asset Protection, Landscaping and VMPs

The modification of the endangered ecological community will also result from the establishment of the Asset Protection Zone in the area of the site between the northern part of the Riparian Zone and the internal road turning circle. Additionally, the APZ will modify smaller area in the northern part of the western boundary and an area to the area east of the entrance (Appendix 2, Map 6).

The submitted proposal includes a Landscape Plan. Tree retentions are highlighted, and species selection will exclude invasive species that could impact the riparian zone and adjoining habitats. A specification of minimum percentages of locally indigenous and genetically integral plantings in areas outside of the mapped areas of Swamp Sclerophyll Forest retained and the Riparian Zone (subjects of specific Vegetation Management Plans) will satisfy requirements of the DCP B4 and 4.14.

A Vegetation Management Plan (VMP) should complement the Landscape Plan prepared for the project in order to carry out suitable restoration activities that result in improved biodiversity values for the site above those currently occurring. The Riparian Zone requires a VMP to satisfy the requirements of the Water Management Act (2000). The Office of Water's Guidelines inform the requirements for Riparian Zones. These guidelines are also the required template for maintenance of Threatened Ecological Communities as part of the requirements of the EP&A Act. As such a separate VMP needs to be prepared for areas of Swamp Sclerophyll Forest retained.

The proposed development includes the proposed rehabilitation of remnant vegetation within the Riparian Zone, and remnant EEC communities elsewhere on site through regeneration, revegetation and weed control measures, and these activities should be continued within these zones initially by the developer and then transferred to Council/and or a Trust, with works set out in a site specific Management Plan. The risk of weed infestation from increased urbanisation, while high, is not considered to be significantly different to the current situation.

In summary, the impacts of the overall proposal to the remnant native vegetation via clearing or modification of SSF, proposed regeneration of SSF within the Riparian Zone and elsewhere on the site is as follows.

Table 5 Summary of vegetation clearing, retention and restoration.

Vegetation Community Treatment	Area m^2
Existing Swamp Sclerophyll Forest	10,684
Swamp Sclerophyll Forest Cleared in Total on Site	2,796
Swamp Sclerophyll Forest Cleared as APZ	1,135
Swamp Sclerophyll Forest Retained Outside Development Footprint	7,278

10 ENVIRONMENTAL MANAGEMENT AND RECOMMENDATIONS

10.1 Environmental Management Measures to be implemented before Construction

- Inspection (by a qualified ecologist) of hollow-bearing trees, dense shrub thickets, and derelict built structures for fauna habitation, prior to their felling and removal. Where animals are located, they would be carefully released at the time, or captured for later release. Captured animals would generally be released into the edges of the Warriewood Wetlands or similar suitable nearby reserves at dusk, and injured fauna would be transferred to the care of WIRES;
- The retention of hollow-bearing trees and all native trees within the Riparian Zone is required. This may include exotic species identified as particular habitat value. Under Section B4.4 of P21 DCP there is to be no net loss of native canopy trees as a result of the development;
- Installation of nest boxes for hollow dependent species such as birds and microbats provide habitat. A Nest Box Plan should be prepared and approved prior to construction. The Nest-Box Plan should utilise the latest research and set out the numbers of nest boxes required, target species, nest box designs, installation and monitoring requirements;
- Seed collection and establishment of SSF of local provenance and collected to ensure genetic integrity (Florabank Guidelines) suitable for use in the revegetation works within the riparian zone and other retained SSF;
- Installation of temporary exclusion fencing along the outer boundaries of buffer zones, including a 10m Buffer Strip and remnant native vegetation areas, prior to construction. Appendix 4 of P21 DCP addresses the protection of existing vegetation, and states that "The existing vegetation, to be retained, should be protected from root compaction, root, trunk and limb damage, soil contamination and changes in surface level that may affect the health of each specimen. Protection measures are to be installed prior to the commencement of any earthworks. It is suggested that a chain wire fence be erected 1 metre beyond the dripline of each specimen for the full circumference of all vegetation to be protected". All stands of Swamp Sclerophyll Forest adjacent to the development footprint that will be retained will be protected by erecting temporary exclusion fencing during construction in accordance with the Arborists recommendations;
- A VMP for both the Riparian Zone and other retained SSF should include a description of proposed regeneration, rehabilitation and restoration methodologies, planting layout and densities, including a list of appropriate species for use in revegetation in any rehabilitation areas and provide a maintenance program for a minimum period of 2 years after the completions of works, including monitoring and reporting responsibilities;
- The retention of all mapped Swamp Sclerophyll Forest (except for the area proposed for removal) should occur, and all construction activities should be excluded from this area. The retention of the Swamp Sclerophyll Forest vegetation adjacent to the proposed buildings close to MacPherson Street may require additional bushfire protection measures are incorporated into the building design in addition to APZ to achieve a satisfactory level of protection to residents, emergency workers and buildings in the event of a fire. Native canopy species in this area should be retained in particular; and
- Removal of all noxious weeds and conduct primary weeding using bush regeneration techniques of all areas of retained vegetation on the site.

10.2 Environmental Management Measures to be implemented during Construction

- Monitoring of retained stands of Swamp Sclerophyll Forest, the riparian zones and adjacent APZ for the presence of threatened birds species during their breeding season that may nest within this type of habitat. This would include *Ixobrychus flavicollis* Black Bittern.
- A program of weed control and bush regeneration should be implemented for all Swamp Sclerophyll Forest and riparian zones, in accordance with any approved VMPs. Regular follow-up or secondary weeding within the SSF and Riparian Zones is required as per VMPs;

- Revegetation of the Riparian Zone with locally indigenous plant species. Species selection will be based on achieving a target community similar in structure and diversity to the Swamp Sclerophyll Forest community within the Riparian Zone, and canopy cover within the APZ as per the bush fire recommendations. Appropriate and inappropriate species for the revegetation works are listed in the Appendices of P21 DCP, and should be prescribed contained with any VMPs;
- Revegetation or landscaping within the Asset Protection Zone must be designed so that the function of the APZ is not compromised by the revegetation or landscaping works. This will require careful selection of species, creation of gaps in the canopy and separation of the ground and canopy fuel layers;
- Landscaping around the entrance way at MacPherson Street, and in the other areas of the development that required removal of Swamp Sclerophyll Forest, should consist of species characteristic of this community, and that only genetically integral plantings of species diagnostic of the community be used in landscaping in the area beside the roads and dwellings;
- The location of material stockpiles and vehicle parking areas must be on already cleared and disturbed land, well away from vegetation to be retained on the site and the boundary close to the wetlands;
- Chipping of felled trees and other vegetation (excluding noxious or invasive weeds) from the site for use as mulch in rehabilitation works is recommended;
- Maintenance and installation of appropriate erosion control measures during the construction phase of the development (e.g. silt fences, sediment ponds etc), to protect terrestrial habitats on-site and wetland habitats downslope of the site. These will conform to *Managing Urban Stormwater - Soils and Construction* (NSW Department of Housing 1998), and will be maintained throughout the construction period.
- Management of stormwater, wastewater and runoff as per the P21 DCP and design plans in relation to the sites proximity to a significant wetland; and
- Management of construction materials, fuels and wastes should be controlled to minimise the potential for any discharge of chemicals or contaminants (such as concrete or other building materials) impacting upon adjacent areas of native vegetation or waterways.

10.3 Environmental Management Measures to be implemented after Construction

- The program of weed control and bush regeneration in all conservation areas retained on-site is to continue, with preference to areas of Swamp Sclerophyll Forest and the riparian zones, in accordance with the approved VMP to enhance the quality of the remaining vegetation. Conduct monitoring in accordance with the approved VMP;
- Implement a fauna monitoring program as set out in a Nest Box Plan;
- Material stockpiles and vehicle parking areas that have been created on site are to be removed and made good upon completion of the construction works;
- Non-permanent erosion control measures (e.g. silt fencing, sediment ponds) implemented during the construction phase of the development are to be carefully removed following completion and stabilisation of the works; and
- Management of stormwater, wastewater and runoff will continue as per the project design and P21 DCP in relation to the sites proximity to a significant wetland.

11 CONCLUSION

Three threatened species (Grey Headed Flying Fox, Eastern Bentwing-bat, and Little Bentwing-bat) were identified on site during the current survey. One threatened Ecological Community, Swamp Sclerophyll Forest (listed as an Endangered Ecological Community under the TSC Act (1995)), was

identified on site during the current study. It is recognised that despite this absence it is possible that mobile, nomadic or migratory threatened species could occur on the site on a temporary or occasional basis, including several threatened birds (*e.g.* the Swift Parrot, Regent Honeyeater, or Powerful Owl). Some direct clearing impacts to the Swamp Sclerophyll Forest community will occur, with a little more than half of the community proposed for retention to be contained within the proposed Riparian Zone.

As described previously in this report, one endangered ecological communities have been recorded on site. Three 7-part Tests have been prepared under the *TSC Act* s5A Assessment (7-part test) in order to assess the significance of the proposal upon the Swamp Sclerophyll Forest in the Locality, and threatened species recorded onsite.

The assessments have concluded that the current proposal is unlikely to result in a significant effect on the threatened biodiversity recorded on site, or their habitats. The subject site is predominately a highly modified semi-rural landscape with very limited natural resources; no critical habitat was assessed within the site. The proposed actions to supplement the removal of exotic trees and weed species with native species characteristic of the local vegetation communities that will provide future fauna habitat, the removal of exotic weeds, the rehabilitation of the bounding banks of Narrabeen Creek and the regeneration of the Riparian Zone will be significant proposed ecological improvements on the current biodiversity within the subject site. The low native floristic assemblage represented within the subject site is the result of anthropogenic practices and extensive weed infestation. The proposed improvements will provide food and foraging substrata for local and migrating threatened species, and increase the plant diversity within the retained remnants.

The site could potentially provide habitat for a limited number of threatened or migratory fauna species, most of which are highly mobile with large home ranges. Three threatened fauna species was recorded utilising the subject site, however the proposed actions will not directly increase the risk of extinction to local threatened populations or species. Retention of native vegetation on the subject site where possible, creation of riparian zones, habitat, and maintenance of linkages with adjacent natural areas has been recommended in this report. The risks associated with changes to overshadowing, stormwater and groundwater flows and habitat connectivity are considered to be low, and the threats to the biodiversity located on the site, and to the adjoining Warriewood Wetland are not significant.

While the proposal includes clearing 2,796m^2 of the endangered ecological the retention and enhancement of the vegetation in retained areas will be maximised to provide for the preservation of habitat for threatened species in the locality. A total of approximately 7,278 m^2 of SSF will be retained and additional areas will be regenerated and rehabilitated within the Riparian Zone not currently mapped as SSF.

Compensation for the proposed impacts to the SSF community will occur on site, with regeneration and restoration of this community within the Riparian Zone. These actions will result, over time, in the maintenance of the biodiversity values of the site, and these will improve over time as the riparian zones are established.

This report concludes that the long-term viability of the threatened biodiversity occurring within the site and the wider locality will not be reduced as a result of the proposal, and no increased risk of extinction is considered likely. No Critical Habitat for threatened biodiversity has been declared for the subject species or the locality that would impact the current proposal. Therefore, in light of this assessment, a Species Impact Statement or a Referral to the Federal Environment Minister, is not required.

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Appendix A

Flora Species Inventories

Table A. Plant species recorded in the study area of 2 Macpherson Street and surrounds, Warriewood, are provided in the following table.

General Status	
*	Exotic (not native to Australia)
N( )	Noxious weeds and 'Control Class' as listed on the NSW Noxious Weeds Act 1993 for the Pittwater LGA
ni	Non - indigenous native species (does not naturally occur at this locality)
Conservation Status	
CE	Critically Endangered - listed under Schedule 1A of the TSC Act
E	Endangered - listed under Schedule 1 of the TSC Act
V	Vulnerable - listed under Schedule 2 of the TSC Act
Abundance	
c	Common, species occur all over the site
o	Occasional, species occur over the survey area but not in large numbers at any occurrence
u	Uncommon, species occur only once or twice during the survey

Status	Family	Genus species	Common Name	2 Macpherson Street	Adjoining areas outside subject site
	Amaranthaceae	Alternanthera denticulata	Lesser Joyweed	u	u
*	Araceae	Alocasia brisbanensis	Cunjevoi	u	-
*	Araceae	Colocasia esculenta	Taro	u	-
	Arecaceae	Livistona australis	Cabbage Fan-palm	-	u
*	Arecaceae	Livistona chinensis	Chinese Fan Palm	u	-
*	Arecaceae	Washingtonia filifera	Cotton Palm	-	u
*	Asteraceae	Ageratina adenophora	Crofton Weed	o	u
*	Asteraceae	Tagetes minuta	Stinking Roger	u	-
	Azollaceae	Azolla pinnata		u	-
N(4)	Basellaceae	Anredera cordifolia	Madeira Vine	u	u
*	Bignoniaceae	Jacaranda mimosifolia	Jacaranda	u	-
*	Cannaceae	Canna x generalis	Canna Lily	-	u
	Casuarinaceae	Casuarina glauca	Swamp Oak	c	c
	Commelinaceae	Commelina cyanea	Scurvy Weed	u	u
*	Commelinaceae	Tradescantia fluminensis	Wandering Jew	c	c
N(4)	Convolvulaceae	Ipomoea indica	Morning Glory	o	-

Status	Family	Genus species	Common Name	Macpherson/Warriewood Inside	Macpherson/Warriewood Outside
	Dennstaedtiaceae	Hypolepis muelleri	Harsh Ground Fern	u	-
	Dicksoniaceae	Calochlaena dubia	Soft Bracken	u	-
	Euphorbiaceae	Glochidion ferdinandi var ferdinandi	Cheese Tree	o	-
N(4)	Euphorbiaceae	Ricinus communis	Castor Oil Plant	u	u
*	Fabaceae - Caesalpinioideae	Senna pendula var glabrata		o	o
*	Fabaceae - Faboideae	Erythrina crista-galli	Cockspur Coral Tree	o	o
*	Fabaceae - Faboideae	Erythrina sykesii	Coral Tree	o	o
*	Haloragaceae	Myriophyllum aquaticum	Parrots Feather	u	u
	Lemnaceae	Spirodela polyrhiza		u	-
ni	Moraceae	Ficus benjamina	Fig	o	o
ni	Moraceae	Ficus elastica	Rubber Tree	o	-
	Moraceae	Ficus macrophylla	Moreton Bay Fig	o	-
	Myrtaceae	Eucalyptus robusta	Swamp Mahogany	u	c
	Myrtaceae	Melaleuca linariifolia	Flax-leaved Paperbark	u	o
	Myrtaceae	Melaleuca quinquenervia	Broad-leaved Paperbark	u	-
	Najadaceae	Najas tenuifolia	Waternymph	u	u
N(4)	Oleaceae	Ligustrum lucidum	Large Leaved Privet	o	o
N(4)	Oleaceae	Ligustrum sinense	Small Leaved Privet	o	o
	Philydraceae	Philydrum lanuginosum	Woolly Waterlily	u	u
*	Phormiaceae	Phormium tenax	NZ Flax	-	u
*	Poaceae	Arundo donax	Spanish Reed	c	u
	Poaceae	Phragmites australis	Common Reed	u	-
*	Polygonaceae	Rumex sp	Dock	o	o
*	Salicaceae	Salix babylonica		-	u
N(3)	Solanaceae	Cestrum parqui	Green Poisonberry	c	c
	Thelypteridaceae	Christella dentata	Binung	o	c
N(4)	Urticaceae	Parietaria judaica	Asthma Weed	u	-
N(4)	Verbenaceae	Lantana camara	Lantana	o	u

Species highlighted in Green are characteristic of Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion Endangered Ecological Community.

[1] Class 1 State Prohibited Weeds. The plant must be eradicated from the land and the land must be kept free of the plant.
Class 2 Regionally Prohibited Weeds. The plant must be eradicated from the land and the land must be kept free of the plant.
Class 3 Regionally Controlled Weeds. The plant must be fully and continuously suppressed and destroyed.
Class 4 Locally Controlled Weeds. The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
Class 5 Restricted Plants. The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with.

Table B. Fauna species recorded in the study area of 2 Macpherson Street and surrounds, Warriewood, are provided in the following table

General Status

*	Exotic/introduced species
(?)	Uncertain identification
P	Protected
U	Unprotected

Conservation Status

CE	Critically Endangered - listed under Schedule 1A of the TSC Act
E	Endangered - listed under Schedule 1 of the TSC Act
V	Vulnerable - listed under Schedule 2 of the TSC Act

Record Type

O Observed	B Burnt
F Tracks/scratchings	T Trapped or netted
H Hair, feathers, or skin	Y Bone or teeth
R Road kill	P Scat
D Dog kill	W Heard call
C Cat kill	Z In raptor/owl pellet
V Fox kill	E Nest/roost
K Dead	M Miscellaneous
S Shot	N Not located
X In scat	A Stranding/Beached
Sh Shell/carapace	

Certainty (anabat analysis only)

D Definite
Pr Probable
Po Possible

Status	Order	Family	Scientific Name	Common Name	Obs Type	Certainty
P	Amphibia	Anura	Litoria fallax	Eastern Dwarf Tree Frog	au	

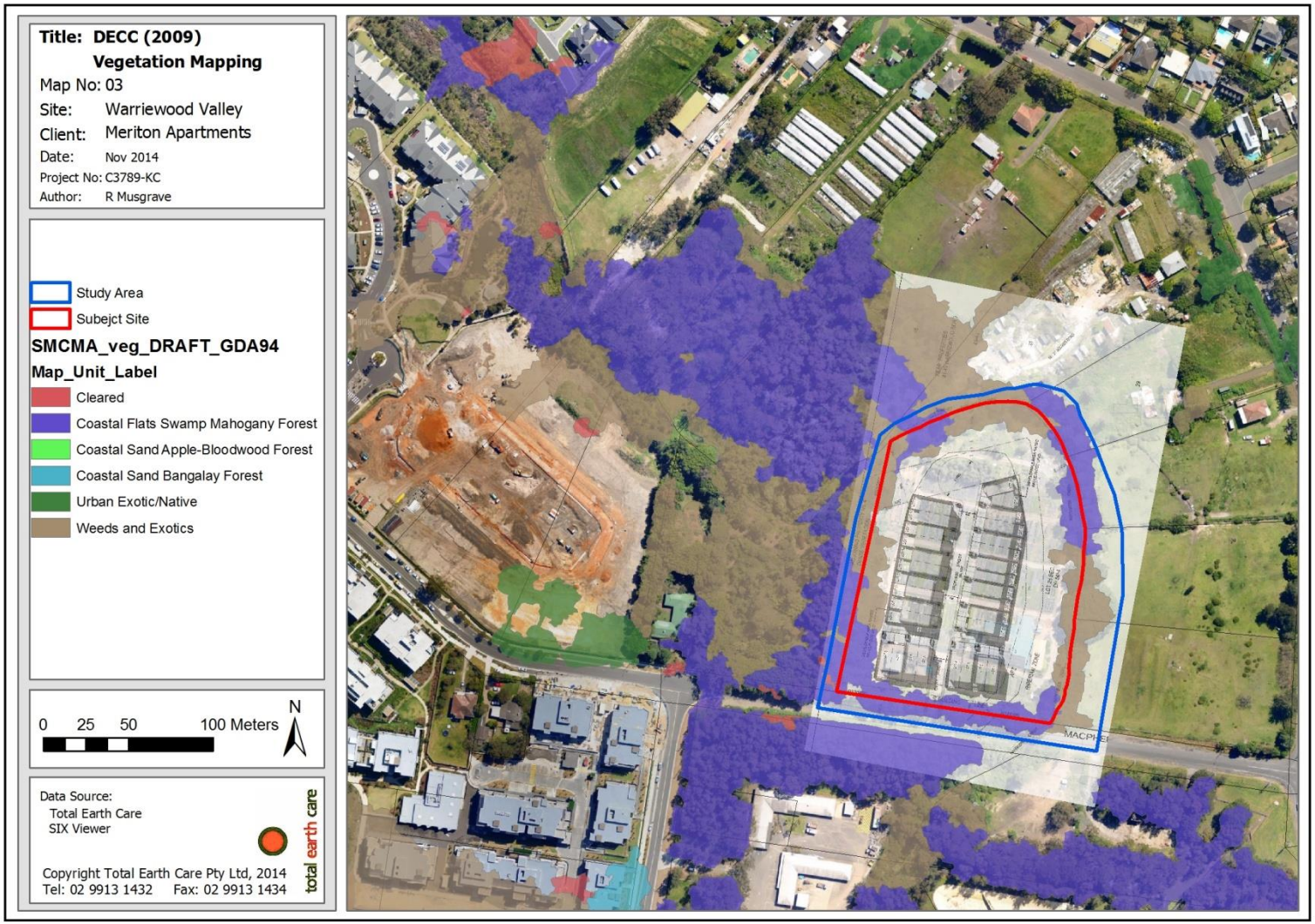
P	Amphibia	Anura	Litoria peronii	Peron's Tree Frog	au	
P	Amphibia	Anura	Crinia signifera	Common Eastern Froglet	au	
P	Amphibia	Anura	Limnodynastes peronii	Brown-striped Frog	au	
P	Aves	Coraciiformes	Dacelo novaeguineae	Laughing Kookaburra	o	
P	Aves	Passeriformes	Gymnorhina tibicen	Australian Magpie	au	
P	Aves	Passeriformes	Strepera graculina	Pied Currawong	o	
P	Aves	Psittaciformes	Cacatua galerita	Sulphur-crested Cockatoo	au	
P	Aves	Charadriiformes	Vanellus miles	Masked Lapwing	au	
P	Aves	Passeriformes	Psophodes olivaceus	Eastern Whipbird	o	
P	Aves	Passeriformes	Anthochaera carunculata	Red Wattlebird	au	
P	Aves	Passeriformes	Manorina melanocephala	Noisy Miner	o	
P	Aves	Psittaciformes	Trichoglossus haematodus	Rainbow Lorikeet	o	
U	Mammalia	Rodentia	Rattus rattus	Black Rat	o	
P	Mammalia	Diprotodonta	Trichosurus vulpecula	Common Brushtail Possum	o	
V	Mammalia	Chiroptera	Pteropus poliocephalus	Grey-headed Flying-fox	o	
P	Mammalia	Chiroptera	Chalinolobus gouldii	Gould's Wattled Bat		C
P	Mammalia	Chiroptera	Vespadelus darlingtoni	Large Forest Bat		Po
V	Mammalia	Chiroptera	Miniopterus australis	Little Bentwing-bat		C
V	Mammalia	Chiroptera	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		P
P	Mammalia	Chiroptera	Tadarida australis	White-striped Freetail-bat		C

Appendix B

Maps and Figures


Title: Subject Site & Study Area
Map No: 01
Site: Warriewood Valley
Client: Meriton Apartments
Date: Nov 2014
Project No: C3789-KC
Author: R Musgrave
Study Area
Subejct Site
0 12.5 25 50 Meters
N
Data Source:
Total Earth Care
SIX Viewer
Copyright Total Earth Care Pty Ltd, 2014
Tel: 02 9913 1432 Fax: 02 9913 1434
total earth care


Title: Proposal
Map No: 02
Site: Warriewood Valley
Client: Meriton Apartments
Date: Nov 2014
Project No: C3789-KC
Author: R Musgrave
Study Area
Subejct Site
0 12.5 25 50 Meters
N
Data Source:
Total Earth Care
SIX Viewer
Copyright Total Earth Care Pty Ltd, 2014
Tel: 02 9913 1432 Fax: 02 9913 1434
total earth care
ADJOINING PROPERTY No 4
DENSE VEGETATION
BOUNDARY
NARRABEEN CREEK
APZ
RIPARIAN ZONE
BUILDING LINE
LOT 25 SEC. C
DP 5464
MACPHE


Title: DECC (2009)
Vegetation Mapping
Map No: 03
Site: Warriewood Valley
Client: Meriton Apartments
Date: Nov 2014
Project No: C3789-KC
Author: R Musgrave
Study Area
Subejct Site
SMCMA_veg_DRAFT_GDA94
Map_Unit_Label
Cleared
Coastal Flats Swamp Mahogany Forest
Coastal Sand Apple-Bloodwood Forest
Coastal Sand Bangalay Forest
Urban Exotic/Native
Weeds and Exotics
0 25 50 100 Meters
N
Data Source:
Total Earth Care
SIX Viewer
Copyright Total Earth Care Pty Ltd, 2014
Tel: 02 9913 1432 Fax: 02 9913 1434
total earth care


Title: OEH (2013)
Vegetation Mapping
Map No: 04
Site: Warriewood Valley
Client: Meriton Apartments
Date: Nov 2014
Project No: C3789-KC
Author: R Musgrave
Study Area
Subejct Site
SydneyMetroArea_2013_v2_0_E_3817
MapUnitNam
Cleared
S_DSF21: Coastal Sand Bangalay Forest
S_FoW02: Coastal Flats Swamp Mahogany Forest
S_FoW03: Coastal Freshwater Swamp Forest
S_FrW03: Coastal Freshwater Wetland
Urban_E/N: Urban Exotic/Native
Weed_Ex: Weeds and Exotics
0 35 70 140 Meters
N
Data Source:
Total Earth Care
SIX Viewer
Copyright Total Earth Care Pty Ltd, 2014
Tel: 02 9913 1432 Fax: 02 9913 1434
total earth care


Title: TEC (2014)
Vegetation Mapping
Map No: 05
Site: Warriewood Valley
Client: Meriton Apartments
Date: Nov 2014
Project No: C3789-KC
Author: R Musgrave
Study Area
Subejct Site
Swamp Sclerophyll Forest
Exotic Riparian Vegetation
0 12.5 25 50 Meters
N
Data Source:
Total Earth Care
SIX Viewer
Copyright Total Earth Care Pty Ltd, 2014
Tel: 02 9913 1432 Fax: 02 9913 1434
total earth care
ADJOINING PROPERTY No 4
DENSE VEGETATION
PROPOSED STREET
APZ
RIPERIAN ZONE
BUILDING LINE
BOUNDARY
LOT 25 SEC. C
DP 3464
MACPH


Title: Impacts
Map No: 06
Site: Warriewood Valley
Client: Meriton Apartments
Date: Nov 2014
Project No: C3789-KC
Author: R Musgrave
Study Area
Subject Site
Swamp Sclerophyll Forest
Exotic Riparian Vegetation
Impacts
Riparian Area (VMP required)
0 10 20 40 Meters
N
Data Source:
Total Earth Care
SIX Viewer
Copyright Total Earth Care Pty Ltd, 2014
Tel: 02 9913 1432 Fax: 02 9913 1434
total earth care
MACPHE


Title: Impacts
Map No: 07
Site: Warriewood Valley
Client: Meriton Apartments
Date: October 2016
Project No: C10253.1
Author: G Cadiou
Subject site
Impacts 2016
Study Area
Swamp Sclerophyll Forest
Exotic Riparian Vegetation
Riparian Area (VMP required)
0 12.5 25 50 Meters
N
Data Source:
Total Earth Care
SIX Viewer
Copyright Total Earth Care Pty Ltd, 2014
Tel: 02 9913 1432 Fax: 02 9913 1434
total earth care

Appendix C

Assessment of Significance

Swamp Sclerophyll Forest (SSF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

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

The TSC Act defines a "threatened species" as "a species specified in Part 1 or 4 of Schedule 1 or in Schedule 2" of the Act. Swamp Sclerophyll Forest is not a "threatened species", as defined under the TSC Act.

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

The TSC Act defines an "endangered population" as "a population specified in Part 2 of Schedule 1" of the Act. Swamp Sclerophyll Forest is not an "endangered population", as defined under the TSC Act.

3 in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

a) 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

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

The majority of the construction works to occur during the development of the proposed housing will affect the Cleared and Disturbed and the Exotic Riparian Forest plant communities. The current development footprint will impact on the south and west extent of the SSF with the construction of roads and APZ management, and in areas in the north with the maintenance of APZs which includes the construction of a road.

The total area of SSF present on the site has been mapped as 10,684 m² with 2,796 m² (approximately 26%) to be cleared (2016 proposal) as a direct result of the proposed development footprint and APZ works.

The largest area of native vegetation to be removed will be on the southern and western edge of the current extent of SSF on the site, with two other areas in the north extent. This area of SSF on the site forms a broken corridor with larger patches of SSF in the Warriewood Waste Water Treatment Plant property to the south. This current connectivity is broken by the double lane MacPherson Street that separates the subject site and the Waste Water Treatment Plant. The proposed development will further attenuate the broken corridor between these two extents of SSF around MacPherson Street, setting back further the break of connectivity currently formed by MacPherson Street. It should be noted that there have been recent attenuations of the connectivity across Boondah Road between the Waste Water Treatment Plant and the varied EECs of the greater Warriewood Wetland remnant.

Some structural modification of the SSF will occur on site as a result of the establishment and long term maintenance of SSF within the Asset Protection Zone (APZ). The isolated SSF with the APZ in the north of the site will be almost completely cleared for road construction with remaining areas too small for

meaningful conservation. This area of SSF retained within APZs will be maintained at a more open structure so as to not create a fire path. The APZ will be maintained with a low understorey and/or groundcover only.

Areas of SSF on site that are proposed to be regenerated are the Riparian Zone (RZ) occupying 6,143m² of SSF, and the area of SSF outside the RZ and the APZ that is proposed to be retained which occupies 1,016m² of SSF. These totals of SSF that will be maintained or improved by regeneration are 7,278m², or approximately 70% of the total SSF on the site.

It has been recommended by this report that the native vegetation present in this area be preserved as much as possible so that the proposed development will minimise the impacts. It is recommended that native canopy be retained where practicable and that only genetically integral plantings of species diagnostic of the community be used in landscaping in the area beside the roads and dwellings.

In order to mitigate negative impacts to the community from the proposal it has also been recommended that fencing be installed along the boundary of the areas of this community that are to be retained prior to construction to preserve the vegetation and control potential erosion and sedimentation. The compilation of a vegetation management plan has been recommended in order to properly manage this high conservation area including provisions for the careful management of the vegetation in relation to APZ works, and revegetation to improve the corridor values present. The northern isolated occurrence of SSF and a strip through the middle of this community along MacPherson Street will be directly impacted on by construction. It should also be noted that this extent along MacPherson Street represents a floristic area dominated by *Eucalyptus robusta* rather than *Casuarina glauca* in the rest of the site.

The proposed development is unlikely to have a substantial or adverse effect on the composition of the community such that its local occurrence is likely to be placed at risk of extinction. The construction works will not result in any significant indirect impacts.

4 in relation to the habitat of a threatened species, population or ecological community:

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

b) 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

c) 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,

It is estimated that Coastal Floodplain Wetlands (which include Swamp Oak Floodplain Forest and Swamp Sclerophyll Forest) currently cover less than 30% of its original distribution. As these two subunits are a small component of Coastal Floodplain Wetlands it can be assumed that these communities currently occupy an even smaller area of land (NSW Scientific Committee, 2004a and b).

A strip of SSF present along the southern boundary of the site adjacent to MacPherson Street is to be directly impacted on through clearing for the construction of an entranceway and APZ. This area occupies 1,135m² or 10% of total SSF on the site. Another isolated area of SSF in the north of the site occupying 535m² will be cleared for road and APZ. Another isolated extent of SSF in the south-west of 152m² will be removed for building construction. More than half (6,143m² or 57.5%) of the remainder of this community is to be maintained in a Riparian Area with another 1,135m² in a Conservation/Restricted Development Area principally on the western boundary and south-western corner. These areas are proposed to be revegetated and regenerated according to individual VMPs. It has been recommended that the removal of 'SSF be minimised as much as practicable as part of the development and that the areas that are to be retained be fenced off for the duration of construction. The area to be impacted is moderate, and with the implementation of various management measures, the impacts to this community on site will be minimised. In addition, no indirect impacts on the endangered community

within the subject site, or the surrounding locality, are expected with the implementation of appropriate mitigation measures and proposed buffer widths.

The existing cover of the community will be altered due to the removal of vegetation in the area of the development footprint. The nature of the development footprint is such that there will be some fragmentation of the current SSF community and consequently some level of isolation of habitats on site. At a locality scale there will only be slight increases in the fragmentation or isolation of this particular stand of 'Swamp Sclerophyll Forest' as it currently exists in a relatively fragmented landscape, although thresholds of connectivity may be broken, although they are not easy to assess.

The stand of 'Swamp Sclerophyll Forest' proposed for clearing located adjacent to MacPherson Street is highly disturbed due to previous clearing that has reduced the size of the stand allowing for the recruitment of exotic woody weeds. Due to the heavy invasion of exotic species and the low numbers of native understorey species, the viability of this community can be considered moderate to low. It has been recommended that the areas not marked for removal are regenerated and/or revegetated in order to increase the native species present, and strengthen corridor values.

The isolation of sections of this stand of 'Swamp Sclerophyll Forest' is difficult to assess when considering individual species and ecological processes. While the proposal will undoubtedly increase fragmentation and restrictions to connectivity, whether it will isolate or fragment SSF to the degree that the local extent will become extinct is similarly difficult to determine one way or the other.

Remnant vegetation, particularly of SSF, within the Warriewood Valley forms a cohesive remnant naturally isolated from other areas of SSF in the wider locality. This isolated remnant of SSF within Warriewood Valley occupies the catchment of Narrabeen Ck, which is a sub-catchment of Narrabeen Lagoon. All patches of SSF mapped by OEH as part of this remnant occur within a 1.4 km radius of the subject site. The total area of SSF mapped by OEH within this remnant is 306,752.4 m², although this figure would now be less due to recent developments in Warriewood Valley. The area proposed for clearing for the current development proposal is 2,796 m² or approximately 0.9% of the total area of SSF mapped by OEH within the Warriewood Valley locality. Outside of this Warriewood Valley remnant there are remnants of SSF mapped by SMCMA occurring along the Deep Creek, Middle Creek and South Creek sub-catchments of Narrabeen Lagoon to the south of the subject site.

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

No area has been designated as 'critical habitat' under Part 3 of the TSC Act 1995 for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

6 whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There was no Threat Abatement Plan or Recovery Plan created by OEH for Swamp Sclerophyll Forest to assist in the recovery of this community before amendments to the TSC Act removed the mandatory requirements for their preparation. There are however 12 strategies identified by OEH in their Priorities Action Statement for Swamp Sclerophyll Forest to help in the recovery of this community and in threat abatement to abate Key Threatening Processes. The proposed development is generally consistent with the strategies and actions listed in the Priority Action Statement.

7 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 TSC Act defines “threatening process” as “a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”. Schedule 3 of the TSC Act provides a list of the “key threatening processes” (KTP). Of the KTP’s listed in Schedule 3 of the TSC Act and in the context of the current and continuing land use, it is considered that the following KTP’s are relevant to Swamp Sclerophyll Floodplain Forest :

- Invasion and spread of *Lantana camara*;
- Clearing of native vegetation;
- Alteration to the natural flow regime of rivers, streams, floodplains and wetlands; and
- Ecological consequences of high frequency fire.

Clearing of native vegetation for the purposes of construction will occur as part of the current proposal. However, clearing of vegetation as part of the current proposal will be limited mainly to exotic planted species and will only involve the removal of a small section of degraded ‘Swamp Sclerophyll Forest’. The remaining vegetation within the riparian area will be conserved and enhanced under the recommendations of this report. Such management will lead to the control of *Lantana camara* present on-site, and as such, will not increase the threat of this process. Other recommendations in relation to fencing and erosion control will aid to mitigate any effects to the natural flow regimes of the site.

The building pad for the proposal aims to not significantly alter the flow of water above or below the soil; the pad will be built above the flood line.

High frequency fire is not part of the proposal for the subject site. Hazard reduction burns and/or bushfires may have occurred in the past in this area, and may have already altered the habitat to varying degrees. Creation of an APZ, as described in the body of the report, will act to mitigate the effect of fire on the vegetation of the site.

Conclusion

In light of the consideration of the above seven factors (a to g), the proposed activity on the subject site is not “likely” to impose “a significant effect” on the ecological communities, as:

- the proposal is not likely to compromise the extent of the local occurrence such that it is likely to be placed at the risk of extinction;
- the proposal is not likely to substantially and adversely modify the composition of the community such that its local occurrence is likely to be placed at the risk of extinction;
- the proposal will only involve the removal of a moderate portion of habitat, and will result in the minor fragmentation and isolation of an already fragmented and isolated stand of the community not considered critical to its long term survival in the locality;
- the proposal aims to enhance retained areas of ‘Swamp Sclerophyll Forest’ adjacent to the development footprint;
- The proposal is generally consistent with the objectives of the Priorities Action Statement for the community; and
- the proposal will increase the operation of key threatening processes occurring at the subject site.

7-part Test – *Microchiropteran Bat Species*

Microchiropteran bats (micro-bats) are small bats, with wingspans up to 30cm and with up to 170g. The majority of species in the suborder are insectivorous and feed upon moths and flying insects, although some catch fish and aquatic insects (Strahan 1995). All micro-bats hunt and navigate by echolocation. The Sydney Basin supports at least 19 species of micro-bats and of these four are predominantly cave-roosting; sheltering during the day in caves, mines, tunnels, culverts and stone basements. The remaining species roost during the day in tree hollows, under bark and in buildings (KBCS 2009). Preferred roost sites are species-specific (DIPNR 2004).

Two threatened microbat species, Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis* and Little Bentwing-bat *Miniopterus australis* were recorded on the subject site and have been considered within the assessment.

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

Caves are the primary roosting habitat for Eastern Bent-wing Bats, however they also use derelict mines, storm-water tunnels, buildings and other man-made structures. They form discrete populations clustering within a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within a territorial range of about 300 km from the maternity cave (Churchill, 1998). Movement between territories is rare. Breeding or roosting colonies can number from 100 to 150,000 individuals. Eastern Bentwing-bats and Little Bentwing-bats share maternity cave habitat. As such, they are prone to population damage if their roosting site is disturbed or modified. Little Bentwing-bats also roost within caves and man-made structures, however, they also within small hollows and under the bark of trees.

Habitat features of the subject site which may support the Eastern Bentwing-bat and Little Bentwing-bat include some foraging habitat above the existing canopy and within the 'Clear and Disturbed' habitat, and roosting habitat in some man-made structures onsite. Little Bentwing-bats may roost in the larger trees offsite. The subject site does not contain maternity camp habitat.

The proposed action includes the development of the 'Clear and Disturbed' habitat, and the removal of a small proportion of Swamp Sclerophyll Forest EEC onsite. However, the majority of the large remnant canopy trees on the subject site will be retained. This will result in the loss of poor quality roosting habitat and an area of foraging habitat for both species; however, the loss of habitat is small when compared to available habitat within the locality. As a result, the proposed actions are unlikely to have an adverse effect on the life cycle of the species of threatened micro-bats considered in this 7-part test such that viable local populations are likely to be placed at risk of extinction.

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

The TSC Act defines an ‘endangered population’ as ‘a population specified in Part 2 of Schedule 1’ of the Act. The aforementioned bat species are not listed as an ‘endangered population’, as defined under the TSC Act.

(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.**

The TSC Act defines an 'endangered ecological community' as an 'ecological community specified in Part 3 of Schedule 1' of the Act. The aforementioned species are not an 'endangered ecological community', as defined under the TSC Act.

(d) In relation to a 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.**

As noted, the subject site supports foraging habitat above the existing canopy and potential roosting habitat for species of micro-bat considered in this 7-part test. Suitable roosting habitat for both species of microbat is found within the man-made structures onsite, while Little Bentwing-bats would also roost within hollows and delaminating bark within the canopy trees on the subject site. The majority of the canopy trees are being retained as part of the proposed development.

Preferred foraging habitat for these species is above the canopy of forested areas, where they hunt moths and other flying insects. In an urban landscape, this preferred habitat is highly fragmented across the locality. Tree canopy cover is discontinuous in the locality as a result of roads, residential areas, and other urban infrastructure. As very few canopy trees are being removed, the proposal is unlikely to further significantly fragment or isolate foraging habitat of species of micro-bat considered in this 7-part test.

The long-term survival of the relevant micro-bats in the locality is unlikely to be affected by the selective removal of native and exotic trees from the subject site.

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

No area has been designated as 'critical habitat' under Part 3 of the TSC Act 1995 for Eastern Bentwing-bats or Little Bentwing-bat.

(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 on Threat Abatement Plan in place for Eastern Bentwing-bats, or Little bentwing-bats. Recovery strategies include actions such as retaining stands of native vegetation, especially those with hollow-bearing trees (including dead trees), and retain other structures containing bats, retain a buffer of vegetation around roost sites in vegetated areas and protect hollow-bearing trees for breeding sites and younger mature trees should also be retained to provide replacements for the older trees.

(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 TSC Act defines a 'key threatening process' as 'a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities'. Schedule 3 of the TSC Act provides a list of the 'key threatening processes' (KTP). The proposed action will result in the operation of:

- Clearing of native vegetation

Conclusion

In light of the consideration of the above seven factors (1 -7), the proposed activity on the subject site is not likely to have “a significant effect” on Eastern Bentwing-bats or Little Bentwing-bats on the subject site or wider locality as a result of the current proposal, as:

- The proposal will not adversely affect the lifecycle of the species such that a viable local population is likely to be placed at risk of extinction;
- The proposal will not remove, modify or further fragment or isolate a significant area of habitat for the species; and
- The proposal does not significantly contribute to any KTP threatening the species.

Consequently, a Species Impact Statement is not required to be prepared.

7-part Test – *Pteropus poliocephalus* Grey-Headed Flying-Fox

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

Pteropus poliocephalus Grey-Headed Flying-Fox is listed as a Vulnerable species under Part 1 of Schedule 2 of the *Threatened Species Conservation Act 1995* (TSC Act).

Distribution of the Grey-headed Flying-fox is from Bunderberg in Queensland in the north to Melbourne in Victoria to the south, typically between the coast and the western slopes of the Great Dividing Range. In NSW, it occurs along the east coast, eastern slops of the Great Dividing Range and the tablelands. A high number of records of the Grey-Headed Flying Fox occurring within 100km^2 of the subject site were obtained from the DECC Wildlife Atlas database. This high incidence is most likely due to the close proximity of the nearest known roosting camp to the subject site located at Gordon.

Habitat for this species includes subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps, while additional foraging is provided by urban gardens and cultivated fruit crops. Grey-headed Flying-foxes roost in large numbers, with up to tens of thousands of flying foxes using individual camps for mating, birth and rearing of young. Camps are typically located in gullies, close to water, in vegetation with a dense canopy, within 20km of a regular food source. Individuals may fly up to 50km to forage, with diet typically comprising nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Site fidelity to camps is high, with some camps being used for over 100 years (NPWS 2001).

Habitat features of the subject site which may support the Grey-Headed Flying-Fox include some potential foraging habitat provided by a number of exotic and native trees located on the subject site. The subject site does not support roosting habitat for this species.

The Grey-Headed Flying-Fox is a highly mobile species with a nightly feeding range of 20 to 50km from a roosting camp and feeds upon a wide variety of flowering and fruiting plants (Tidemann 1995, Churchill 1998). Non-indigenous and exotic tree species introduced to the urban landscape provide additional foraging habitat for this species within the locality; where previously existed a period of reduced availability of native food resource during the winter months, non-native species now supply food resources throughout the year (Parry-Jones & Augee 2001, Williams *et al* 2006). The proposed action includes the removal of several exotic trees and a small number of native canopy trees, however, as these do not produce flesh fruit they are not considered a foraging resource for GHFF. All remnant canopy trees will be retained as part of this proposal.

As a result, the proposed actions are highly unlikely to have an adverse effect on the life cycle of the Grey-Headed Flying-Fox such that a viable local population is likely to be placed at risk of extinction.

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

The TSC Act defines an 'endangered population' as 'a population specified in Part 2 of Schedule 1' of the Act. The Grey-Headed Flying-Fox is not an 'endangered population', as defined under the TSC Act.

(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.**

The TSC Act defines an 'endangered ecological community' as an 'ecological community specified in Part 3 of Schedule 1' of the Act. The Grey-Headed Flying-Fox is not an 'endangered ecological community', as defined under the TSC Act.

(d) In relation to a 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.**

As mentioned previously, some potential foraging habitat is provided by the remnant canopy trees located on the subject site, many of which are being retained.

Foraging habitat of the Grey-Headed Flying Fox is already highly fragmented across the urban landscape of the locality. The proposal will not further fragment or isolate foraging habitat of this species. Thus, the long-term survival of the Grey-Headed Flying Fox in the locality is unlikely to be affected by the proposal.

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

No area has been designated as 'critical habitat' under Part 3 of the TSC Act 1995 for the Grey-Headed Flying-Fox.

(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 in place for the Grey-Headed Flying-Fox. There are no Threat Abatement Plans currently in operation for any Key Threatening Processes threatening the Grey-Headed Flying-Fox.

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

The TSC Act defines a 'key threatening process' as 'a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities'. Schedule 3 of the TSC Act provides a list of the 'key threatening processes' (KTP). The proposed action will result in the operation of:

- Clearing of native vegetation

Conclusion

In light of the consideration of the above seven factors (1 -7), the proposed activity on the subject site is not likely to have "a significant effect" on the Grey-Headed Flying-Fox on the subject site or wider locality as a result of the current proposal, as:

- The proposal will not adversely affect the lifecycle of the species;
- The proposal will not remove, modify or further fragment or isolate a significant area of habitat for the species; and
- The proposal does not significantly contribute to any KTP threatening the species.

Consequently, a Species Impact Statement is not required to be prepared.