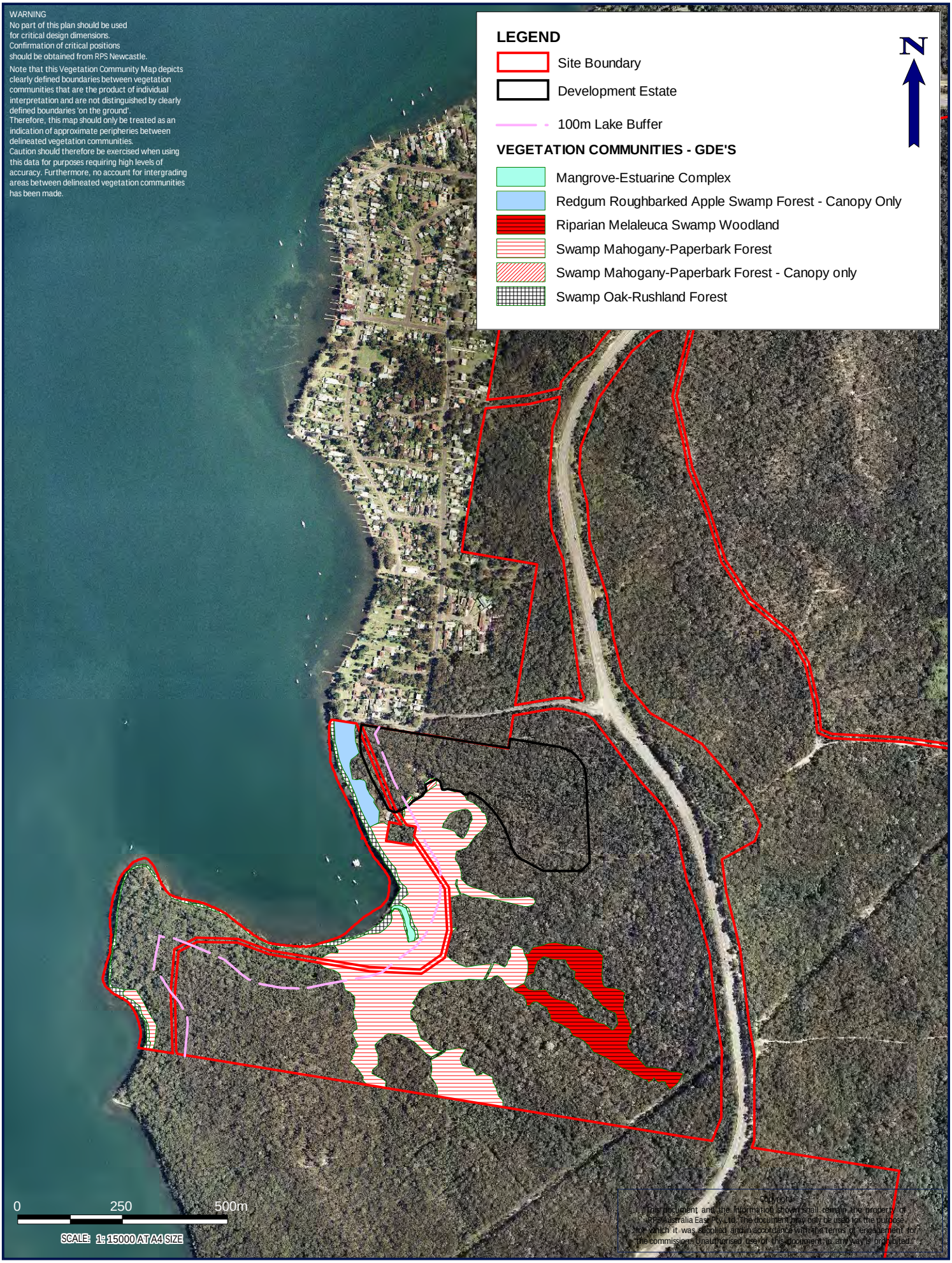

TITLE: FIGURE 4-3 GDE DISTRIBUTION | LOCATION: NORDS WHARF | DATUM: DATUM | PROJECTION: MGA ZONE 56 (GDA 94) | DATE: 8/10/2010 | PURPOSE: EAR | LAYOUT REF: 24530\DRAFT\ECO\SOUTHERN\2010TEMPLATES\FIGURE 4-3 GDE MAP 2010 A 3 | VERSION (PLAN BY): A(A.P-M.D)

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4.2 Fauna

The results of fauna survey work carried out on the site are as follows (Refer Figure 4-4). A comprehensive list of species expected and recorded during the survey period is presented in Appendix 3.

4.2.1 NPWS Threatened Species Database Search Results

The results of the above search indicated that 35 threatened fauna species have been previously recorded within 10km (DECCW Wildlife Atlas 2010) of the site. Of these species, six were recorded during the fauna survey (indicated by an asterisk '*'), although one of those species, namely Glossy Black-Cockatoo, was recorded from secondary indications in the form of chewed *Allocasuarina littoralis* cones. For a number of these species no suitable habitat occurs within the site, but discussion is added below with regard to the potential for these species to occur as a precautionary approach to the assessment process.

Calyptorhynchus lathami	Glossy Black-Cockatoo*
Callocephalon fimbriatum	Gang-gang Cockatoo
Lathamus discolor	Swift Parrot
Glossopsitta pusilla	Little Lorikeet
Crinia tinnula	Wallum Froglet
Ixobrychus flavicollis	Black Bittern
Ephippiorhynchus asiaticus	Black-necked Stork
Pandion haliaetus	Osprey
Haematopus fuliginosus	Sooty Oystercatcher
Haematopus longirostris	Pied Oystercatcher
Charadrius mongolus	Lesser Sand Plover
Sterna albifrons	Little Tern
Ptilinopus regina	Rose-crowned Fruit-Dove
Ptilinopus superbus	Superb Fruit-Dove
Ninox connivens	Barking Owl
Ninox strenua	Powerful Owl*
Tyto novaehollandiae	Masked Owl
Tyto tenebricosa	Sooty Owl
Xanthomyza phrygia	Regent Honeyeater
Pomatostomus temporalis temporalis	Grey-crowned Babbler
Climacteris picumnus	Brown Treecreeper
Pyrrholaemus saggitatus	Speckled Warbler
Stagonopleura guttata	Diamond Firetail
Dasyurus maculatus	Spotted-tailed Quoll
Phascolarctos cinereus	Koala
Cercartetus nanus	Eastern Pygmy-possum
Petaurus norfolcensis	Squirrel Glider
Pteropus poliocephalus	Grey-headed Flying-fox*
Mormopterus norfolkensis	Eastern Freetail-bat*

Falsistrellus tasmaniensis	Eastern False Pipistrelle
Miniopterus australis	Little Bentwing-bat*
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat*
Myotis macropus	Large-footed Myotis
Scoteanax rueppellii	Greater Broad-nosed Bat
Vespadelus troughtoni	Eastern Cave Bat

In addition to the above threatened species, a number of threatened oceanic fauna species, including oceanic bird species and whale species, occurred within a 10km perimeter buffer of the site as a consequence of the site's proximity to oceanic habitats. These species have not been included within the above 10km threatened species list as potential impacts within the site will not include the habitats of these oceanic species.
Nevertheless, a small number of species for which records do not occur within 10km of the site (due in part, to a measure of difficulty in their surveying and limits on previous and current survey works) are considered as having a moderate or greater opportunity of occurring within the site on at least an intermittent basis. For this reason those species are included below.

Hoplocephalus bitorquatus	Pale-headed Snake
Hoplocephalus stephensii	Stephen's Banded Snake
Lophoictinia isura	Square-tailed Kite
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat

The above species were considered for their potential to occur within the site. In considering the potential occurrence of these species those broad vegetation community types found to exist within the site are discussed below with regard to their containing potential habitat attributes for those fauna species listed above.

There are hollows of sufficient size within the site's open forest habitats to represent potential nesting sites for Glossy Black-Cockatoos and *Allocasuarina* spp. occurring widely with the site provide an abundance of potential foraging for this species.

The site's open forest habitats contain hollow-bearing trees of sufficient size to provide nesting and roosting opportunities for forest owl species including the Powerful and Masked Owls and the site's forests represent potential foraging habitat for these species.
Records for Barking Owls are relatively uncommon from near coastal areas, and a local record from the vicinity of Sunshine on the Morisset peninsula is considered somewhat unusual. As such, it is considered unlikely that the site represents important habitat for this species.

Potential foraging habitat occurs for Koalas within *Eucalyptus robusta* stands on the swampy flats of the site and within open forest habitats on Browns Point where *Eucalyptus robustus and E. tereticornis* stands may provide foraging opportunities for this species.

Although a woodland and open forest species within its range, the local record of a Grey-crowned Babbler from the coastal heath of Wybung Head is considered very unusual. As such, it is considered unlikely that the site represents important habitat for this species.
Tall open forest habitats occur across the site where vegetation communities approach the lake. Within these forests there are hollow-bearing trees of sufficient size to represent nesting sites for Glossy Black-Cockatoos and forest owls and roosting sites for hollow-dwelling Microchiropteran bat species. The canopy provides insect foraging habitat for Microchiropteran bats and there are potential blossom resources for Flying-foxes, Swift Parrots and Regent Honeyeaters within *E. tereticornis* and *E. robusta* stands on Browns Point and the swampy flats of the site, respectively.

Although there are local records of Squirrel Gliders, this species appears to favour woodland habitats over tall forest habitats within the locality and it is considered unlikely that this species would occur within the site.

There are trees of sufficient size within these forests to represent nesting trees for the Osprey and conveniently located foraging habitat in the adjacent lake.

A local Gwandalan peninsula record of the Spotted-tailed Quoll is considered unusual, due to this species' preference for remote and high quality habitat. As such, the site's habitats are not considered to possess an adequate combination of sufficient remoteness, quality or extent for this species.

Rose-crowned Pigeons may move through the site on odd occasions, but most forest habitat within the site provides little foraging potential for this species.

Swamp Sclerophyll and Swamp Oak vegetation assemblages and associated wetland habitats on the lower reaches of the site's drainage lines provide habitat for Wallum Froglets; potential canopy foraging resources for Flying-foxes, Swift Parrots and Regent Honeyeaters and foraging habitat for Microchiropteran bats.

There is potential habitat within the open forest habitats of the site for both the Pale-headed and Stephen's Banded Snakes and these lands fall wholly within lands to be protected as Conservation Lands.

There is foraging habitat within the site for both the Square-tailed Kite and Yellow-bellied Sheath-tailed-bat, but those vegetation communities containing the greatest structural diversity are likely to be preferred foraging habitats for these species.

There are no wetland habitats within the site of sufficient extent or of the open nature that is suited to Black-necked Storks.

The interface of the site's drainage lines and the estuarine habitats of Lake Macquarie may represent foraging and nesting habitat for the Black Bittern, but there is no suitable habitat within the site for a range of other estuarine bird species, including, Pied and Sooty Oystercatchers, Little Tern and Lesser Sand Plover despite their occurrence in the wider locality.

4.2.2 Regionally Significant Fauna Species

Lake Macquarie Flora and Fauna Guidelines (2001) contain a list of regionally significant fauna species, of which three were identified within the site, and are listed as follows:

Macropus rufogriseus	Red-necked Wallaby
Petaurus breviceps	Sugar Glider
Vespadelus pumilus	Eastern Forest Bat

4.2.3 Terrestrial Mammals

Mammals recorded within the site encompassed species from terrestrial, arboreal and aerial guilds. Terrestrial fauna survey captures were dominated by *Antechinus stuartii* (Brown Antechinus), particularly where understorey vegetation densities were higher within open forest habitats. There was a noted absence of *Rattus fuscipes* (Bush Rat) within terrestrial fauna surveys, which may be displaced within the area by the introduced *Rattus rattus* (Black Rat), as this species was recorded in forest associated with drainage lines across the site. *Rattus lutreolus* (Swamp Rat) was recorded within and adjacent to wet habitats exhibiting dense understorey vegetation across the site and somewhat regularly within swamp sclerophyll forest with a sedge understorey habitat to the south of the scout camp. In addition to these small terrestrial mammals, foxes or secondary fox indications, such as scent marking and scats, were encountered throughout the site, but generally along track lines. *Wallabia bicolour* (Swamp Wallaby) was observed across the site during diurnal and nocturnal surveys. Grazing opportunities occur across the site for this species.

4.2.4 Arboreal Mammals

Petaurus breviceps (Sugar Glider) was identified during arboreal fauna surveys within open forest habitat across the site. This species was also observed during nocturnal spotlight surveys.
Pseudocheirus peregrinus (Ring-tail Possum) and *Trichosurus vulpecula* (Common Brush-tail Possum) were observed during nocturnal surveys on several occasions within open forest habitat with moderate understorey.

4.2.5 Bats

A number of Microchiropteran bat species were detected within the site during nocturnal surveys with a definite – probable confidence, including *Miniopterus australis* (Little Bentwing Bat), *Tadarida australis* (White-striped Freetail Bat) and calls possibly belonging to *Chalinolobus morio* (Chocolate Wattle Bat) and *Vespadelus* sp. Note: *Miniopterus australis* (Little Bentwing Bat) is listed as Vulnerable under the *TSC Act 1995*.

Pteropus poliocephalus (Grey-headed Flying Fox) was observed foraging and heard calling within the site during nocturnal survey work. Habitat occurs across the site in the form of flowering Eucalypt species with winter flowering species *Eucalyptus robusta* (Swamp Mahogany), *E. tereticornis* (Forest Red Gum) and *Corymbia maculata* (Spotted Gum) being of note during the survey period.

4.2.6 Avifauna

Habitat opportunities for avifauna within the Nords Wharf lands are largely limited to forest habitats, due to the predominance of open forest habitats within the site. Forest bird species encompassed a number of guilds with those species recorded including, whistlers and thrushes, robins, flycatchers, fairy-wrens, scrub-wrens, thornbills, whipbirds, cuckoos, finches, butcherbirds and birds of prey amongst others. The presence of nectar producing *Eucalyptus* and Proteaceous plant species throughout the understorey and canopy strata attract a wide range of nectivorous bird species such as honeyeaters and lorikeets. The lower drainage lines of the site contain *Eucalyptus robusta* (Swamp Mahogany) within swamp sclerophyll vegetation assemblages and this species is an important source of winter nectar for nectivorous species. Due to the presence of Swamp Mahogany it is possible that the site might be visited by *Lathamus discolor* (Swift Parrot) and *Xanthomyza phrygia* (Regent Honeyeater) during the winter months when these species seasonally move into the Central Coast and Lower Hunter Valley regions. The Swift Parrot and Regent Honeyeater are both listed as Endangered under the *TSC Act 1995* and the *EPBC Act 1999*. No Swift Parrots were observed during the targeted surveys. Surveys conducted in June 2008 found that *E. robusta* blossom was in short supply, although these forests are likely to represent local resources for Swift Parrots and other nectivorous birds during seasons when *E. robusta* is blossoming strongly. Observation of nectivorous bird species during the June 2008 survey were limited to sedentary honeyeater species.

Throughout the sites open forest habitats there is a widespread presence of *Allocasuarina* sp. (She Oaks), which are the source of the dominant food resource for *Calyptorhynchus lathami* (Glossy Black-Cockatoo). Chewed *Allocasuarina littoralis* (Black She-oak) nuts were noted within the Development Estate in the northwest of the site, indicating the presence of Glossy Black-Cockatoos. Glossy Black-Cockatoos are listed as Vulnerable under the *TSC Act 1995*.

Extensive wooded habitats within the site, containing moderate to high levels of understorey structural diversity and numerous hollow-bearing trees, support populations of terrestrial and arboreal mammal species. These habitat attributes are important features for forest owl species, particularly, in relation to the Nords Wharf Site, *Ninox strenua* (Powerful Owl) and *Tyto novaehollandiae* (Masked Owl). A Powerful Owl was recorded at the northern extremity of the site during nocturnal fauna surveys and other records from the locality and vicinity of the site are recorded in the DECCW Atlas of NSW Wildlife. This species requires large tracts of forest and open forest but will persist in fragmented areas. Habitat for this species occurs within open forest areas, particularly where main prey species, Sugar Gliders and Ringtail Possums, were found to occur. Roost sites occur within dense forest areas particularly within areas of *Allocasuarina littoralis.* Breeding occurs within large hollow bearing trees with quality surrounding habitat.

No evidence of Masked Owls could be detected within the site despite targeted surveys, previous records from lands to the south and west of the site (DECCW Atlas of NSW Wildlife data) and the presence of a healthy terrestrial mammal population, which is the

favoured prey guild of this forest owl species. Masked and Powerful Owls are listed as Vulnerable under the *TSC Act 1995*.

Forested habitats abut Lake Macquarie in the west of the site and here there are roosting and foraging opportunities for estuarine bird species, such as Cormorants, Pelicans, Herons, Egrets, Ducks and those birds of prey species, which frequent adjacent estuarine habitats.

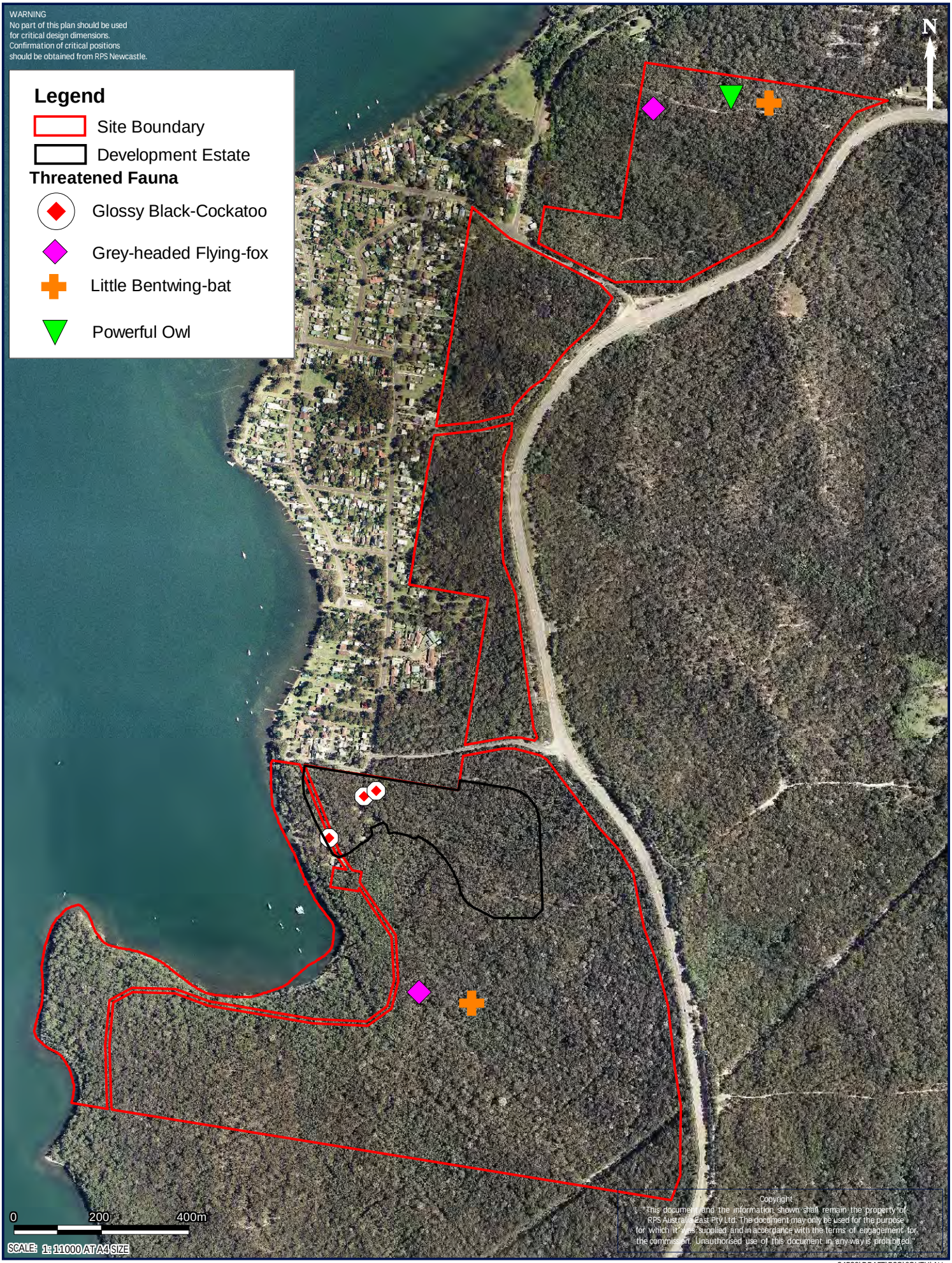
The site contains a moderate number of large and prominent Eucalypt trees that are the favoured nesting sites for birds of prey, which frequent estuarine habitats. Large estuarine birds of prey, which may use the site are White-bellied Sea Eagles, Whistling Kites and the Osprey, which is a fishing specialist that is listed as Vulnerable under the *TSC Act 1995*.

4.2.7 Amphibians

Crinia signifera (Common Froglet) was heard to call across the site within wetland environs and ephemeral ponds and creeks.

4.2.8 Reptiles

Common skink species were found within ground debris active during the day and included *Lampropholis delicata* (Grass Skink). *Pseudechis porphyriacus* (Red-bellied Black Snake) was observed active during a diurnal reptile search within the northern area of the site.



24530\DRAFT\ECO\SOUTH\ALL WORK\2010\NORDS\ FIGURE 4-6 FAUNA RESULTS 2010 A4

TITLE: FIGURE 4-4 FAUNA RESULTS
LOCATION: NORDS WHARF
DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 31/3/2010
PURPOSE: EAR
LAYOUT REF: 4-6 FAUNA RESULTS 2010 A4
VERSION (PLAN BY): A (A.P-M.D)

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JOB REF: 24530-1

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4.3 Habitat Survey

4.3.1 Flora Habitat

The vegetation communities present throughout the site offer a number of suitable habitat types for an array of native flora species. A number of geomorphological factors contribute to the diversity of vegetation communities present within the Nords Wharf site. These factors include the geology, soils, elevation, proximity to Lake Macquarie and rainfall patterns. This range of geomorphological influences has produced six vegetation communities. Swamp Mahogany Paperbark Forest and Swamp Oak Floodplain Forest vegetation communities, which occur within the site, are of significance. These vegetation communities are listed as an Endangered Ecological Communities (EEC) under the *TSC Act 1995*.

The condition of the vegetation communities varies across the site and corresponds to close proximity to urban development, tracks, fire regimes and previous clearing. The main disturbances within areas which are not adjoining urban development, are unformed tracks and associated erosion across the site. These tracks are regularly used by unauthorised motorbike riders and to a lesser extent 4WDs. Soil erosion is present along and within close proximity to the majority of the tracks along with pasture weed incursions and rubbish dumping. In addition to the aforementioned disturbances the tracks also fragment the vegetation communities across the site. The most disturbed areas are the communities immediately adjoining the urban areas in the north of the site. The Kananga Scout Camp along the foreshore of Lake Macquarie is highly disturbed due to regularly mowing and pasture weed incursions. The vegetation on Browns Point and along the foreshore is highly disturbed from weed incursions (particularly Bitou and Lantana), rubbish which has washed up on the foreshore, and also dumping of rubbish such as old cars is present within close proximity of the tracks. The vegetation within this site is of varying condition depending upon the access by the general public. The southern portion of the site has had frequent fire events that have resulted in dominance of *Pultenaea villosa* and *Dodonaea triquetra* in the understorey. The wet estuarine vegetation communities have weed incursions along the edges with remaining portions of these communities in good condition.

The Narrabeen Foreshore Redgum Ironbark community is unique to the Lake Macquarie district and occurs on the slopes exposed to Lake Macquarie behind the Swamp Oak Floodplain Forest. Whilst this community was quite disturbed by an increase in fire frequency evidenced by the density of *Dodonaea triquetra* and *Imperata cylindrica* var. *major* within this community, this vegetation community occurs only within the vicinity of Lake Macquarie in this locality.

The wetland and estuarine habitats provide habitat for the threatened species *Callistemon linearifolius,* and common occurring species such as Melaleucas, sedges, ferns and grasses.

The remaining areas of open forest have been delineated into three vegetation assemblages and the understorey varies from open grassy areas to dense shrubby understorey. These three communities provide optimum habitat for *Tetratheca juncea*, cryptic orchids and a wide variety of commonly occurring Myrtaceous, Fabaceae, herbs and grass species.

4.3.2 Fauna Habitat

Fauna recorded within the site varies with respect to vegetation quality, density and community form. The site encompasses vegetation communities ranging from Cyperoid Heath and Sedgeland habitats through Swamp Sclerophyll Forests to Tall Open Forest communities and Open Woodlands with both sparse and dense shrubby understoreys. The variation in vegetation within the site provides habitat for a diversity of common fauna species and opportunities for a moderate number of threatened fauna species.

Eucalypt and other dominant trees flowering times have potential to supply nectar and foraging opportunities for a diversity of species throughout the majority of the year. Dominant tree species and flowering period are shown in Table 4-3 below.

Table 4-3: Dominant Tree Species and Flowering Period

Threatened Flora Species	TSC listed	EPBC listed	Habitats (But not confined to) Map units REMS	Potential Threatened Fauna Species that May be attracted by Blossom	Flowering Period (Best time to Survey) in Months of the Year											
					J	F	M	A	M	J	J	A	S	O	N	D
Angophora costata	NA	NA	15, 30, 31, 34 39, 51	Micro bats (insects)	■									■	■	■
Eucalyptus punctata	NA	NA	Narrabeen Sheltered & 15	Micro bats (insects), Flying Foxes, Gliders	■	■	■								■	■
Eucalyptus resinifera	NA	NA	15, 30, 31, 34 37, 39, 42, 51	Micro bats (insects), Flying Foxes, Gliders	■	■								■	■	■
Eucalyptus haemastoma	NA	NA	31	Micro bats (insects)									■	■	■	■
Eucalyptus robusta	NA	NA	37, 42	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot					■	■	■					
Eucalyptus piperita	NA	NA	Narrabeen Sheltered & 30	Micro bats (insects)	■	■										
Eucalyptus tereticornis	NA	NA	15, 38	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot	■	■	■									
Corymbia gummifera	NA	NA	Narrabeen Sheltered & 30, 31	Micro bats (insects), Flying Foxes, Gliders	■	■	■									
Corymbia maculata	NA	NA	15	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot				■	■	■	■	■	■			

Note: The cleared areas occurring within the site are considered to be insignificant in terms of providing habitat for native fauna species aside from providing foraging habitat along the edge of the forested areas (such as for hunting bats).

Terrestrial Mammals

The site's Open Forest communities provide suitable habitat for a number of terrestrial mammals. The slopes of the site are characterised by grassy understories, providing foraging opportunities for macropods, while forest debris on the forest floor provide shelter for small marsupials. The denser understory strata of swamp sclerophyll communities on the lower flats provide foraging and shelter for native rodents and marsupials.

Trends observed from the trapping surveys indicate that small mammals such as *Antechinus* and Native Rats are generally abundant throughout any dry woodland/ forest areas across the site regardless of habitat quality.

Arboreal Mammals

The Open Forest communities contain quality foraging resources such as foliage, pollen, nectar and invertebrates for Possums and Gliders. The dominant tree species have potential to supply nectar for the majority of the year. Hollow bearing trees occur across the site. Local records for the Squirrel Glider are generally limited to woodland habitats and as such the site is not considered to provide highly suitable habitat for this species.

Bats

Wooded areas within the site provide extensive foraging habitat for insectivorous Microchiropteran bats. Potential roosting sites for those species that utilise tree hollows for roosting purposes are available in varying densities across the site. Although there are widespread foraging resources for cave-dwelling Microchiropteran bats within the site, there are no known roosting opportunities for these species occurring within the vicinity of the site.

Blossom of *Eucalyptus spp*. provide foraging opportunities for Grey-headed Flying-foxes. *E. robusta* on the site, within Swamp Mahogany – Paperbark Forest and *E. tereticornis* within Swamp Oak Rushland Forest and Narrabeen Foreshore Redgum-Ironbark Forest are likely to be the most important foraging resources for flying-foxes within the site. The Grey-headed Flying Fox is listed as Vulnerable under both the *TSC Act 1995* and the *EPBC Act 1999*.

Frogs

Permanent swamp forest habitats and creeklines with ephemeral pools that would persist after significant rain events provide significant habitat opportunities for a variety of common frog species. These habitats provide opportunities for *C. tinnula*, which is listed as Vulnerable under the *TSC Act 1995*. Adjacent wooded habitats are likely to provide foraging and shelter opportunities for a variety of common tree dwelling frog species.

Reptiles

Habitat within the site has potential for representing shelter and foraging opportunities for a diversity of common reptile species. This can be attributed to the diversity of onsite habitats, including open forest and swamp sclerophyll communities with a moderate to high floristic diversity within understorey strata.

Semi to permanent wetlands are likely to provide year round habitat, while creeklines and drainage lines with ephemeral ponds within the site provide intermittent foraging opportunities for common snake and turtle species. Upslope wooded areas are likely to represent habitat for common lizard and snake species.

Avifauna

The wooded areas provide suitable foraging resources (e.g. Invertebrate habitat and blossom) and nesting and roosting opportunities for a variety of sedentary and migratory birds. Hollow bearing trees may provide nesting habitat for hollow dependant birds such as Forest Owls, Treecreepers, Parrots, Kingfishers and Woodswallows.

Those areas of forest communities containing dense understorey strata provide cover and foraging niches for a diversity of small common forest bird species, including Scrub-wrens, Fairy-wrens, Flycatchers and Thornbills. Understorey and canopy nectar producing shrubs and trees provide foraging opportunities for a number of common honeyeaters and parrots.

The site's forest habitats provide foraging, roosting and breeding habitat for nocturnal birds, including Owlet Nightjars, Tawny Frogmouths and Forest Owls. Established populations of both arboreal and terrestrial mammal species represent the favoured prey species of forest owls and the site has hollow-bearing trees of sufficient size to represent breeding sites for these birds and roosting sites for Masked Owls. The site has vegetation of sufficient density to provide roosting sites for Powerful Owls.

4.3.3 Habitat Mapping

Habitat mapping has been undertaken based on the results of field assessment coupled with the results of floristic investigations and RPS Ecology staff combined observations and experience. To optimise the habitat mapping for display and analysis, habitat quality has been divided into the five categories outlined below, based on the habitat assessment elements discussed previously in Table 3-2. The habitat assessment elements are; hollow bearing tree density, Eucalypt diversity, Allocasuarina species density, Proteaceae species density, structural diversity and fallen timber density.

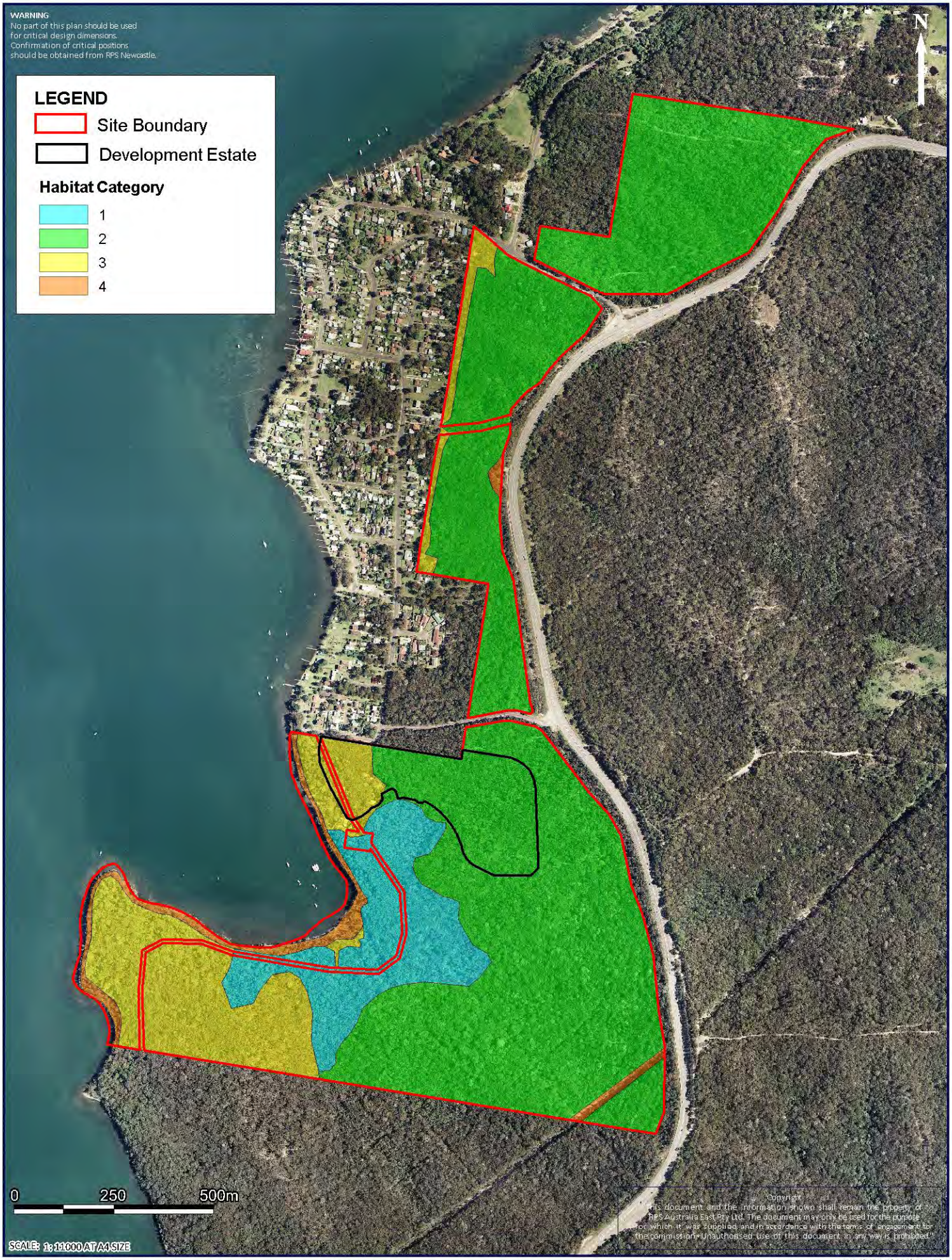
1. **High** – Quality habitat with native flora showing no significant disturbance, with old growth elements, intact understorey and year round foraging opportunities preferable to significant and threatened fauna species that includes forest owls, arboreal mammals, avifauna (includes EEC with no weed incursion and areas perceived to have regionally unique floristic representations or fauna habitat).

2. **Above average** – Quality habitat with native flora showing little to no disturbance with moderate level of key elements. These areas are likely to be utilised by native fauna species, including threatened species, as part of a larger home range (includes EEC with minor weed incursion).

3. **Average quality** – Habitat with dominant native community with low – moderate level within elements, and includes areas of recent fire disturbance where understorey diversity is low with long term natural regeneration likely (also includes EEC with moderate weed incursion).

4. **Below average** – Habitat representing a native vegetation community with high weed incursion and other disturbances and low level of foraging opportunities (includes EEC with severe weed incursion, and disused tracks with signs of native regeneration).

5. **Low** – Cleared land dominated by exotic flora species and representing preferred habitat for exotic fauna species (includes highly disturbed and frequently used tracks).



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TITLE: FIGURE 4-5 HABITAT CONDITION MAP	LOCATION: NORDS WHARF	DATUM: DATUM PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 31/3/2010 PURPOSE: EAR	LAYOUT REF:FIG4-7 HABITAT 2010 A4 VERSION (PLAN BY):A (A.P-M.D)

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JOB REF: 24530-1

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5 Threatened Species and Communities Assessment

5.1 Identification of Subject Species and communities

Those threatened flora and fauna species (listed under the *TSC Act 1995* and *EPBC Act 1999*) that have been gazetted / recorded from within the vicinity of the site have been considered within this assessment. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the overall proposal. This assessment deals with each species / community / population separately and identifies the ecological parameters of significance associated with the overall proposal.

Those species / communities that have been identified as having either a moderate level of impact (or greater) as a result of the proposed Development Estate or that have been recorded within the site during field investigations have been subject to further assessment within Section 5.2 of this report.

'Species' or **'EEC / Population'** – Lists each threatened species / EEC / population known from the vicinity of the site. The status of each threatened species under the *TSC Act 1995* and *EPBC Act 1999* is also provided.

'Habitat Description and Known Populations' or **'Habitat Description and Known Stands / Populations'** – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

'Chance of Occurrence within Site'– Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impact within Development Estate'– Assesses the likely level / significance of impacts to each species / community / population that would result from the proposed Development Estate, taking into account both short and long-term impacts. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposal, including the likely 'ecological footprint', duration of construction works, proposed remediation works etc. All impact assessment is undertaken with due consideration to the conservation lands forming part of the proposal.

Table 5-1: Threatened Species

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Plants			
Caladenia porphyrea (E)	An endemic Australian orchid, *C. porphyrea* grows in coastal sclerophyll forest on sandy soils. In NSW, this species has a highly restricted geographic distribution. It has been recorded from 2 localities in the Wyong local government area north of Gosford approximately 2 km apart. At these locations it covers areas of about 2 ha and 0.2 ha respectively.	**Moderate** Flora surveys were conducted within the flowering season for this species, in the Development Estate and the areas to the south of the DA area. Whilst, sub-optimal habitat for this species occurs throughout the DA area the dense cover of *Dodonaea triquetra* reduces the area of habitat. Not all areas of the conservation lands to the north were survey and therefore this species could be present within that area.	**Low** Although there is some sub-optimal habitat for this species to occur within the Development Estate lands, those areas representing the best habitat opportunities for this species will be conserved within the current proposal.
Caladenia tessellata Tessellated Spider Orchid (E, V*)	A small terrestrial orchid, which regrows its single leaf on an annual basis. It is known to occur in grassy woodland and locally it has potential to occur within Coastal Plains Scribbly Gum Woodland. It has been recorded within Munmorah State Recreation Area to the south of the site.	**Moderate** Flora surveys were conducted within the flowering season for this species, in the Development Estate and the areas to the south of the DA area. Whilst, sub-optimal habitat for this species occurs throughout the DA area the dense cover of *Dodonaea triquetra* reduces the area of habitat. Not all areas of the conservation lands to the north were survey and therefore this species could be present within that area.	**Low** Although there is some sub-optimal habitat for this species to occur within the Development Estate lands, those areas representing the best habitat opportunities for this species will be conserved within the current proposal.
Callistemon linearifolius (V)	Shrub that grows in dry sclerophyll forest on the coast and adjacent ranges. Significant populations recently found within the Lower Hunter, including Werakata National Park. Re-sprouting / juvenile specimens difficult to distinguish from other *Callistemon* species such as *C. rigidus* or *C. linearis* without the aid of flowering parts. Locally this species has been recorded where dry forest habitats interface with salt tolerant vegetation communities, such as Swamp Oak Rushland Forest and Riparian Melaleuca forest.	**Moderate** Potential habitat for this species occurs on the lower slopes of the site where dry forest habitats merge with Swamp Oak and Swamp Sclerophyll vegetation assemblages bordering Crangan Bay in the west. Targeted searches failed to locate this species within the Development Estate and the majority of the conservation lands.	**Low** Much of the areas where this species might occur within the site will be retained as conservation areas, but there is some potential for this species to occur near to the southern boundary of the Development Estate.
Cryptostylis hunteriana Leafless-tongue Orchid (V, V*)	A cryptic Saprophytic orchid species that flowers between December and February. Distribution limits N-Gibraltar Range S- south of Eden. Grows in a variety of habitats from tall open forests to swamp heath on sandy soils. Local records exist from the Wallarah peninsula to the north of the site (Atlas of NSW Wildlife data).	**Moderate – High** The relatively wide range of possible habitats that this species potentially occurs within and the ubiquitous presence of a closely related species, *C. subulata*, with which this species is sometimes associated, suggests that it may occur within any of the site's habitats, except those that are very wet or saline in nature. As targeted searches for this species have note been completed within the flowering period of this species the presence of this species within the Development Estate cannot be discounted.	**Low** Although there is some potential for this species to occur within the Development Estate lands, abundant areas representing excellent habitat opportunities for this species will be conserved within the current proposal.
Diuris praecox Newcastle Doubletail (V, V*)	Found predominantly in coastal Eucalypt forests on hilltops or slopes. This species has been recorded at a number of dry woodland locations to the southeast of Lake Macquarie.	**High** A record exists for this species just outside boundary in the central section of the site (Atlas of NSW Wildlife data). Onsite habitat in the vicinity is commensurate with the sites of other records in the area. This species was not recorded during targeted searches but habitat contained a number of other terrestrial orchid species. Habitat within the Development Estate lands is not considered optimal for this species, due to the dominance of understorey vegetation by *Dodonaea triquetra*.	**Low** Those areas representing the most suitable habitat for this species will be retained within the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Genoplesium insignis Variable Midge Orchid (E)	Genoplesium insignis (Variable Midge Orchid) is a terrestrial orchid only known from four localities between Chain Valley Bay and Wyong in the Wyong Local Government Area, where it grows in patches of Themeda australis (Kangaroo Grass) amongst shrubs and sedges in heathland and forests. Associated vegetation at Chain Valley Bay is described as dry sclerophyll woodland dominated by Eucalyptus haemastoma (Scribbly Gum), Corymbia gummifera (Red Bloodwood), Angophora costata (Smooth-barked Apple) and Allocasuarina littoralis (Black She-oak).	**Low - Moderate** The presence of records within the central coast area and the occurrence of habitat, as described from other locations where this species has been recorded, suggests that this species may have sub-optimal habitat within the site.	**Low** Although there is some potential for this species to occur within the Development Estate lands, abundant areas representing excellent habitat opportunities for this species will be conserved within the current proposal
Melaleuca biconvexa Biconvex Paperbark (V, V*)	A shrub to small tree, which grows in poorly drained areas from Jervis Bay to Port Macquarie. Records in the Hunter Region are confined to western Lake Macquarie (Atlas of NSW Wildlife data).	**Low** The closest records for this species occur to the west of Lake Macquarie and this species was not recorded during flora surveys conducted within the site. Therefore it is considered unlikely to exist within the site.	**Low** It is unlikely that the current proposal will represent a threat to this species due to the unlikelihood of it occurring within the site.
Microtis angusii Angus's Onion Orchid (E, E*)	Record from the Terry Hill's district of Sydney. Occurs upon disturbed soil horizons that were originally ridgetop lateritic soils supporting a distinctive open to low open forest community, Duffy's Forest Vegetation Community, which is listed as an EEC. Suspected occurrences in the southern Lake Macquarie hinterland are derived from a tentative record by Bell (1998) in the Lake Macquarie State Recreation area, which occurs to the south of Gwandalan.	**Low - Moderate** The presence of records within the central coast area and the occurrence of habitat, as described from other locations where this species has been recorded, suggests that this species may have sub-optimal habitat within the site.	**Low** Considered unlikely to be adversely affected by the current proposal due to suitable habitat existing within the Conservation Estates.
Syzygium paniculatum Magenta Lilly Pilly (V, V*)	A shrub to small tree, found in sub-tropical and littoral rainforest on sandy soils or sheltered gullies mostly near water courses. Distribution between Bulahdelah and Jervis Bay. Hunter Region records confined to the Lake Macquarie hinterland (Atlas of NSW Wildlife data).	**Low** Marginal habitat for this species occurs within the drainage flats and associated mesic vegetation assemblages of the lower western slopes of the site. Investigation of Lilly Pilly species in these areas identified all species to be *Acmena smithii*. Targeted searches failed to locate this species within the Development Estate or the majority of the conservation lands.	**Low** It is unlikely that the current proposal will represent a threat to this species due to the unlikelihood of it occurring within the site. Notwithstanding, any possible occurrences within potential habitat will be retained as conservation lands within the current proposal.
Tetratheca glandulosa (V, V*)	Tetratheca glandulosa (Black-eyed Susan) is a small erect or spreading shrub growing to 50cm high. It is found in heath and woodland communities and prefers well-drained soils in an open sunny position	**Low – Moderate** A small amount of sub-optimal habitat exists within the site. Despite searches being conducted during the flowering period, no individuals were recorded within the site. It is therefore considered that this species has a low – moderate chance of occurrence on site	**Low** Considered unlikely to be adversely affected by the current proposal due to suitable habitat existing within the Conservation Estates.
Tetratheca juncea Black-eyed Susan (V)	Occurs in a variety of forested and heathy habitats. Locally found in Open Forests and Woodlands with dense, undisturbed understorey, often in association with *Angophora costata* / *Corymbia gummifera* on slopes with south-easterly aspects. A number of records exist from the locality including a record from the central northern area near the Pacific Highway (Atlas of NSW Wildlife data).	**High** A large population of this species (over 6,500) was located throughout the Coastal Sheltered Peppermint -Apple Forest, Narrabeen Wallarah Sheltered Grassy Forest and Coastal Plains Smooth-barked Apple Forest within the Nords Wharf site. The distribution of the species was spread throughout both the Development Estate and the Offset Lands, with the majority occurring within the conservation lands.	**Low** Although a portion of the current population within the site will be removed (12%) a large portion will be retained within the conservation lands. In addition, large populations are currently reserved within conservation lands within the Wallarah Peninsula. Therefore the current proposal is unlikely to place a local population of this species at a greater risk of extinction.
Herpetofauna			
Crinia tinnula Wallum Froglet (V)	Occurs in coastal, low-lying acid Paperbark forest, within the 'wallum country' (often on sandy soils). Regional records for this species are confined to three main areas; Lake Macquarie, Central Coast and Medowie and Port Stephens (Atlas of NSW Wildlife data).	**Moderate – High** Although this species was not recorded within the site during fauna surveys, there is suitable habitat within the lower swamp flats in the corner of Crangan Bay and records for this species in the local area.	**Low – Moderate** The habitats within which this species occurs within the site will be retained within areas dedicated to Conservation Land. However, minimisation of potential impacts to the population occurring within down-slope habitat will be dependent upon careful management of stormwater from proposed residential development represented by the proposed Development Estate.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Hoplocephalus bitorquatus Pale-headed Snake (V)	A nocturnal and partially arboreal snake, which inhabits a wide range of habitats from rainforest to drier Eucalypt forest. This species is patchily distributed from Tuggerah to Cape York Peninsula (Cogger 1996). Records in the Hunter Sub-bioregion exist from Paterson (Atlas of NSW Wildlife data).	**Low – Moderate** Due to its generalist habitat requirements, this species could potentially exist in any of the tall open forest habitats within the site, particularly within mesic vegetation within the lower drainage lines of the site.	**Low** The habitats within which this species might potentially occur within the site will be retained within areas dedicated to conservation lands.
Hoplocephalus stephensii Stephen's Banded Snake (V)	A nocturnal and partially arboreal snake which inhabits a range of habitats from rainforests to both wet and dry sclerophyll forests from Gosford north into southern QLD (Swan *et. al*. 2004).	**Low – Moderate** Due to its generalist habitat requirements, this species could potentially exist in any of the tall open forest habitats within the site, particularly within mesic vegetation within the lower drainage lines of the site.	**Low** The habitats within which this species might potentially occur within the site will be retained within areas dedicated to conservation lands.
Litoria aurea Green and Golden Bell Frog (E, V*)	Inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. Thought to be displaced from more established sites by other frog species, thus explaining its existence on disturbed sites. Previously widespread within the Sydney Basin Bio-region, but now sparsely distributed within the Lower Hunter and Central Coast areas.	**Low** Wetland habitats within the site are not strongly suited to this species and the marked decline of this species from those areas which it once frequented and the absence of records from the locality strongly suggest that this species is unlikely to occur within the site. This species was not recorded within the site during fauna surveys encompassing potential habitat.	**Low** The occurrence of this species within the site is unlikely, however, habitats within which this species might potentially occur will be retained within areas dedicated to conservation lands.
Litoria littlejohni Little John's Tree Frog (V, V*)	A pale brown frog with dark speckles, which occurs along permanent rocky creeks with thick fringing vegetation associated with Eucalypt woodlands and heaths among sandstone outcrops. Occurs on the plateaus and eastern plains of the Great Dividing Range. Records within the Hunter Region are from within the Watagan National Park.	**Low** This frog is not likely to occur within the study area, given the apparent specificity of habitat to sandstone –based creeks within the high country to the west of Lake Macquarie.	**Low** Considered unlikely to be affected by the proposal.
Mixophyes balbus Southern Barred Frog (E, V*)	A relatively large and muscular frog, growing to about 8 cm in length. Stuttering Barred Frogs occur along the east coast of Australia from southern Queensland to north-eastern Victoria. The species has suffered a marked decline in distribution and abundance, particularly in south-east NSW. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	**Low** This species is unlikely to occur within the site as its known to prefer foothills and escarpment areas well to the west of the site in the Watagan Mountains.	**Low** Considered unlikely to be affected by the proposal.
Mixophyes iteratus Giant Barred Frog (V)	A large frog up to 115 mm in length. It inhabits rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000m. Found in coastal and upland areas from south-eastern Queensland to the Hawkesbury River in NSW. North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is now a stronghold. Deep damp leaf-litter is preferred shelter and foraging sites for this frog.	**Low** Given the preference of this frog for rainforest and wet sclerophyll forest within mountainous country. It is unlikely to occur within the site.	**Low** Considered unlikely to be affected by the proposal.
Pseudophryne australis Red-crowned Toadlet (V)	The Red-crowned Toadlet has a restricted distribution. 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 and occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits 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. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Disperses outside the breeding period, when they are found under rocks and logs on sandstone ridges and forage amongst leaf-litter.	**Low** This frog has quite specific habitat requirements being restricted to substantial areas of Hawkesbury sandstone. It is therefore unlikely to occur within the site.	**Low** Considered unlikely to be affected by the proposal.
Avifauna			
Lophoictinia isura Square-tailed Kite (V)	Inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. They may also range in nearby open habitats but not into extensive treeless regions. This species is notably absent from alpine regions and small isolated remnant woodlands in large open areas. Records exist from the Cessnock and Maitland LGA's and there are records for this species from Cooranbong in the southwest of the Lake Macquarie LGA (Atlas of NSW Wildlife data; HBOC records). Records for this species within the Lower Hunter are generally limited to Autumn.	**Low – Moderate** Due to the generalist habitat requirements of this species, it could potentially occur within the site on a seasonal basis. Records in the Hunter Sub-bioregion are generally sparse and it would be difficult to locate during targeted surveys.	**Low** Given that those areas most suitable as hunting habitat for this species will be retained within conservation areas it is unlikely that the current proposal will represent a significant threat to this species.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Pandion haliaetus Osprey (V, M*)	Requires water bodies for fishing in close proximity (usually <1km) to suitably tall nesting site such as dead tree, power pole etc. Recorded from various sites around Lake Macquarie, Port Stephens and the Hunter River Estuary. An accidental species on freshwater wetlands away from the coast. Coastal records for this species occur to the south of the site.	**Moderate** Ospreys have been recorded in southern Lake Macquarie and the waters of Crangan Bay offer excellent hunting opportunities for this species. Small numbers of trees within the site are of sufficient size to represent potential nesting trees for this species although no nests or birds were noted during fauna surveys.	**Low** Potential nesting habitat for this species will be retained within the current proposal.
Ixobrychus flavicollis Black Bittern (V)	Solitary species, living near water (estuarine to brackish) in mangroves and other trees which need to form only a narrow fringe of cover. A riparian species that occasionally ventures into the open within estuarine habitats.	**Moderate** This species is known to occur along the lower tidal sections of creeks entering Lake Macquarie (Author pers. obs., HBOC) and it is possible that this species may use the estuarine habitats in the corner of Crangan bay.	**Low - Moderate** The habitats within which this species potentially occurs within the site will be retained within areas dedicated to conservation lands. Despite the conservation of these lands, there is potential for the Bittern's estuarine foraging habitats to be adversely impacted upon by increases in stormwater and sediment flows unless sediment and stormwater management plans are incorporated into the planning, construction and residential phases of the current proposal.
Callocephalon fimbriatum Gang-gang Cockatoo (V)	Occurs in forests and woodlands where it forages on the seed capsules of Eucalypts. Sedentary, seasonally nomadic or part-migratory, this species shows a general trend to leave highland habitats in winter for more lowland districts. Requires large Eucalypt tree hollows for nesting. Records exist from the Watagan Mountains and adjacent lowlands and foot hills (Atlas of NSW Wildlife data; Author pers. obs.).	**Low – Moderate** Most local records for this species occur from the Watagan Mountains and their adjacent lowlands, well to the west of the site. However, seasonal movements of this species to areas east of the Watagans have been observed (Author pers. obs.) and this species is known to feed on the fruit of *Eucalyptus signata*, which is abundant within the site. Therefore its use of the site on at least an intermittent basis cannot be discounted.	**Low** Large areas representing potential foraging habitat for this species will be retained within the current proposal despite the loss of a small amount of potential foraging habitat.
Calyptorhynchus lathami Glossy Black-Cockatoo (V)	Occurs in forests and woodlands where it forages predominantly on *Allocasuarina* cones. Requires large Eucalypt tree hollows for nesting. Records within the Hunter Sub-bioregion predominantly from relatively undisturbed forested areas on the ranges such as the Watagan Forests, with isolated records from the valley floor remnants. Locally there are records from Gwandalan and Point Wollstonecraft (Atlas of NSW Wildlife data) to the north of the site.	**High** Chewed *Allocasuarina littoralis* cones noted within the development Estate. Due to the occurrence of records within the vicinity of the site and the abundant presence of *Allocasuarina littoralis* (Black She-oak), which is a known feed species for Glossy Black-Cockatoos, it is highly likely that this species occurs within the site on a regular basis.	**Low** Although it is likely that a small amount of foraging resources for this species may be lost during the process of development, large areas containing foraging habitat and potential nesting habitat will be retained and protected as conservation lands under the current proposal.
Xanthomyza phrygia Regent Honeyeater (E, E*)	Nomadic Honeyeater that disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. Within the Lake Macquarie LGA this species is generally associated with *Eucalyptus robusta* (Swamp Mahogany). Local occurrences are during winter months when this species flowers, although their stronghold is west of the great divide and it appears that movements to the coast only occur when foraging resources to the west and, to some extent, the Central to Lower Hunter Valley fail.	**Moderate** Potential foraging habitat for this species in the form of winter-flowering eucalypts, such as *E. robusta* and *E. tereticornis*. Therefore its seasonal presence within the site on at least an intermittent basis cannot be discounted.	**Low** Those areas representing potential foraging habitat for this species will be retained within the current proposal.
Lathamus discolor Swift Parrot (E, E*)	On the mainland this species frequents Eucalypt forests and woodlands with large trees having high nectar production during winter. Mainland winter foraging sites often vary from year to year. Nests only in Tasmania. When recorded within the Lake Macquarie LGA this species is often associated with winter flowering eucalypt species such as *E. robusta* and *E. tereticornis* (Author pers. obs.), but they are known to forego nectar resources for lerps, which occur on a variety of eucalypt species. Locally this species has been recorded on the Wallarah Peninsula to the north and Point Wollstonecraft and Wyee Point to the west (Atlas of NSW Wildlife data).	**High** Due to the occurrence of records within the vicinity of the site, its high mobility and the presence of winter-flowering eucalypts, such as *E. robusta* and *E. tereticornis* within the site, it is highly likely that this species occurs within the site on at least an intermittent basis.	**Low** Those areas representing potential foraging habitat for this species will be retained within the current proposal.
Ninox strenua Powerful Owl (V)	Occurs in sclerophyll forests and woodlands where suitable prey species occur (being predominantly arboreal mammals). Requires large hollows, usually in Eucalypt trees, for nesting. Roosts in dense vegetation within such areas. Records from the Hunter Sub-bioregion are fairly widespread (HBOC records; RPS ecologists pers. obs.).	**High** This species was recorded within the northern portion of the site during nocturnal fauna surveys and habitat assessment noted hollows of sufficient size to represent potential breeding sites for this species.	**Low – Moderate** Large areas representing potential foraging habitat for this species will be retained within the current proposal. However, some potential foraging habitat for this species will be lost within the Development Estate.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Tyto novaehollandiae Masked Owl (V)	Found in a range of habitats, locally within sclerophyll forests and woodlands where appropriate / preferred prey species occur (being predominantly terrestrial mammals). Requires large Eucalypt hollows for nesting and prefers to roost in these hollows as well. Records from the Hunter Sub-bioregion are fairly widespread within the sub-coastal districts and often of road kill birds (HBOC records; RPS ecologists pers. obs.). Local records for this species occur on Point Wollstonecraft, several on the Wallarah Peninsula to the north and 2 records within 2km of the site to the south.	**High** There are a number of records for this species within the vicinity of the site and the terrestrial mammal species that they prefer occur within the site in abundance. Therefore it is highly likely that the site represents part of the home range of individuals of this species. Hollows of sufficient size to represent potential breeding sites for this species were noted during habitat assessment.	**Low – Moderate** Although it is likely that a small amount of foraging habitat for this species may be lost during the process of development, large areas containing foraging habitat and potential nesting habitat will be retained as conservation lands under the current proposal.
Tyto tenebricosa *Sooty* Owl (V)	Occurs in wet Eucalypt forest and rainforest with tall emergent trees, often in easterly facing gullies. Within these areas this species hunts for a range of mainly mammalian prey at all levels of the forest strata. Roosts in tree hollow or dense canopy vegetation. Also nests in large Eucalypt tree hollows. Most Hunter records exist from the Watagan mountains (Atlas of NSW Wildlife data), but this species has also been observed to the southwest of Awaba (RPS ecologist pers. obs.) and a record occurs to the north on the Wallarah peninsula (Atlas of NSW Wildlife data).	**Low** Despite the presence of a record existing for this species in the north on the Wallarah Peninsula and mesic vegetation assemblages in lower drainage lines of the site, these communities cannot be classified as wet sclerophyll and are not of sufficient extent or structural diversity to support this species.	**Low** The current proposal is unlikely to impact upon this species due to a lack of suitable habitat within the site.
Mammals			
Planigale maculata Common Planigale (V)	A cryptic species known from a variety of habitats ranging from rainforest, wet and dry sclerophyll forests to grasslands, marshlands and rocky areas. In these habitats it shelters under logs and rocks and any available burrows such as cracking soils. It is a ferocious predator of small insects, often tackling prey of its own size. Within the Hunter Sub-bioregion, no records exist on the Atlas of NSW Wildlife. Records from the wider locality occur only from the Watagan Mountains and Barrington Tops National Park.	**Low** Given its generalist habitat requirements it could potentially occur anywhere containing wooded habitat, although given the complete lack of records in the Lake Macquarie LGA outside of the Watagan Mountains it is considered unlikely to occur within the site.	**Low** Considered unlikely to be affected by the proposal.
Dasyurus maculatus Spotted-tailed Quoll (V)	Found in a variety of forested habitats where suitable prey species occur. This species creates a den in fallen hollow logs or among rocky outcrops. Generally does not occur in otherwise suitable habitats that are in close proximity to urban development, although isolated records from such areas do exist. In the southern Lake Macquarie locality there are a number of records, including a 1998 record from Point Wollstonecraft.	**Low – Moderate** The chances of occurrence are relatively low despite the occurrence of local records, due to the levels of ongoing disturbance outside the site.	**Low** Considered unlikely to be resident although those areas of greatest potential to represent habitat for this species will be retained as conservation areas within the current proposal.
Petaurus australis Yellow-bellied Glider (V)	Usually associated with tall, mature wet Eucalypt forest. Also known from tall dry open forest and mature woodland. The diverse diet of this species is primarily made up of Eucalypt nectar, sap, honey dew, manna and invertebrates found under decorticating bark and pollen. Tree hollows for nest sites are essential, as are suitable food trees in close proximity. Most records in the Lower Hunter Region occur in the Watagan Mountains and other areas exhibiting significant stands of forest (Atlas of NSW Wildlife data).	**Low** No coastal records occur for this species in the vicinity of the site.	**Low** The current proposal is unlikely to impact upon this species due to a lack of suitable habitat within the site.
Petaurus norfolcensis Squirrel Glider (V)	Occurs in Eucalypt forests and woodlands where it feeds on sap exudates and blossoms. In these areas tree hollows are utilised for nesting sites. Also requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species. Widely distributed across the lower Hunter Sub-bioregion, few records from the Upper Hunter (Atlas of NSW Wildlife data). Locally there are a number of records for this species on the Gwandalan peninsula.	**Low – Moderate** Although records for this species occur within woodland habitats to the west of the site, glider records in the open forest habitats within and in the vicinity of the site are generally limited to sugar gliders. However, due to its presence in the locality the potential for this species to occur with the site cannot be discounted.	**Low** Although it is likely that a small amount of potential habitat for this species may be lost during the process of development, large areas containing foraging habitat and potential nesting habitat will be retained as conservation lands under the current proposal.
Phascolarctos cinereus Koala (V)	Occurs in forests and woodlands where it requires suitable feed trees (particularly *Eucalyptus* spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions. Records from the Hunter Sub-bioregion are generally scarce, with a small number of records from Cessnock, Singleton and Muswellbrook LGA's. Within the Greater Hunter Region it is largely confined to the Port Stephens area, the Lake Macquarie hinterland and the Watagan Mountains (Atlas of NSW Wildlife data).	**Low – Moderate** Records for Koalas occur to the south of the site and there are Koala feed tree species within the site. However, no evidence of Koalas was observed during fauna surveys.	**Low** Those areas representing potential foraging habitat for this species will be retained within the current proposal. Therefore, it is unlikely that the current proposal will represent a significant threat to local populations of this species.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Cercartetus nanus Eastern Pygmy Possum (V)	Occurs from rainforest through sclerophyll forest to tree heath. Favoured food includes banksias, myrtaceous shrubs and trees and insects. Nesting sites are generally in drier habitats. Records in the Hunter Sub-bioregion are very scarce. Within the Greater Hunter Region records exist from the Watagan Mountains and Barrington Tops National Park (Atlas of NSW Wildlife data).	**Low – Moderate** No indications that this species occurs within the site were observed during fauna surveys, although there are areas of forest containing Proteaceous plant species, which may be suitable for this species.	**Low** Large areas representing potential habitat for this species will be retained within the current proposal despite the loss of a small amount of marginal habitat for this species.
Pteropus poliocephalus Grey-headed Flying-fox (V, V*)	Forages over a large area for nectar / fruits etc. Seasonally roosts in communal base camps situated within wet sclerophyll forests or rainforest. Frequently observed to forage in flowering Eucalypts. May occur anywhere within the Hunter Sub-bioregion where food or roosting resources are available.	**High** Recorded at a number of locations within the site associated with flowering *E. robusta* and *E. paniculata.* There are no roosting camps for this species in the vicinity of the site.	**Low** Those areas representing potential foraging habitat for this species will be retained within the current proposal.
Miniopterus schreibersii Eastern Bentwing-Bat (V)	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat. Widely distributed across the Hunter Sub-bioregion, particularly in sub-coastal districts (Atlas of NSW Wildlife data). A number of records for this species occur within the vicinity of the site, including a record from the northern end of the site.	**High** This species is likely to use the site regularly as part of its foraging range, but no roosting habitat is known within the site.	**Low – Moderate** Although it is likely that a small amount of foraging habitat for this species may be lost during the process of development, large areas containing foraging habitat will be retained as conservation lands under the current proposal.
Miniopterus australis Little Bentwing-bat (V)	Prefers to forage in well-vegetated areas, such as within wet and dry sclerophyll forests and rainforests. Requires caves or similar structures for roosting habitat. Largely confined to more coastal areas in the Hunter region (Atlas of NSW Wildlife data). A number of records for this species occur within the local area (Atlas of NSW Wildlife data).	**High** This species was recorded during bat surveys and is likely to use the site regularly as part of its foraging range, but no roosting habitat is known within the site.	**Low – Moderate** Although it is likely that a small amount of foraging habitat for this species may be lost during the process of development, large areas containing foraging habitat will be retained as conservation lands under the current proposal.
Mormopterus norfolkensis Eastern Freetail-bat (V)	This species forages predominantly in dry forests and woodlands east of the divide. It roosts in tree hollows, under bark and within man-made structures. Found within a scattered distribution across the Lower Hunter Region. Locally it occurs within the Lake Macquarie hinterland and a record exists from the north of the site (Atlas of NSW Wildlife data).	**High** This species is likely to use the site regularly as part of its foraging range, and may use the abundant hollows within the site for roosting habitat.	**Low – Moderate** Although it is likely that a small amount of foraging habitat for this species may be lost during the process of development, large areas containing foraging and roosting habitat will be retained as conservation lands under the current proposal.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat (V)	Occurs in a range of habitats from rainforest to arid shrubland, roosts in tree-hollows. Near coastal records occur to the south in the Wyong and Gosford LGAs (Atlas of NSW Wildlife data).	**Moderate - High** Due to its mobility and the occurrence of other records in near coastal districts to the south it is likely that this species uses the site on at least an intermittent basis. Potential roosting habitat for this species occurs within the site.	**Low – Moderate** Although it is likely that a small amount of foraging habitat for this species may be lost during the process of development, large areas containing foraging and roosting habitat will be retained as conservation lands under the current proposal and foraging opportunities will continue to exist within the Development Estate.
Falsistrellus tasmaniensis Eastern False Pipistrelle (V)	This species is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m). This species roosts in tree hollows. Few records occur within the Hunter Sub-bioregion, but locally a record for this species occurs on Pulbah Island to the north (Atlas of NSW Wildlife data).	**Moderate - High** Due to its mobility and the occurrence of records within the locality it is likely that this species uses the site on at least an intermittent basis. Potential roosting habitat for this species occurs within the site.	**Low – Moderate** Although it is likely that a small amount of foraging habitat for this species may be lost during the process of development, large areas containing foraging and roosting habitat will be retained as Conservation Lands under the current proposal and foraging opportunities will continue to exist within the Development Estate. Therefore, it is unlikely that the current proposal will represent a significant threat to local populations of this species.
Chalinolobus dwyeri Large-eared Pied Bat (V)	This species forages in tall open forests, including dry forests and the edges of rainforest. It roosts in mine shafts and similar structures. Hunter Region records for this species are largely confined to the Watagan Mountains well to the west of the site (Atlas of NSW Wildlife data).	**Low** Due to the absence of records from within the local area it is unlikely that this species would occur within the site.	**Low** Although this species is unlikely to occur within the site, suitable abundant foraging habitat will be retained as conservation areas within the current proposal and foraging opportunities will continue to exist within the Development.
Myotis macropus Large-footed Myotis (V)	Usually found near bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Roosts in colonies of between a dozen and several hundred individuals in caves, mines and disused railway tunnels. Local records for this species occur at Vales Point and Lake Munmorah (Atlas of NSW Wildlife data).	**Low – Moderate** This species has been recorded within the locality of the site, but there are limited foraging aquatic opportunities within the site. No known roosting sites occur within the site for this species.	**Low – Moderate** Those areas representing potential foraging habitat for this species will be retained within the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Scoteanax rueppellii Greater Broad-nosed Bat (V)	Forages in moister gullies and wet sclerophyll forests as well as in lightly wooded areas and open spaces / ecotones. This species roosts in tree hollows and its relatively widespread within the Lower Hunter Region extends to a local record at the southern end of Ruttleys Road (Atlas of NSW Wildlife data).	**Moderate - High** Due to its mobility and the occurrence of records within the locality it is likely that this species uses the site on at least an intermittent basis. Potential roosting habitat for this species occurs within the site.	**Low – Moderate** Although it is likely that a small amount of foraging habitat for this species may be lost during the process of development, large areas containing foraging and roosting habitat will be retained as Conservation Lands under the current proposal and foraging opportunities will continue to exist within the Development Estate.
Vespadelus troughtoni Eastern Cave Bat (V)	A cave dweller, known from wet sclerophyll forest and tropical woodlands from the coast and Dividing Range to the drier forests of the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally in buildings. In all situations, the roost sites are frequently in reasonably well-lit areas. The distribution of this species is largely to the north of the Hunter (Strahan 1995), with one record at Windermere Park in south-western Lake Macquarie (Atlas of NSW Wildlife data).	**Low** Considered unlikely to occur within the site on more than a rare occasion.	**Low** Although this species is unlikely to occur within the site, suitable abundant foraging habitat will be retained as conservation areas within the current proposal.
Endangered Ecological Communities			
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bio-regions	This community is associated with periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains, typically occurring on grey-black clay-loams and sandy loams. Usually occurring below 20 m altitude, this community is generally dominated by *Casuarina glauca* (Swamp She-oak). Within the site this community correlates with LHCCREMS MU 40 ‘Swamp Oak – Rushland Forest’.	**High** This community occurs adjacent to Lake Macquarie as a relatively thin strip of vegetation on the lakeshore and as a riparian community bordering the estuarine influenced lower drainage lines of the site.	**Low** Those areas of this EEC that occur within the site will be conserved as part of the current proposal. However, there is potential for this community to be indirectly affected by the proposal if sound water and sediment management practices are not adhered to during the planning and construction phases of the development.
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions	The community is associated with humic clay or sandy loams on waterlogged or episodically flooded alluvial flats and drainage lines within coastal floodplains. It is generally characterised by an open to dense canopy of Eucalypts and / or Paperbarks. Canopy heights generally vary from 8m to 25m depending on species composition. In the Hunter Region the canopy often contains *Eucalyptus robusta* and / or *Melaleuca quinquinervia* although other species, such as *Casuarina glauca*, *Eucalyptus resinifera* subsp. *hemilampra* and *Livistona australis* may be present. Within the site this community correlates with LHCCREMS MU 37 ‘Swamp Mahogany - Paperbark Swamp Forest’	**High** This community occurs within the site on the alluvial flats in the corner of Crangan Bay.	**Moderate** All of this EEC will be retained within the current proposal, within the Conservation Lands. However, indirect threats to the retained EEC may also potentially exist without appropriate sediment and water management control measures incorporated into planning and construction phases of the development.

Notes: (V) = Vulnerable Species listed under the *Threatened Species Conservation Act 1995*.
(E) = Endangered Species listed under the *Threatened Species Conservation Act 1995*.
(V*) = Vulnerable Species listed under the *Commonwealth EPBC Act 1999*.
(E*) = Endangered Species listed under the *Commonwealth EPBC Act 1999*.
(CE*) = Critically Endangered Species listed under the *Commonwealth EPBC Act 1999*.
(M*) = Migratory Species listed under the *Commonwealth EPBC Act 1999*.

5.2 Assessment of Significant Species / Communities

As per the assessment carried out within Table 5-1, the following species / communities have been deemed appropriate to be applied further detailed assessment due to projected potential levels of impacts likely to result from the proposal.

Flora

- *Diuris praecox* Rough Double Tail Orchid
- *Tetratheca juncea* Black-eyed Susan

Endangered Ecological Communities

- Swamp Oak Floodplain Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

Fauna

- *Crinia tinnula* Wallum Froglet
- *Hoplocephalus bitorquatus* Pale-headed Snake
- *Hoplocephalus stephensii* Stephen's Banded Snake
- *Pandion haliaetus* Osprey
- *Ixobrychus flavicollis* Black Bittern
- *Calyptorhynchus lathami* Glossy Black-Cockatoo
- *Xanthomyza phrygia* Regent Honeyeater
- *Lathamus discolor* Swift Parrot
- *Ninox strenua* Powerful Owl
- *Tyto novaehollandiae* Masked Owl
- *Petaurus norfolcensis* Squirrel Glider
- *Pteropus poliocephalus* Grey-headed Flying-fox
- *Miniopterus schreibersii* Eastern Bentwing-bat
- *Miniopterus australis* Little Bentwing-bat
- *Mormopterus norfolkensis* Eastern Freetail-bat
- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat
- *Falsistrellus tasmaniensis* Eastern False Pipistrelle
- *Myotis adversus* Large-footed Myotis
- *Scoteanax rueppellii* Greater Broad-nosed Bat

5.2.1 Threatened Flora

It should be recognised (as alluded to below) that potential habitat for unrecorded species does exist within the site, including in areas that were not intensively surveyed during these investigations. The following species were confirmed to exist during the studies either in or within close proximity to the Development Estate.

Diuris praecox

This species was recorded by DECCW Wildlife Atlas within lands owned by Lake Macquarie Council approximately 50m to the west of the site boundary within the Coastal Plains Apple – Peppermint Forest (Figure 4-1). RPS ecologists performed targeted surveys during the flowering season of *Diuris praecox* but could not relocate this record or any others within the vicinity. Approximately 9.04 ha (9%) of potential habitat will be removed as part of the proposal and approximately 93.77 ha (91%) will be conserved within the Conservation Lands within the Nords Wharf site. Therefore no known populations of this species will be removed as part of the proposal.

Tetratheca juncea

A large population (865 individuals) of this species was located within the Development Estate during the targeted surveys undertaken in September 2007. The population was widely distributed throughout the areas surveyed (Figure 4-2).

Whilst a large population will be removed as part of the proposal over 5,933 (88%) individuals of this species will be reserved with the Conservation Lands within the Nords Wharf site. This number is likely to increase as approximately 35 ha of potential habitat has not been surveyed. Larger populations are currently conserved within Wallarah National Park to the north of the site (over 9,900 individuals) and with further populations located by RPS within Coal & Allied lands Catherine Hill Bay and Gwandalan area which will be conserved in conservation reserves the number conserved is likely to increase. Thus, in the Wallarah peninsula the total number of *Tetratheca juncea* totals over 49,000. Of these over 29,000 are to be conserved in conservation reserves. Such a large number of known plants protected in several disjunct but proximate conservation areas bode well for the long term security of the species within the locality. Therefore, it is considered that the development proposal will not have a significant impact upon the population.

Other threatened flora species

Several threatened flora species have potential habitat within the site and are considered as having at least a moderate potential to occur. No populations of these species could be found during targeted searches, the majority of these cryptic orchids were in flower at the time of the *Tetratheca juncea* surveys which were performed in September 2007. However, many of the orchids are either undescribed or do not flower each year and therefore it is possible that stands of these species may have not been detected within the proposed Development Estate.

It is unlikely that this species should be significantly impacted upon by proposed development given the large tracts of similar habitat that is to be retained as conservation lands in perpetuity.

5.2.2 Endangered Ecological Communities

All of the EEC's listed in Section 5 present within the site. In some cases, only a very small amount of vegetation will be affected and any long-term discernable impacts are considered likely to be quite minimal. The impacts upon extant EEC's within the Development Estate are summarised below.

5.2.3 Swamp Sclerophyll Forest on Coastal Floodplains

Swamp Mahogany Paperbark Forest (SMPF) is commensurate to the EEC of Swamp Sclerophyll Forest on Coastal Floodplains. RPS HSO conducted a ground survey using a registered surveyor to delineate the edge of this vegetation community where it adjoins the Development Estate. This was done by an ecologist marking the edge of the community and surveyors surveying this line by survey accurate techniques. The resulting survey accurate line was used in the amended vegetation mapping shown in Figure 4-1.

The SMPF represents a broad band of vegetation encompassing lowlands from the Scout Camp in the site's northwest to the southern slopes of the ridge that terminates at Browns Point. These communities represent higher than average to high habitat quality, although there are areas of SMPF that have been degraded by understorey management where it occurs on Scout Camp lands. The northern portion of this EEC encroaches within the existing Scout Camp and exists as canopy only variant where the understorey is being managed through mowing and pedestrian use of unformed tracks throughout. The revised boundary will require the removal of approximately 525m^2 (0.0525ha) of Swamp Mahogany-Paperbark Forest (179m^2) and Swamp Mahogany-Paperbark Forest – Canopy only Variant (346m^2). The remaining SMPF area represented by over 13ha will be dedicated to conservation at Nords Wharf. Furthermore, the revised Gwandalan Concept plan shall retain Strangers Gully which is considered a highly significant area to the regions ecological character. The retention of Strangers Gully will result in the preservation of a further 1.03ha of this Swamp Sclerophyll Forest EEC. As such the loss at Nords Wharf will be offset through the conservation, 'in perpetuity', of 73.12ha of this EEC across the Southern Estates.

Due to the proximity of SMPF to proposed residential development and the occurrence of unformed tracks throughout this community it is possible that indirect impacts may cause degradation of this community unless suitable management strategies, such as mitigated pedestrian access through well-formed tracks and appropriate pet management are observed. Water Sensitive Urban Design (WSUD) has been implemented into the proposed development in the form of the installation of detention systems and temporary nutrient / sediment control systems to be installed pre development and to be maintained post development to mitigate any adverse effects from runoff from the Development Estate into the remaining portions of this EEC. In summary the additional lands scheduled for conservation at Catherine Hill Bay and Gwandalan provide an abundance of habitat for regionally significant / threatened species, populations and ecological communities. While the EEC removal at Nords Wharf does not represent a maintain or improve result, when viewed holistically on a regional scale, the quantum of conservation

lands that will be realised, for the Wallarah Peninsula, under the Coal & Allied proposal are considered a more than reasonable outcome.

5.2.4 Littoral Rainforest

Assessment of the possibility that Littoral Rainforest may occur within close proximity to Lake Macquarie. A visit by RPS HSO ecologists was undertaken during May 2008 to make an assessment of this community to determine if it occurs within Nords Wharf. During this assessment one 20m X 20m quadrat was performed within the vegetation suspected to be Littoral Rainforest and one 20 m X 20 m quadrat within the adjoining Swamp Mahogany Paperbark Forest. A random meander was also performed and all species observed were recorded.

The Scientific Determination describes this community as being a closed forest with the structure and composition being strongly influenced by its close proximity to the ocean. Whilst the Nords Wharf site does not occur on sand dunes or hind dunes, Lake Macquarie is a saltwater lake that is open to the sea and therefore some maritime influence would occur from Lake Macquarie. The structure of the vegetation on site ranges from open forest to closed forest.

The dominance and presence of *Eucalyptus robusta* (Swamp Mahogany), *Melaleuca linearifolia* (Snow-in-Summer) and *Callistemon salignus* (Willow Bottlebrush) in the canopy layer suggests that the community is Swamp Mahogany Paperbark Forest. However, the understorey of this vegetation contains several mesic species which can occur as part of Littoral Rainforest, these include *Synoum glandulosum* (Scentless Rosewood), *Trema tomentosa* (Native Peach), *Duboisia myoporoides* (Corkwood) *Elaeocarpus reticulatus* (Blueberry Ash), *Cryptocarya microneura* (Murrogun), *Rapanea howittiana* (Muttonwood), and the vines *Smilax glyciphylla, Dioscoria transversa* (Native Yam), *Sarcopetalum harveyanum* (Pearl Vine) and *Stephania japonica* var. *discolor* (Snake Vine). In saying this, some of these species can also occur within Swamp Mahogany Paperbark Forest. The scientific determination describes the vegetation within Littoral Rainforest to consist of five sub-alliances of the *Cupaniopsis anacardioides – Acmena* spp. alliance of Floyd (1990). Several of these sub-alliances are restricted in their geographic distribution. These include Sub alliance 16 *Syzygium leuhmannii-Acmena hemilampra* (North of Macleay River), Sub-alliance 18 *Lophostemon confertus* (Mid North Coast) and Sub-alliance 20 *Acmena smithii – Ficus – Livistonia – Podocarpus* (mainly south of Sydney).

The most widespread sub-alliance which is encompassed by this determination is Sub-alliance 17 *Cupaniopsis anacardioides* which is most closely associated with MU 4 Littoral Rainforest as described by the LHCCREMS mapping project. Sub-alliance 17 *Cupaniopsis anacardioides* is also closely associated with the two variants of Littoral Rainforest that were described by the Wyong vegetation project (Bell 2002), being MU 11 Coastal Sand Scrub-Littoral Rainforest (CSSLR) and MU 12 Coastal Sand Littoral Rainforest (CSLR). The latter of these two vegetation communities differs from the vegetation found on site in that it contains species that typically only occur within littoral rainforest, such as *Cupaniopsis anacardioides* (Tuckeroo), *Polyscias elegans* and

Endiandra sieberi. MU 11 CSSLR is more of an ecotonal vegetation community between Littoral Rainforest and Banksia Scrub Forest and contains drier species such as *Banksia* and *Acacia*. The vegetation within this section of the site has neither representative typical littoral rainforest species that are characteristic of MU12 CSLR nor drier species that are characteristic of MU 11 CSSLR.

The flora species identified within the suspected Littoral Rainforest were compared with those species listed within the Scientific Determination and 18% were recorded within the Nords Wharf site (Table 5-2). However, when comparing the species present with those present within the Swamp Sclerophyll Forest on Coastal Floodplains EEC Scientific Determination there was 42% present within the site. It must be noted that for the Littoral Rainforest all the species which are known as occurring to the south of Sydney have been removed and the list has been reduced from 117 to 75 species as a result. This was done as the Littoral Rainforest community varies throughout its range and thus species south of Sydney were not considered to be indicative of this community within the Nords Wharf locality. Due to the close proximity of the suspected Littoral Rainforest to the adjoining Swamp Mahogany Paperbark Forest and to Lake Macquarie, this area clearly has ecotonal influences as noted by Bell (2008) and this affects the ease of delineation.

In conclusion, it is considered that this vegetation community is a variant within Swamp Mahogany Paperbark Forest due to the dominance of *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca linearifolia* (Snow-in-Summer) and the higher proportion of flora species in common with the Swamp Sclerophyll Forest EEC Scientific Determination than Littoral Rainforest. The proposed residential subdivision which is to occur within the Nords Wharf Development Estate will not remove any of this area and providing that the ameliorative measures outlined within the Swamp Sclerophyll Forest discussion above adverse impacts from the development will be avoided and thus a significant impact will not result.

Table 5-2: Littoral Rainforest Species Comparison

Scientific Name	Possible Littoral Rainforest Quadrat	Scientific Determination Littoral Rainforest * (EEC)	Scientific Determination Swamp Sclerophyll (EEC)
Acacia binervata		x	
Acacia irrorata subsp. *irrorata*			x
Acacia longifolia var. *longifolia*			x
Acacia terminalis subsp. *augustifolia*			
Acmena smithii	x	x	x
Acronychia oblongifolia		x	
Adiantum aethiopicum	x		x
Alectryon subcinereus		x	
Allocasuarina littoralis			x
Alphitonia excelsa	x		
Alpinia caerulea		x	
Angophora costata			
Asplenium australasicum		x	
Baloghia marmorata		x	
Banksia integrifolia subsp. *integrifolia*		x	
Banksia oblongifolia			x
Banksia spinulosa var. *collina*			
Baumea articulata			x
Baumea juncea			x

Scientific Name	Possible Littoral Rainforest Quadrat	Scientific Determination Littoral Rainforest * (EEC)	Scientific Determination Swamp Sclerophyll (EEC)
Blechnum camfieldii			x
Blechnum indicum			x
Breynia oblongifolia		x	x
Callistemon salignus	x		x
Calochlaena dubia	x		x
Carex appressa	x		x
Casuarina glauca	x		x
Cayratia clematidea		x	
Centella asiatica	x		x
Cissus antarctica		x	
Cissus hypoglauca	x	x	
Cissus sterculiifolia		x	
Claoxylon australe		x	
Clematis aristata	x		
Clerodendrum tomentosum	x		
Cordyline stricta		x	
Cryptocarya glaucescens		x	
Cryptocarya microneura	x	x	
Cupaniopsis anacardioides		x	
Cynanchum elegans		x	
Cynodon dactylon	x		
Dendrocnide excelsa		x	
Dendrocnide photinophylla		x	
Dianella caerulea var. *producta*	x		x
Dichondra repens			
Dioscorea transversa	x	x	
Diospyros australis		x	
Diospyros pentamera		x	
Dodonaea triquetra			x
Doodia aspera		x	
Duboisia myoporoides	x	x	
Echinopogan ovatus			
Ehretia acuminata		x	
Elaeocarpus obovatus		x	
Elaeocarpus reticulatus	x		x
Endiandra discolor		x	
Endiandra sieberi		x	
Entolasia marginata	x		x
Entolasia stricta			x
Eucalyptus botryoides		x	x
Eucalyptus longifolia			x
Eucalyptus resinifera subsp. *resinifera*			x
Eucalyptus robusta	x		x
Eucalyptus tereticornis		x	
Eupomatia laurina		x	
Eustrephus latifolius		x	
Ficus coronata		x	x
Ficus obliqua		x	
Ficus rubiginosa		x	
Flagellaria indica		x	
Gahnia clarkei	x		x
Gahnia sieberiana			x
Geitonoplesium cymosum	x	x	
Glochidion ferdinandii	x	x	x
Glycine clandestina		x	x
Gonocarpus tetragynus			x
Guioa semiglauca		x	
Homalanthus populifolius			x
Hydrocotyle peduncularis	x		x

Scientific Name	Possible Littoral Rainforest Quadrat	Scientific Determination Littoral Rainforest * (EEC)	Scientific Determination Swamp Sclerophyll (EEC)
Hypolepis muelleri			x
Imperata cylindrica var. *major*	x		x
Isachne globosa			x
Lantana camara	x		
Leptospermum polygalifolium subsp. *polygalifolium*			x
Litsea reticulata		x	
Livistona australis	x	x	x
Lomandra longifolia		x	x
Lophostemon confertus		x	x
Mallotus philippensis		x	
Marsdenia suaveolens	x		
Melaleuca ericifolia			x
Melaleuca linearifolia	x		x
Melaleuca quinquenervia		x	x
Melaleuca sieberi			x
Melaleuca styphelioides			x
Melicope micrococca		x	
Melicope vitiflora		x	
Morinda jasminoides		x	x
Myrsine variabilis	x	x	x
Notelaea longifolia	x	x	
*Ochna serrulata**	x		
Oplismenus aemulus	x		x
Oplismenus imbecillis	x	x	x
Pandorea pandorana		x	
Pararchidendron pruinosum var. *pruinosum*		x	
Parsonsia straminea	x	x	x
Phragmites australis			x
Piper novae-hollandiae		x	
Pittosporum multiflorum		x	
Pittosporum undulatum	x	x	
Platycerium bifurcatum subsp. *bifurcatum*		x	
Podocarpus elatus		x	
Polyscias elegans		x	
Polyscias sambucifolia			x
Pratia purpurascens	x		x
Pteridium esculentum	x		x
Rhodamnia rubescens		x	
Rhodomyrtus psidioides		x	
Ripogonum album		x	
Rubus hillii	x		
Rubus ulmifolius	x		
Sarcopetalum harveyanum	x		
Scolopia braunii		x	
Smilax australis		x	
Smilax glyciphylla		x	
Stephania japonica var. *discolor*	x	x	x
Synoum glandulosum		x	
Syzygium australe		x	
Syzygium oleosum		x	
Syzygium paniculatum		x	
Themeda australis			x
Trema tomentosum	x		
Villarsia exaltata			x
Viola hederacea	x		x
Wilkiea heugeliana		x	
Percentage of species present in Quadrat from each EEC		**18%**	**42%**

* Only includes species found north of Sydney

5.2.5 River Flat Eucalypt Forest on Coastal Floodplains

The Redgum Roughbarked Apple Swamp Forest delineated within the Nords Wharf site is commensurate with EEC River Flat Eucalypt Forest on Coastal Floodplains. This community occurs within the site upon foreshore flats and steep slopes adjoining Lake Macquarie. These habitats occur primarily within the Scout Camp and along the narrow edge of the lake to the southwest of the Scout Camp. The Redgum Roughbarked Apple Swamp Forest within the Scout Camp is only discernable by canopy components because understorey strata have been displaced by managed lawns that are inconsistent with the natural understorey strata of this community. Occurrences of this community along the lake edge to the southwest of the Scout Camp are limited to a few individuals of *E. tereticornis* and the natural understorey vegetation is somewhat obscured by incursions of weeds. The Redgum Roughbarked Apple Swamp Forest community is bounded on the lake side by a narrow band of *Casuarina glauca* on the immediate edge of the lake with *E. tereticornis* individuals occurring behind this band, often within metres of the lake's edge. On the northern slopes of the site the inland edge of this community abuts Coastal Sheltered Apple – Peppermint Forest and where it occurs at the lake's edge between the Scout Camp and Browns Point it is bounded on the inland side by Swamp Mahogany – Paperbark Forest. There will be no direct impacts to this community as a consequence of proposed development, but due to its lakeside position this community may be at risk from indirect impacts as a consequence of its proximity to residential development and potential over usage by local residents. Therefore, the community may require protective measures such as well-defined pathways to prevent further degradation to understorey strata. The eastern portion of the vegetation community that occurs adjacent to the development area has a small risk of damage from urban runoff. If nutrient and sediment control measures are put in place to mitigate runoff, prior to and during the construction phase, then this will ensure that any adverse impacts from the development will be avoided and thus a significant impact will not result.

5.2.6 Riparian Melaleuca Swamp Woodland

Riparian Melaleuca Swamp Woodland is encompassed within the definition of 'Swamp Sclerophyll Forest on Coastal Floodplains' EEC as defined within the final determination of this EEC by the Scientific Committee. This community is commensurate with MU 42 'Riparian Melaleuca Swamp Woodland' as described in 'LHCCREMS Vegetation Mapping'. Riparian Melaleuca Swamp Woodland occurs on drainage lines on the site's eastern slopes extending down onto the flats where it merges with Swamp Mahogany Paperbark Forest. This community is not located within the proposed Development Estate and thus it is unlikely that the development proposal will have a significant impact upon this vegetation community.

Swamp Oak Floodplain Forest

This EEC occurs on the foreshore of Lake Macquarie along the western border of the site. It is a highly degraded community in many places with high weed and rubbish incursions. The area adjoining the scout camp will be reserved as open space and the remainder of this community occurs within the conservation lands. If nutrient and sediment control measures are put in place to mitigate runoff then this will ensure that any adverse impacts

from the development will be avoided. Therefore, it is unlikely that the development proposal will have a significant impact upon this EEC.

Swamp Sclerophyll Forest

This EEC occurs within the drainage line and low lying areas in the south east of the site. It is a degraded along the edges with high weed and rubbish incursions. This EEC encompasses approximately 15.34 ha and will be retained within the conservation lands. If nutrient and sediment control measures are put in place to mitigate runoff then this will ensure that any adverse impacts from the development will be avoided. Given that the majority all of this EEC will be reserved within the conservation lands, it is considered highly unlikely that the proposed development will have a significant impact upon this EEC.

5.2.7 Threatened Fauna

Wallum Froglet

Although this species was not recorded within the site there is moderate to high potential for it to exist in the lower drainage lines, particularly within swamp sclerophyll and wetland vegetation communities. The majority of those lands within which this species is likely to occur will be retained within the current proposal as conservation lands. However, due to the downstream location of potential Wallum Froglet Habitat, with respect to the proposed Development Estate, there is potential for stormwater runoff from construction works to increase sediment loads to downstream wetland habitats and for the displacement of vegetation by manmade surfaces to increase water-flows, which may alter drainage channel profiles of wetland habitats. This combination of potential water derived impacts is likely to represent the Key Threatening Process (KTP) “Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands”. Therefore, sediment and water management strategies will need to be incorporated into the planning, construction and occupation phases of the proposed Development Estate to ensure that potential impacts to downstream wetland habitats are prevented.

Pale-headed Snake

The Development Estate will displace a relatively small area of habitat within which this species might potentially occur. However, it is considered that the retention of a much greater area of similar or better quality potential habitat, as conservation lands within the current proposal, will ensure that the viability of potential local populations remains secure. Therefore it is unlikely that the current proposal will threaten the viability of any potential local population of this species.

Stephen’s Banded Snake

The Development Estate will displace a relatively small area of habitat within which this species might potentially occur. However, it is considered that the retention of a much greater area of similar or greater quality potential habitat, as conservation lands within the current proposal, will ensure that the viability of potential local populations remains secure. Therefore it is unlikely that the current proposal will threaten the viability of any potential local population of this species.

Osprey

Although this species was not recorded within the site there is moderate potential for it to use the site for roosting and nesting purposes due to the proximity of potential foraging habitat within Crangan Bay. Large areas of open forest within which this species might roost or nest will be retained within the current proposal as conservation lands, therefore it is considered that sufficient roosting / nesting habitat will be retained to secure habitat for local individuals or pairs. However, due to the downstream location of potential foraging habitat, there is potential for stormwater runoff from construction works to increase sediment loads to estuarine habitats and for the displacement of vegetation by manmade surfaces to increase runoff water-flows, which may impact upon estuarine community characteristics. As a consequence there is potential for Osprey hunting habitat to be indirectly impacted upon by the current proposal. Therefore, sediment and water management strategies will need to be incorporated into the planning, construction and occupation phases of the proposed Development Estate to ensure that potential impacts to downstream estuarine habitats are prevented.

Black Bittern

Although this species was not recorded within the site there is moderate potential for it to use the site for foraging and nesting purposes in the lower reaches of the site's drainage lines where they enter Lake Macquarie. Those areas that are potential habitat for this species will be retained as conservation lands, within the current proposal, thereby increasing secured habitat for potential local individuals or pairs. However, due to the downstream location of potential foraging Habitat, with respect to the proposed Development Estate, there is potential for stormwater runoff from construction works to increase sediment loads to estuarine habitats and for the displacement of vegetation by manmade surfaces to increase water-flows, which may impact upon estuarine and associated wetland community characteristics. As a consequence there is potential for Black Bittern hunting habitat to be indirectly impacted upon by the current proposal. Therefore, sediment and water management strategies will need to be incorporated into the planning, construction and occupation phases of the proposed Development Estate to ensure that potential impacts to downstream estuarine habitats are prevented.

Glossy Black-Cockatoo

Potential foraging habitat for this species, in the form of *Allocasuarina* sp., is widespread within the site. Chewed *A. littoralis* cones were observed within the Development Estate lands, indicating that Glossy Black Cockatoos use the site for foraging purposes. Furthermore, the site contains trees of sufficient size to provide nesting hollows for this species. The Development Estate will displace a relatively small area of potential forging habitat, although large areas containing potential foraging and nesting habitat will be secured as conservation lands within the current proposal. It is considered that the current proposal will ensure that locally occurring individuals or family groups of Glossy Black Cockatoos will benefit due to increases in conserved habitat. Therefore it is unlikely that the current proposal will threaten the viability of the local population of this species.

Regent Honeyeater

This species does not occur in the Central Coast and Lower Hunter Region on a continuous basis, as its stronghold is the western slopes of the Great Dividing Range. Nevertheless, Regent Honeyeaters are recorded in Swamp Sclerophyll vegetation communities and associated woodlands on an intermittent seasonal basis in the Lake Macquarie LGA when resources in the west or Lower Hunter are scarce. Potential foraging habitat for this species, in the form of *Eucalyptus robusta* and *E. tereticornis*, occurs along the lower reaches of drainage lines and lake edges within the site. Those areas that represent potential foraging habitat for this species within the site will be retained within the current proposal, thereby securing coastal foraging habitat for this species.

Swift Parrot

This species does not occur in the Central Coast and Lower Hunter Region on a continuous basis, as it only moves into South-eastern Australia during the winter months and spends the summer in Tasmania. There is a local record for this species within the site and records elsewhere at Nords Wharf and on the Gwandalan peninsula. Potential foraging habitat for this species, in the form of *Eucalyptus robusta* and *E. tereticornis*, occurs along the lower reaches of drainage lines, the lake edges and in Narrabeen Foreshore Redgum-Ironbark Forest within the site. Those areas that represent potential foraging habitat for this species within the site will be retained within the current proposal, thereby securing coastal foraging habitat for this species.

Powerful Owl

This species was recorded within open forest habitat in the north of the site during nocturnal fauna surveys. Furthermore, there are other records for this species on the Wallarah peninsula to the north and south of the site. The Development Estate within the current proposal will displace a small amount of potential Powerful Owl foraging habitat. However, much greater areas of similar and higher quality foraging and potential nesting habitat for this species will be retained as conservation lands within the site. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Masked Owl

Although this species was not recorded within the site during nocturnal fauna surveys, other records occur within the vicinity of the site to the south. Furthermore, there are other records for this species on the Wallarah Peninsula to the east of the site. The Development Estate within the current proposal will displace a small amount of Masked Owl foraging habitat. However, much greater areas of similar and higher quality foraging and potential nesting habitat for this species will be retained as conservation lands within the site. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Squirrel Glider

The only glider species records for this site and in adjacent areas of open forest habitat are limited to the Sugar Glider. Even though the Squirrel Glider was not recorded during this survey, records do show it occurring within woodland habitats to the west of this site. As a consequence, its presence within the site cannot be totally discounted. Even though it is likely that a small amount of Squirrel Glider feeding and nesting habitat will be lost during the land development process, large areas containing potential foraging and nesting habitat are to be retained as conservation lands under the current proposal. This offset of good quality habitat for gliders will significantly reduce any threat to local populations of this species.

Grey-headed Flying Fox

There was no indication of roosting camps for this bat in the vicinity of the site. Foraging habitat occurs within *Eucalyptus robusta*, *E. tereticornis* and *E. paniculata* and this species was observed using these resources during fauna surveys. Those areas of potential foraging habitat for this species are to be retained under the current proposal, and therefore it is unlikely that the current proposal will represent a significant threat to this species.

Eastern Bentwing-Bat

Being a species that utilises a diverse range of woodland habitats for potential foraging, it is likely that this site will be regularly used as part of its foraging range, however being a cave-rooting species, no caves nor artificial roosting habitats are known within the site. Although it is likely that a small amount of foraging habitat for this bat will be modified during the development process, large areas of suitable foraging habitat will be retained as conservation land under the current proposal and foraging opportunities will continue to exist within the Development Estate. It is therefore unlikely that the current proposal will represent a significant threat to this species.

Little Bentwing-Bat

The survey recorded this bat within the site and it is likely to use areas of the site regularly as part of its foraging range however no roosting habitat is known within the site. Although it is likely that a small amount of foraging habitat for this bat will be modified during the development process, large areas of suitable foraging habitat will be retained as conservation land under the current proposal and foraging opportunities will continue to exist within the Development Estate. It is therefore unlikely that the current proposal will represent a significant threat to this species.

Eastern Freetail-Bat

This bat was recorded within the site, and being a species that forages predominantly in dry woodlands and forests, it is likely to use this site regularly as part of its foraging range, and may use the abundant tree hollows as roosting habitat. Although it is likely that a small amount of foraging habitat for this bat will be modified during the development process, large areas of suitable foraging habitat will be retained as conservation land under the current proposal and foraging opportunities will continue to exist within the Development Estate. It is therefore unlikely that the current proposal will represent a significant threat to this species.

Eastern False Pipistrelle

This species was not recorded during the survey but a record from Pulbah Island in Lake Macquarie strongly suggests that it is likely to uses the site on at east an intermittent basis. The occurrence of suitable woodland within the site provides potential roosting habitat. Although it is likely that a small amount of foraging habitat for this bat will be modified during the development process, large areas of suitable foraging habitat will be retained as conservation land under the current proposal and foraging opportunities will continue to exist within the Development Estate. It is therefore unlikely that the current proposal will represent a significant threat to this species.

Yellow-bellied Sheathtail-Bat

This species was not recorded during the survey but is known to occur in the Central Coast Region within a range of woodland habitats. Due to its mobility and occurrence in the near-coastal districts to the south, it is likely that this species uses the site on at least an intermittent basis. Although it is likely that a small amount of foraging habitat for this bat will be modified during the development process, large areas of suitable foraging habitat will be retained as conservation land under the current proposal and foraging opportunities will continue to exist within the Development Estate. It is therefore unlikely that the current proposal will represent a significant threat to this species.

Greater Broad-nosed bat

Although not recorded during this survey, this species is relatively widespread in a broad range of habitats within the Lower Hunter Region. Due to its mobility and local occurrence at the southern end of Ruttleys Road, it is likely that this species uses the site on at least an intermittent basis. Although it is likely that a small amount of foraging habitat for this bat will be modified during the development process, large areas of suitable foraging habitat will be retained as conservation land under the current proposal and foraging opportunities will continue to exist within the Development Estate. It is therefore unlikely that the current proposal will represent a significant threat to this species.

5.3 Key Threatening Process (KTP)

A Key Threatening Process (KTP) is defined in the *TSC Act (1995)* as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Something can be a threat if it:

- *adversely affects two or more threatened species, populations or ecological communities; or*
- *could cause species, populations or ecological communities that are not currently threatened to become threatened.*

Key Threatening Processes are listed in Schedule 3 of the *TSC Act 1995*. Those potentially applicable to the proposal, are as follows:

1. Loss of Hollow-bearing trees;
2. Clearing of native vegetation;