signata (Scribbly Gum).

Upper Stratum – 20 to 25 m with a PFC of 30% to 60%, the dominant species being *Eucalyptus punctata* (Grey Gum), *Eucalyptus paniculata subsp. paniculata* (Grey Ironbark), *Eucalyptus globoidea* (White Stringybark), *Allocasuarina torulosa* (Forest She-oak), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus piperita* (Sydney Peppermint), *Angophora costata* (Smooth-barked Apple), *Eucalyptus signata* (Scribbly Gum), and in the moist gullies *Eucalyptus resinifera subsp. resinifera* (Red Mahogany).

Mid Stratum 1 – 6 m to 10 m with a PFC of 20%, the dominant species being *Allocasuarina torulosa* (Black She-oak) and juvenile *Eucalyptus* species.

Mid Stratum 2 – 1 m to 2 m with a PFC of 10% to 30%, the dominant species being *Acacia longifolia var. longifolia* (Sydney Golden Wattle), *Dodonaea triquetra* (Common Hop Bush), *Bursaria spinosa* (Blackthorn), *Polyscias sambucifolia* (Elderberry Panax), *Podolobium ilicifolium* (Native Holly) and *Acrotriche divaricata*.

Lower Stratum – to 1 m with a PFC of 30% to 60%, the dominant species being *Xanthorrhoea macronema* (Grass Tree), *Themeda australis* (Kangaroo Grass), *Entolasia stricta* (Wiry Panic), *Pratia purpurascens* (White Root) and *Dianella caerulea var. producta* (Blue Flax Lily).

3 Coastal Plains Scribbly Gum Woodland

This vegetation community occurs on the ridgetops and covers approximately 36.08 ha. This vegetation community is commensurate with MU 31 – Narrabeen Doyalson Coastal Woodland (including variant a) as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002) and MU 31 Coastal Plains Scribbly Gum Woodland as described by LHCCREMS (NPWS 2000; House 2003). The three small linear sections of this community are less diverse and have a more grassy understorey than the remaining two sections.

Upper Stratum – to 15 m with a Projected Foliage Cover (PFC) of 20% to 30%, the dominant species being *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus capitellata* (Brown Stringybark) and occasionally *Angophora costata* (Smooth-barked Apple).

Mid Stratum 1 – 2 to 3 m with a PFC of 5% the dominant species being, *Leptospermum trinervium* (Paperbark Tea-tree), juvenile *Eucalyptus haemastoma* (Scribbly Gum) and *Corymbia gummifera* (Red Bloodwood).

Mid Stratum 2 – 1 to 2 m with a PFC of 30% to 40% the dominant species being, *Banksia spinulosa subsp. collina* (Hair-pin Banksia), *Acacia brownii* (Brown's Wattle), *Banksia oblongifolia*, *Leptospermum polygalifolium* (Lemon-scented Tea-tree), *Hakea dactyloides, Persoonia levis* (Broad-leaved Geebung), *Lambertia formosa* (Mountain Devil), *Lomatia silaifolia* (Crinkle Bush) and *Isopogon anemonifolius* (Drumsticks).

Lower Stratum – to 1 m with a PFC of 70% to 80%, the dominant species being *Epracris pulchella* (NSW Coral Heath), *Patersonia sericea* (Purple Flag Flower), *Ptilothrix deusta*, *Lomandra obliqua* (Fishbones), *Xanthorrhoea latifolia subsp. latifolia* (Forest Grass Tree), *Themeda australis* (Kangaroo Grass) and *Entolasia stricta* (Wiry Panic).

4 Swamp Oak Rushland Forest (EEC – Swamp Oak Floodplain Forest)

This vegetation community occurs in two small areas within the low lying estuarine drainage lines. This vegetation community encompasses approximately 3.48 ha and is commensurate with MU 3 – Estuarine Swamp Oak Forest as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002) and MU 40 Swamp Oak Sedge Forest as described by LHCCREMS (NPWS 2000; House 2003).

Upper Stratum – to 10 m with a PFC of 10% to 20%, the dominant species is *Casuarina glauca* (Swamp Oak).

Mid Stratum – to 3 m with a PFC to 80%, the dominant species being, *Melaleuca ericifolia* (Swamp Paperbark) around the fringes of the community.

Lower Stratum – to 1 m with a PFC of 80% to 90%, the dominant species being *Juncus kraussii subsp*. *australiensis* (Sea Rush), *Chrysanthemoides monilifera subsp*. *rotundata* (Bitou Bush), *Baumea juncea*, *Cyperus sp*., *Isolepis nodosa* (Nodding Sedge) and *Phragmites australis* (Native Reed).

5 Swamp Mahogany - Paperbark Forest (EEC Swamp Sclerophyll Forest on Coastal Floodplains)

This vegetation community occurs in the low lying estuarine drainage lines and encompasses 20.02 ha. This vegetation community is commensurate with MU 10 – Coastal Sand Mahogany – Paperbark Forest as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002) and MU 37 Swamp Mahogany – Paperbark Forest as described by LHCCREMS (NPWS 2000; House 2003). This vegetation community is highly disturbed in the south-eastern areas with the understorey completely dominated by *Lantana camara* (Lantana) and *Chrysanthemoides monilifera subsp*. *rotundata* (Bitou Bush).

Upper Stratum – to 20 m with a Projected Foliage Cover (PFC) of 50% to 70%, the dominant species being *Eucalyptus robusta* (Swamp Mahogany), *Melaleuca quinquinervia* (Broad-leafed Paperbark) and occasionally *Livistonia australis* (Cabbage Tree Palm).

Mid Stratum 1 – 4 m to 8 m with a PFC of 10% to 20%, the dominant species being *Melaleuca linearifolia* (Snow-in Summer), *Melaleuca styphelioides* (Prickly-leaved Melaleuca), *Callistemon salignus* (Willow Bottlebrush) and *Glochidion ferdinandi* (Cheese Tree).

Mid Stratum 2 – 3 m to 5 m with a PFC of 30% to 90%, the dominant species being *Lantana camara* (Lantana), *Chrysanthemoides monilifera subsp*. *rotundata* (Bitou Bush) and *Pittosporum undulatum* (Sweet Pittosporum).

Lower Stratum – to 1.5 m with a PFC of 10% to 50%, the dominant species being *Gahnia clarkei* (Tall Saw Sedge), *Blechnum indicum* (Swamp Water Fern), *Hydrocotyle peduncularis*, *Viola hederacea* (Native Violet), *Dioscoria transversa* (Pencil Yam), *Marsdenia suaveolens* (Scented Marsdenia), *Oplismenus aemulus* (Basket Grass) and *Smilax glyciphylla* (Native Sarsaparilla).

6 Riparian Melaleuca Swamp Woodland (EEC - Swamp Sclerophyll Forest on Coastal Floodplains)

This vegetation community occurs in three drainage line two sections adjoining Flowers Drive in the north of the site and the remaining adjoining the Swamp Oak Forest in the east of the site. This vegetation community covers approximately 4.69 ha and is not commensurate with any vegetation community described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002). However this community is commensurate with MU 42 and 42a Riparian Melaleuca Swamp Woodland as described by LHCCREMS (NPWS 2000; House 2003).

Upper Stratum – 15 m to 18 m with a Projected Foliage Cover (PFC) of 30% to 50%, the dominant species being *Melaleuca sieberi* (Sieber's Paperbark), *Melaleuca linearifolia* (Snow-in-summer), and occasionally *Corymbia maculata* (Spotted Gum).

Mid Stratum – 4 m to 8 m with a PFC of 20% to 30%, the dominant species being *Melaleuca nodosa* (Ball Honeymyrtle), *Callistemon rigidus*, and *Glochidion ferdinandi* (Cheese Tree).

Lower Stratum – to 1.5m with a PFC of 60% to 80%, the dominant species being *Gahnia clarkei* (Tall Saw Sedge), *Empodisma minus* (Spreading Rope Rush), *Blechnum nudum*, *Oplismenus aemulus* (Basket Grass), *Calochlaena dubia* (False Bracken) and *Hemarthria uncinata* (Matt Grass).

7 Coastal Foothills Spotted Gum Ironbark Forest

This community occupies four separate sections within the central and northern portion of the site and covers approximately 31.68ha. This vegetation community is not commensurate with any vegetation communities described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002) however; this community is commensurate with MU 15 Coastal Foothills Spotted Gum – Ironbark Forest as described by LHCCREMS (NPWS 2000; House 2003).

Upper Stratum – to 20 m with a PFC of 30% to 50%, the dominant species being *Corymbia maculata* (Spotted Gum), *Eucalyptus paniculata subsp*. *paniculata* (Grey Ironbark), *Eucalyptus punctata* (Grey Gum) and *Eucalyptus umbra subsp*. *umbra* (Broad-leaved Mahogany).

Mid Stratum – 2 m to 5 m with a PFC of 30% to 40%, the dominant species being *Allocasuarina torulosa* (Forest Oak), *Daviesia ulicifolia* (Gorse Bitter Pea), *Podolobium ilicifolium* (Native Holly), *Bursaria spinosa* (Blackthorn), *Pultenaea villosa*, *Dodonaea triquetra* (Common Hop Bush) and *Persoonia linearis* (Narrow-leaved Geebung).

Lower Stratum – to 1.5 m with a PFC of 30% to 60%, the dominant species being *Xanthorrhoea macronema* (Grass Tree), *Lepidosperma laterale* (Variable Sword Sedge), *Lomandra longifolia* (Mat Grass), *Macrozamia communis* (Burrawang), *Imperata cylindrica var*. *major* (Blady Grass), *Vernonia cinerea var*. *cinerea*, *Themeda australis* (Kangaroo Grass), *Entolasia stricta* (Wiry Panic), *Echinopogan caespitosus* (Tufted Hedgehog Grass), *Panicum simile* (Two Colour Panic) and *Hardenbergia violacea* (False Sarsparilla).

8 Freshwater Wetland Complex (EEC – Freshwater Wetlands on Coastal Floodplains)

This vegetation community occurs above the cleared areas to the north of Middle Camp. This was previously a dam that was used for the underground coal mine located at Catherine Hill Bay. A small spillway was observed in the southwest corner of the community, which has caused soil erosion within the creekline below. This community was floristically diverse and provides habitat for a range of native flora and fauna. This vegetation community covers approximately 1.47 ha and is commensurate with MU 14 Freshwater Wetlands as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002). This community is also commensurate with MU 46 Freshwater Wetland Complex as described by LHCCREMS (NPWS 2000; House 2003).

Upper Stratum – to 10 m with a Projected Foliage Cover (PFC) of 10% to 20%, the dominant species being *Callistemon salignus* (Willow Bottlebrush), *Melaleuca styphelioides* (Prickly-leaved Melaleuca) and *Melaleuca ericifolia* (Swamp Paperbark).

Mid Stratum – to 2 m with a PFC of 30% to 40%, the dominant species being, *Acmena smithii* (Lillypilly) and *Gahnia clarkei* (Tall Saw Sedge).

Lower Stratum – to 1.5m with a PFC of 20% to 30%, the dominant species being *Gahnia clarkei* (Tall Saw Sedge), *Carex appressa*, *Adiantum aethiopicum* (Common Maidenhair), *Blechnum indicum*, *Entolasia marginata* (Bordered Panic), *Persicaria hydropiper* (Water Pepper), *Hydrocotyle peduncularis*, *Dichondra repens* (Kidney Weed) and *Paspalium distichum* (Water Couch).

Emergents – *Baumea articulata* (Jointed Twig-Rush), *Juncus continuus*, and *Philydrum lanuginosum* (Woolly Frogmouth).

Aquatics – *Azolla pinnata* (Ferny Azolla).

9 Apple – Palm Gully Forest

This vegetation community was located within the drainage lines and gullies within the site and covers an area of approximately 14.08ha. This vegetation community is commensurate with MU 25 Munmorah Palm-Apple Dry Drainage Line Forest as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002). This community is also commensurate with MU 39 Apple - Palm Gully Forest as described by LHCCREMS (NPWS 2000; House 2003). Structurally this community is generally of an open forest nature, however where drainage lines converge this community can be closed due to the increased density in *Livistonia australis* (Cabbage Tree Palms). This

vegetation communities has some affinities with the endangered ecological community of "Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion' but the dominance of eucalypts and the variable canopy cover. Whilst this vegetation community had a wide diversity of moist species but due to the high number of eucalypts and variable canopy cover it is considered not to be commensurate with this EEC.

Upper Stratum – 20 to 25 m with a PFC of 50% to 70%, the dominant species being *Livistona australis* (Cabbage Tree Palm), *Angophora costata* (Smooth-barked Apple), *Syncarpia glomulifera* (Turpentine), *Eucalyptus resinifera subsp*. *resinifera* (Red Mahogany) and occasionally *Eucalyptus robusta* (Swamp Mahogany).

Mid Stratum 1 – 10 to 15 m with a PFC of 40% to 70%, the dominant species being, *Callistemon salignus* (Willow Bottlebrush), *Glochidion ferdinandi* (Cheese Tree), and *Allocasuarina torulosa* (Forest She-oak).

Mid Stratum 2 – 2 to 3 m with a PFC to 30%, the dominant species being, *Acmena smithii* (Lilly Pilly), *Melaleuca linearifolia* (Snow-in-Summer), *Elaeocarpus reticulatus* (Blueberry Ash), *Leptospermum polygalifolium* (Lemon-scented Tea Tree), and *Melaleuca nodosa* (Ball Honeymyrtle).

Lower Stratum – to 1 m with a PFC of 20% to 30%, the dominant species being *Doodia apsera* (Rasp Fern), *Schoenus melanostachys*, *Adianthum aethiopicum* (Common Maidenhair), *Adianthum formosum* (Giant Maidenhair), *Blechnum indicum*, *Gahnia clarkei* (Tall Saw Sedge), *Gahnia melanocarpa* (Black-fruit Saw-sedge), *Smilax australis* (Lawyer Vine), *Cissus hypoglauca* (Native Grape), *Morinda jasminoides* (Jasmine Morinda), *Calochlaena dubia* (False Bracken) and *Gymnostachys anceps* (Settlers Flax).

10 Coastal Clay Heath

This vegetation community encompasses the coastal headland areas and comprises of both open and closed heath structure. The community encompasses 82.44 ha. This vegetation community is commensurate with MU 13 Coastal Headland Complex (Grassland and Shrubland) as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002). Included in this vegetation community are four variants of Grassland, Shrubland, Sheltered Gully and Tall Scrub as described by Bell (2002). This community is also commensurate with MU 48 Coastal Clay Heath as described by LHCCREMS (NPWS 2000; House 2003). The threatened species Eucalyptus parramattensis var. decadens was identified on the northern headland of Middle Camp Beach. This species is usually restricted to sand deposits from the Cessnock LGA and Tomago sandbeds, thus the local population is considered of high conservation value.

This community is variable with a variety of stunted Eucalypts that are dispersed throughout this community. Within this community are sections of closed heath, which conform to the Shrubland variant as described by Bell (2002) that is dominated by *Allocasuarina distyla*, *Melaleuca nodosa*, *Banksia integrifolia subsp*. *integrifolia*, *Westringia fruticosa* and *Leptospermum laevigatum*. Variations in dominance differed in some areas as dense patches of stunted Melaleuca nodosa occurred and in other section dense patches of *Allocasuarina distyla* were present.

There are areas of graminoid heath which have small shrubs (*Banksia oblongifolia*, *Banksia integrifolia*, *Lasiopetulum* parviflorum) interspersed with herbs and grasses. There are a few sheltered gullies in the north of the community in which the Sheltered Gully variant occurs, comprised of *Acmena smithii* as the dominant species. The Tall Scrub variant (up to 6 m) was also present in the areas that were sheltered from the coastal winds, this comprised of tall individuals of *Banksia integrifolia subsp*. *integrifolia* and *Leptospermum laevigatum*.

Upper Stratum – to 10 m with a Projected Foliage Cover (PFC) of 5% scattered trees of *Eucalyptus resinifera subsp*. *resinifera* (Red Mahogany), *Angophora costata* (Smooth-barked Apple), *Eucalyptus umbra subsp*. *umbra* (Broad-leaved Mahogany), *Eucalyptus capitellata* (Brown Stringybark), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus haemastoma* (Scribbly Gum) and *Corymbia maculata* (Spotted Gum).

Mid Stratum 1 – 4 m to 6 m with a PFC of 40% to 60%, the dominant species being, *Banksia integrifolia subsp*. *integrifolia* (Coast Banksia) and *Leptospermum laevigatum* (Coastal Tea Tree) within the Tall Scrub variant only.

Mid Stratum 2 – 2 m to 4 m with a PFC of 30% to 90%, the dominant species being *Westringia fruticosa* (Coast Westringia), *Allocasuarina distyla*, *Leptospermum laevigatum* (Coastal Tea Tree), *Melaleuca nodosa* (Ball Everlasting), *Banksia oblongifolia*, *Acacia longifolia var*. *longifolia* (Sydney Golden Wattle), *Lambertia formosa* (Mountain Devil), *Petrophile pulchella* (Conesticks), *Acacia myrtifolia* (Myrtle Wattle) and *Hakea dactyloides* (Broad-leaved Hakea).

Lower Stratum – to 1.5 m with a PFC of 40% to 90%, the dominant species being *Lomandra obliqua* (Fish Bones), *Patersonia sericea* (Purple Flag Flower), *Astroloma humifusum* (Cranberry Heath), *Lasiopetulum parvifolium* (Rusty Petals), *Melichrus procumbens* (Jam Tarts), *Leucopogon ericoides* (Bearded Heath), *Xanthorrhea latifolia subsp*. *latifolia* (Grass Tree), *Gonocarpus teucroides* (Raspwort), *Ptilothrix deusta*, *Cassytha glabella forma glabella* (Slender Devil's Twine) and *Themeda australis* (Kangaroo Grass).

11 Themeda Grasslands on Seacliffs and Coastal Headlands (EEC)

This vegetation community is interspersed within the Coastal Clay Heath vegetation community and occurs on the exposed slopes and ridge tops. A small area of this vegetation community occurs within the Development Estate on the ridgetops. Review of aerial photos for this area reveals that this area was previously cleared for coal mining and this community is considered to be highly disturbed, as there is high pasture weed incursions. This vegetation community encompasses approximately 1.17 ha. This vegetation community is commensurate with MU 13 Coastal Headland Complex (Grassland and Shrubland) as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002). This vegetation community is consistent with 13a Grassland variant as described by Bell (2002). This community is also commensurate with MU 48 Coastal Clay Heath as described by LHCCREMS (NPWS 2000; House 2003).

Upper Stratum – 0.5 m to 2 m with a PFC to 10%, the dominant species being Westringia *fruiticosa* (Coast Westringia), *Allocasuarina distyla*, *Melaleuca nodosa* (Ball Everlasting), *Banksia integrifolia subsp*. *integrifolia* (Coast Banksia), *Acacia longifolia var*. *longifolia* (Sydney Golden Wattle) and *Acacia myrtifolia* (Myrtle Wattle).

Lower Stratum – 0 to 0.5 m with a PFC of 90% to 100%, the dominant species being *Themeda australis* (Kangaroo Grass), *Patersonia sericea* (Purple Flag Flower), *Astroloma humifusum* (Cranberry Heath), *Lasiopetulum parvifolium* (Rusty Petals), *Gonocarpus teucroides* (Raspwort), *Ptilothrix deusta* and *Cassytha glabella*, form a, *glabella* (Slender Devil's Twine).

12 Coastal Sand Wallum Heath

This vegetation community occurs in the southern portion of the site on the exposed south facing slopes on Aeolian sands adjoining the Narrabeen Sheltered Grassy Forest and the Coastal Clay Heath. The unique presence of Grass Trees (*Xanthorrhoea resinifera*), which normally has no trunk, occurs within this community. This vegetation community encompasses approximately 8.62ha. This vegetation community is commensurate with MU 7 Coastal Sand Wallum Heath-Scrub as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002). This vegetation community is consistent with 7a Type variant as described by Bell (2002). This community is also commensurate with MU 34a Coastal Sand Wallum Heath as described by LHCCREMS (NPWS 2000; House 2003).

Upper Stratum – to 10 m with a Projected Foliage Cover (PFC) of 30% to 60%, the dominant species being *Banksia aemula* (Wallum Banksia), *Banksia serrata* (Old Man Banksia), *Xanthorrhoea resinifera* (Tree form), *Angophora costata* (Smooth-barked Apple), *Eucalyptus umbra subsp*. *umbra* (Broad-leaved Mahogany) and *Corymbia gummifera* (Red Bloodwood).

Mid Stratum – 2 m to 4 m with a PFC of 40% to 60%, the dominant species being *Leptospermum polygalifolium* (Lemon-scented Tea-tree), *Tetratheca thymifolia*, *Dillwynia retorta* (Eggs and Bacon), *Isopogon anemonifolius* (Drumsticks), *Ricinocarpus pinifolius* (Wedding Bush), *Cassina uncata* (Bent Cassina) and *Persoonia levis* (Broad-leaved Geebung).

Lower Stratum – to 1.5 m with a PFC of 40% to 60%, the dominant species being *Lomandra obliqua* (Fish Bones), *Xanthorrhoea fulva*, *Xanthosia pilosa* (Woolly Xanthosia), *Lomandra longifolia* (Mat Rush), *Leucopogon ericoides* (Bearded Heath), *Monotoca scoparia*, *Cassytha glabella forma glabella* (Slender Devil's Twine) and *Entolasia stricta* (Wiry Panic).

13 Coastal Sand Wallum Woodland

This vegetation community occurs in the southern portion of the site within the sheltered lower south facing slopes adjoining the Swamp Mahogany Paperbark Forest and the Coastal Clay Heath. This vegetation community encompasses approximately 1.82ha. This vegetation community is commensurate with MU 7 Coastal Sand Wallum Heath-Scrub as described by the Natural Vegetation of the Wyong Local Government Area (Bell,

2002). This vegetation community is consistent with 7a Type variant as described by Bell (2002). This community is also commensurate with MU 34 Coastal Sand Wallum Woodland as described by LHCCREMS (NPWS 2000; House 2003). This community is distinguished from Coastal Sand Wallum Heath by the dominance of stunted Eucalypt trees and a taller canopy.

Upper Stratum – 10 to 12 m with a Projected Foliage Cover (PFC) of 20% to 50%, the dominant species being *Banksia aemula* (Wallum Banksia), *Banksia serrata* (Old Man Banksia), *Angophora costata* (Smooth-barked Apple), *Eucalyptus umbra subsp*. *umbra* (Broad-leaved Mahogany) and *Corymbia gummifera* (Red Bloodwood).

Mid Stratum 1 – 2 to 5 m with a PFC of 5% to 15%, the dominant species being *Leptospermum trinervium* (Paperbark Tea-tree), *Leptospermum polygalifolium* (Lemon-scented Tea-tree), *Banksia spinulosa var*. *collina* (Hairpin Banksia), *Persoonia levis* (Smooth Geebung) and *Persoonia lanceolatus ssp*. *lanceolata* (Lance-leaved Geebung).
Mid Stratum 2 – 1 to 2 m with a PFC of 50% to 60%, the dominant species being *Dillwynia retorta* (Eggs and Bacon), *Isopogon anemonifolius* (Drumsticks), *Ricinocarpus pinifolius* (Wedding Bush), *Cassina uncata* (Bent Cassina), *Correa reflexa* (Common Correa), *Pteridium esculentum* (Bracken Fern) and *Pultenaea daphnoides*.

Lower Stratum – to 1.5 m with a PFC of 40% to 90%, the dominant species being *Lomandra obliqua* (Fish Bones), *Xanthorrhoea fulva*, *Xanthosia pilosa* (Woolly Xanthosia), *Lomandra longifolia* (Mat Rush), *Pratia purpurascens* (White Root), *Cassytha glabella*, form a, *glabella* (Slender Devil's Twine), *Gonocarpus teucroides* (Raspwort), and *Entolasia stricta* (Wiry Panic).

14 Coastal Sand Scrub

This vegetation community occurs on the fore dunes along the coastline where it adjoins the Beach Spinifex vegetation community. This vegetation community encompasses approximately 14.28ha. The community is commensurate with MU 6 Coastal Sand Holocene Banksia Scrub within the sheltered back dunes, and with MU 5 Coastal Sand Foredune Acacia Scrub in the foredunes as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002). This community is also commensurate with MU 50 Coastal Sand Scrub as described by LHCCREMS (NPWS 2000; House 2003). Coastal Sand Foredune Acacia Scrub, which is comprised of Acacia longifolia var. sophorae and *Chrysanthemoides monilifera subsp*. *rotundata* (Bitou Bush), occurs along the foredunes in the northern portion of this community. The remainder of the community is commensurate with Coastal Sand Holocene Banksia Scrub. The northern portion behind the cemetery and adjoining the Catherine Hill Bowling Club is highly disturbed with weed incursions, whereas the southern portion of this community has a high diversity of natives and is relatively undisturbed due to the inaccessibility on the cliff line.

Mid Stratum 1 – 4 to 6 m with a PFC of 30% to 80%, the dominant species being *Banksia integrifolia subsp*. *integrifolia* (Coast Banksia) and *Leptospermum laevigatum* (Coastal Tea Tree).

Upper Stratum – 1 to 2 m with a PFC of 20% to 30%, the dominant species being

Westringia fruiticosa (Coast Westringia), *Hakea teretifolia* (Dagger Hakea), *Chrysanthemoides monilifera subsp*. *rotundata* (Bitou Bush) *Acacia longifolia var*. *longifolia* (Sydney Golden Wattle), *Acacia longifolia var*. *sophorae* (Coastal Wattle) and *Acacia myrtifolia* (Myrtle Wattle).

Lower Stratum – 0 to 1 m with a PFC of 20% to 30%, the dominant species being *Themeda australis* (Kangaroo Grass), *Lomandra longifolia* (Mat Rush), *Lasiopetulum parvifolium* (Rusty Petals), *Hibbertia aspera*, and *Cassytha glabella forma glabella* (Slender Devil's Twine).

15 Beach Spinifex

This vegetation community occurs within the foredunes of the coastline in the south-eastern portion of the site. This vegetation community encompasses approximately 1.01ha. This vegetation community is commensurate with MU 4 Coastal Beach Sand Spinifex as described by The Natural Vegetation of the Wyong Local Government Area (Bell, 2002). This community is also commensurate with MU 53 Beach Spinifex as described by LHCCREMS (NPWS 2000; House 2003). Due to the harsh conditions of salt spray and coastal winds there is no upper stratum and very little shrub layer in this community.

Mid Stratum – to 1 m with a PFC to 10%, the dominant species being, *Acacia longifolia var*. *sophorae* (Coastal Wattle), *Chrysanthemoides monilifera subsp*. *rotundata* (Bitou Bush) and *Banksia integrifolia subsp*. *integrifolia* (Coast Banksia).

Lower Stratum – to 0.5m with a PFC of 5% to 30%, the dominant species being Sp*i*nifex *sericeus* (Hairy Spinifex), *Hydrocotyle bonariensis* (Pennywort), *Scaevola calendulacea* (Scented Fan Flower), *Leucopogon parviflorus*, *Cakile edentula* (American Sea Rocket), *Carpobrotus glaucescens* (Pig Face) and *Isolepis nodosa*.

16 Weeds and Cleared Areas

This vegetation community occurs within the central portion of the site and is the result of clearing for the underground mining operations, which were shut down in the 1960's. This community encompasses approximately 31.74 ha and is not commensurate with any vegetation communities that have been described by either the Natural Vegetation of the Wyong Local Government Area (Bell, 2002) or LHCCREMS (NPWS 2000; House 2003). These areas are highly disturbed and have high weed incursions. The threatened species Eucalyptus parramattensis var. decadens was identified to the west of Middle Camp houses within a cleared buffer. This species is usually restricted to sand deposits from the Cessnock LGA and Tomago sandbeds, thus the local population is considered of high conservation value.

Upper Stratum – 15 to 18 m with a Projected Foliage Cover (PFC) of 5%, the dominant species being *Eucalyptus punctata* (Grey Gum), *Eucalyptus robusta* (Swamp Mahogany), *Erythrina x sykesii* (Coral Tree) and *Ficus rubiginosa* (Port Jackson Fig).

Mid Stratum – to 2 m with PFC of 20 to 30%, the dominant species being *Pteridium esculentum* (Bracken Fern), *Acacia longifolia var*. *longifolia* (Sydney Golden Wattle), *Lantana camara* (Lantana), *Cinnamomum camphora* (Camphor Laurel), *Ligustrum sinense* (Small-leaved Privet) and *Chrysanthemoides monilifera subsp*. *rotundata* (Bitou Bush).

Lower Stratum – to 1 m with a PFC of 80% to 90%, the dominant species being *Pennisetum clandestinum* (Kikuyu), *Pteridium esculentum* (Bracken Fern), *Cynodon dactylon* (Common Couch), *Hydrocotyle bonariensis* (Pennywort), *Chloris gayana* (Rhodes Grass), *Verbena bonariensis* (Purple Top), *Eragrostis tenuifolia* (Elastic Grass), *Stenotaphrum secundatum* (Buffalo Grass), *Richardia brasiliensis* (White Eye), *Andropogon virginicus* (Whisky Grass), *Hypochaeris radicata* (Flatweed), *Plantago lanceolata* (Ribwort), *Bidens pilosa* (Farmer's Friends), *Trifolium repens* (White Clover) and *Sida rhombifolia* (Paddy's Lucerne).

17 Dam and Associated Vegetation

This vegetation community occurs adjoining the cleared areas within the north of the site. This community encompasses approximately 0.3ha and is not commensurate with any vegetation communities that have been described by either the Natural Vegetation of the Wyong Local Government Area (Bell, 2002) or LHCCREMS (NWPS 2000; House 2003). This community differs from the Freshwater Wetland Complex in that it is highly disturbed with weed incursions present around the edges of the dam and with very little density of native species.

Upper Stratum – to 15 m with a PFC of 5%, the dominant species being dominant species being *Erythrina x sykesii* (Coral Tree) and *Cinnamomum camphora* (Camphor Laurel).

Mid Stratum –2 to 4 m with a PFC of 30% to 40%, the dominant species being, *Acacia longifolia var*. *longifolia* (Sydney Golden Wattle), *Ligustrum sinense* (Small-leaved Privet), *Pittosporum undulatum* (Sweet Pittosporum), *Senna pendula var*. *glabrata* (Winter Senna) and *Chrysanthemoides monilifera subsp*. *rotundata* (Bitou Bush).

Lower Stratum – to 1 m with a PFC of 80% to 90%, the dominant species being *Pennisetum clandestinum* (Kikuyu), *Pteridium esculentum* (Bracken Fern), *Hydrocotyle bonariensis* (Pennywort), *Carex appressa*, *Eragrostis tenuifolia* (Elastic Grass), *Andropogon virginicus* (Whisky Grass), *Hypochaeris radicata* (Flatweed), *Schoenus* apogon (Fluke Bogrush) and *Schoenus brevifolius*.

Emergents – *Baumea articulata* (Jointed Twig-Rush), *Phragmites australis* (Native Rush), *Juncus subsecundus* (Finger Rush) and *Juncus continuus*.

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle. Note that this Vegetation Community Map depicts clearly defined boundaries between vegetation communities that are the product of individual interpretation and are not distinguished by clearly defined boundaries 'on the ground'. Therefore, this map should only be treated as an indication of approximate peripheries between delineated vegetation communities. Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account for intergrading areas between delineated vegetation communities has been made.

Legend

- Site Boundary
- Development Estate
- Themeda Grasslands on Seacliffs and Coastal Headlands
- MU 48 Coastal Clay Heath
- Tracks (unformed)
- MU 15 Coastal Foothill Spotted Gum Ironbark Forest
- MU 39 Apple - Palm Gully Forest
- MU 50 Coastal Sand Scrub
- Weed
- MU30 Coastal Plains Smooth-barked Apple Woodland
- MU 42 Riparian Melaleuca Swamp Woodland
- MU 40 Swamp Oak - Rushland Forest
- MU 37 Swamp Mahogany - Paperbark Forest
- Cleared Land
- MU 53 Beach Spinifex
- MU 34a Coastal Sand Wallum Heath
- MU 53 Beach Spinifex
- MU 46 Freshwater Wetland Complex
- Narrabeen Wallarah Sheltered Grassy Forest
- MU 37 Swamp Mahogany - Paperbark Swamp Forest
- Themeda Grasslands on Seacliffs and Coastal Headlands (Disturbed Remnant)
- Dam
- MU 31 Coastal Plains Scribbly Gum Woodland
- MU 34a Coastal Sand Wallum Heath

N

0 400 800m

SCALE: 1: 15000 AT A3 SIZE

TITLE: FIGURE 4-1 VEGETATION MAP
LOCATION: CATHERINE HILL BAY
DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 11/3/2010
PURPOSE: PURPOSE
24530\DRAFT\ECO\SOUTHERN\2010TEMPLATES\
LAYOUT REF: FIGURE 4-1 VEGETATION MAP 2010 A 3
VERSION (PLAN BY): A (A.P-M,D)

CLIENT: COAL & ALLIED INDUSTRIES LTD
JOB REF: 24530-1

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
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4.1.2 Conservation Status of Vegetation Communities

Four EEC's that are listed under the TSC Act 1995 occur within five delineated vegetation communities extant on the Catherine Hill Bay site. These four communities are listed below:

- The vegetation community delineated as Swamp Oak Rushland Forest is commensurate with 'Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregions';
- The vegetation communities delineated as Swamp Mahogany - Paperbark Forest and Riparian Melaleuca Swamp Woodland are both commensurate with 'Swamp Sclerophyll Forest on Coastal Floodplains in the NSW North Coast, Sydney Basin and South East Corner Bioregions';
- Freshwater Wetland Complex is commensurate with 'Freshwater Wetlands on Coastal Floodplains in the NSW North Coast, Sydney Basin and South East corner Bioregions'; and
- Themeda grasslands on Seacliffs and Coastal Headlands is commensurate with 'Themeda Grasslands on Seacliffs and Coastal Headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions'.

4.1.3 Regionally Significant Vegetation Communities within Lake Macquarie LGA

The following vegetation communities, which occur within the site, are considered to be regionally significant by Lake Macquarie Flora and Fauna Guidelines within the Lake Macquarie LGA:

- Apple – Palm Gully Forest;
- Coastal Clay Heath;
- Coastal Foothills Spotted Gum – Ironbark Forest;
- Coastal Plains Scribbly Gum Woodland;
- Coastal Sand Scrub;
- Coastal Wallum Heath;
- Coastal Wallum Woodland;
- Narrabeen Wallarah Sheltered Grassy Forest
- **Riparian Melaleuca Swamp Woodland (Swamp Sclerophyll Forest on Coastal Floodplains - listed as EEC)**
- **Swamp Mahogany - Paperbark Forest (Swamp Sclerophyll Forest on Coastal Floodplains - listed as EEC); and**
- **Swamp Oak Rushland Forest (Swamp Oak Floodplain Forest - listed as EEC).**

4.1.4 Regionally Significant Flora Species

No ROTAP listed species (Briggs and Leigh, 1996) were identified within the Catherine Hill Bay site. However, Lake Macquarie Flora and Fauna Guidelines (2001) contain a list of regionally significant flora species and 10 of these were identified within the site, and are listed as follows:

- *Asplenium aethiopicum*;
- *Conospermum ericifolium*;
- *Eucalyptus robusta*;
- *Eucalyptus signata*;
- *Hakea bakerana*;
- *Gompholobium pinnatum*;
- *Muehlenbeckia gracillima*;
- *Woollsia pungens*;
- *Xanthorrhoea fulva*; and
- *Xanthorrhoea resinifera* (Tree Form).

4.1.5 Desktop Assessment – Threatened Flora Search Results

The results of this search indicated numerous threatened flora species have been previously recorded within the locality and/ or have potential habitat within the site. The following have been recorded within 10km (DECCW Wildlife Atlas 2010) of the site:

- *Angophora inopina* (Charmhaven Apple);
- *Caladenia tessellata* (Thick Lip Spider Orchid);
- *Callistemon linearifolius* (Netted Bottle Brush);
- *Corybas dowlingii* (Red Helmet Orchid)
- *Cryptostylis hunteriana* (Leafless Tongue Orchid);
- *Diuris praecox* (Rough Double Tail);
- *Eucalyptus camfieldii* (Camfield's Stringybark);
- *Eucalyptus parramattensis subsp*. *decadens* (Drooping Red Gum);
- *Genoplesium insignis* (Variable Midge Orchid);
- *Pultenaea maritima* (Coastal Headland Pea);
- *Rutidosis heterogama* (Heath Wrinklewort);
- *Syzygium paniculatum* (Magenta Lilly Pilly);
- *Tetratheca glandulosa*; and
- *Tetratheca juncea* (Black-eyed Susan).

Tetratheca glandulosa does not have potential habitat within the Catherine Hill Bay site

and therefore has not been assessed further within this report.

In addition, to the above threatened flora species recorded on the DECCW Wildlife Atlas, it was considered the following species have potential habitat within the site and should be considered within this assessment:

- *Acacia bynoeana*;
- *Chamaesyse psammogeton* (Sand Spurge);
- *Cynanchum elegans* (White-flowered Cynanchum);
- *Dendrobium melaleucaphilum* (Spider Orchid);
- *Grevillea parviflora ssp parviflora* (Little-flower Grevillea);
- *Melaleuca groveana* (Grove's Paperbark); and
- *Microtis angusii* (Angus's Onion Orchid).

Threatened Flora Species with potential to occur

The following nineteen threatened flora species have potential habitat within the Catherine Hill Bay site:

- *Acacia bynoeana* – Potential habitat within Coastal Plains Scribbly Gum Woodland within the site. Identified within the Lake Macquarie SRA to the south west of the site;
- *Angophora inopina* – Potential habitat within Coastal Plains Scribbly Gum Woodland within the site. Identified within the Lake Macquarie SRA to the south west of the site;
- *Caladenia porphyrea* – Potential habitat within the coastal habitats of Coastal Clay Heath, Coastal Plains Scribbly Gum Woodland and Narrabeen Wallarah Sheltered Grassy Forest.
- *Caladenia tessellata* – Potential habitat within the Coastal Plains Scribbly Gum Woodland within the site. Recorded within Munmorah State Conservation Area to the south of the site;
- *Callistemon linearifolius* – A small shrub that has potential habitat within the drainage lines within the site;
- *Chamaesyce psammogeton* – Potential habitat within the Beach Spinifex vegetation community within the site;
- *Cryptostylis hunteriana* – cryptic orchid found in flat plains in coastal areas, marginal habitat may be present within the Coastal Plains Smooth-barked Apple Woodland, Narrabeen Wallarah Sheltered Grassy Woodland and the Coastal Plains Scribbly Gum Woodland within the site;
- *Cynanchum elegans* – vine found in Rainforest habitats. Sub-optimal habitat within the ecotone between the riparian zones and the dry sclerophyll forests within the site;
- *Dendrobium melaleucaphilum* – Epiphytic orchid mostly found on *Melaleuca styphelioides*, habitat within the two wet sclerophyll forests on the site;
- *Diuris praecox* – cryptic orchid with potential habitat within the Coastal Plains Scribbly Gum Woodland, Narrabeen Wallarah Sheltered Grassy Forest and Coastal Plains Smooth-barked Apple Woodland vegetation communities;

- *Eucalyptus camfieldii* – Potential habitat within Coastal Plains Scribbly Gum Woodland. Identified to the south of the site on NPWS database Atlas records;
- *Eucalyptus parramattensis subsp*. *decadens* – Potential habitat for this species within the heath vegetation communities within the site;
- *Genoplesium insignis* – Potential habitat for the species within the Coastal Plains Scribbly Gum Woodland. This species has been located within Lake Macquarie SRA to the south west of the site;
- *Grevillea parviflora subsp*. *parviflora* – a shrub, potential habitat within the Coastal Foothills Spotted Gum Ironbark Forest within the site;
- *Melaleuca biconvexa* – Shrub to small tree found in low-lying swamping areas, marginal habitat within the wet sclerophyll vegetation communities within the site;
- *Melaleuca groveana* – shrub found in closed heath and dry sclerophyll forest, habitat exists in the Coastal Clay Heath vegetation community;
- *Microtis angusii* – A tentative identification of this species within Lake Macquarie SRA, however, potential habitat exists within the Coastal Plains Scribbly Gum Woodland within the site;
- *Pultenaea maritima* – Shrub found in heath on coastal headlands. Habitat exists within the coastal heath in the northern portions of the site;
- *Rutidosis heterogama* – A small shrub that has been located within the heath at Glenrock Lagoon to the north of the site. Potential habitat occurs within the Coastal Clay Heath vegetation community within the site;
- *Syzygium paniculatum* – Shrub to small tree found in rainforests or riparian vegetation, potential habitat within riparian zones within the site;
- *Tetratheca juncea* – Shrub found within dry sclerophyll forests and woodlands, potential habitat within this site occurs within the Coastal Plains Smooth-barked Apple Woodland, Coastal Plains Scribbly Gum Woodland, Narrabeen Wallarah Sheltered Grassy Forest, Coastal Clay Heath and Coastal Sand Wallum Woodland and Heath vegetation communities.

4.1.6 Threatened Cryptic Orchid Species

Following the precautionary approach, areas of vegetation communities that have been known to support these cryptic orchids have been included in calculations of potential habitat within the Catherine Hill Bay lands.

Caladenia tessellata

Potential habitat for this species occurs within Coastal Plains Scribbly Gum Woodland, Coastal Plains Smooth-barked Apple Woodland and Narrabeen Wallarah Sheltered Grassy Forest. Approximately 7.99 ha (2%) of potential habitat for this species will be removed within the development estate. However, over 335.55 ha (98%) of habitat will be retained as part of the conservation lands. Thus, whilst it cannot be determined if this species is present within the development estate without numerous return surveys over many years, as there are large tracks of habitat to be retained within the conservation lands it is unlikely that the proposal will have a significant impact upon this species.

Caladenia porphyrea

Potential habitat for this species occurs within the coastal habitats of Coastal Clay Heath, Coastal Plains Scribbly Gum Woodland and Narrabeen Wallarah Sheltered Grassy Forest. Approximately 0.53 ha (1%) of potential habitat for this species (Narrabeen Wallarah Sheltered Grassy Forest only) will be removed as part of the development proposal. However, over 293.84 ha (99%) of habitat for this species is being retained within the conservation lands. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

Cryptostylis hunteriana

Potential habitat for this species occurs within Coastal Plains Scribbly Gum Woodland, Coastal Plains Smooth-barked Apple Woodland and Narrabeen Wallarah Sheltered Grassy Forest. Approximately 7.99 ha (2%) of potential habitat for this species will be removed for the proposal at Catherine Hill Bay. However over 335.55 ha (98%) of potential habitat for this species will be retained within the conservation lands at Catherine Hill Bay. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

Diuris praecox

Potential habitat exists for this species occurs within the Coastal Plains Smooth-barked Apple Woodland, Coastal Plains Scribbly Gum Woodland, Coastal Foothills Spotted Gum Ironbark Forest and the Narrabeen Wallarah Sheltered Grassy Woodland vegetation communities within the Catherine Hill Bay lands. Approximately 7.99 ha (2%) of habitat will be removed within the Catherine Hill Bay development estate. However, over 367.23 ha (98%) of potential habitat for the species will be retained within the conservation lands. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

Genoplesium insignis

Potential habitat for this species occurs within Coastal Plains Scribbly Gum Woodland within the Catherine Hill Bay site. This vegetation community does not occur within the development estate at Catherine Hill Bay and therefore this species will not be impacted upon by the development and 36.08 ha of potential habitat will be retained within the Catherine Hill Bay conservation lands.

Microtis angusii

Potential habitat for this species occurs within Coastal Plains Scribbly Gum Woodland within the Catherine Hill Bay site. This vegetation community does not occur within the development estate at Catherine Hill Bay and therefore this species will not be impacted upon by the development and 36.08 ha of potential habitat will be retained within the Catherine Hill Bay conservation lands.

4.1.7 Targeted Threatened Flora Species Survey Results

This section lists the results of the threatened flora surveys, three threatened flora species were located within the site, being *Callistemon linearifolius*, *Eucalyptus parramattensis subsp*. *decadens* and *Tetratheca juncea*. One threatened flora species was previously recorded in the vicinity of the site by DECCW Database Atlas in 2003 being *Diuris praecox*. No other threatened flora species were detected within the site.

Caladenia porphyrea

Targeted surveys were undertaken within the development estate during the September flowering season for this species, with no individuals being located. During surveys, the similar species *Caladenia carnea* was checked when it was encountered to ensure it was not *C*. *porphyrea*.

Cryptostylis hunteriana

Potential habitat for this species occurs within the Catherine Hill Bay site. This species was surveyed for within the 2007 flowering period using parallel searches in the development estate and no specimens were located. RPS found a small population of this species on the edge of Narrabeen Doyalson Coastal Woodland (Coastal Plains Scribbly Gum Woodland) on adjacent lands to the south of the Coal and Allied lands within the Catherine Hill Bay locality in November 2007. Thus, this species was known to be flowering in 2007 and targeted surveys were undertaken within the Catherine Hill Bay development estate in late November 2007 with no specimens located.

Callistemon linearifolius

This species has been recorded during the current survey within the Riparian Melaleuca Swamp Woodland vegetation community within the south-east portion of the site (Figure 4-1). The complete population has not been surveyed however the extent of the population has been mapped. Targeted surveys within the development estate did not detect this species. Therefore, no individuals of this species will be removed as part of the proposal. However, the proposed development will occur to the south of this population and if appropriate sediment control measures are put into place during the development's construction phases, then potential impacts to this population will be mitigated. In addition there is a DECCW database atlas record for this species in the drainage line adjoining the northern boundary and therefore more individuals could be present within the conservation lands. Thus, the impact of the proposal upon this species will be minimal.

Diuris praecox

Targeted searches for *Diuris praecox* were conducted throughout the development estate during the flowering period for this species. No individuals of this species were located during any of the targeted searches.

However, this species has been recorded by DECCW Atlas in 2003 in two locations. One record within the Coastal Plains Smooth-barked Apple Woodland to the west of the cleared areas and the remaining within the Narrabeen Wallarah Sheltered Grassy Forest

in the conservation lands in the south west of the site. The former record is within the development estate and some plants may be impacted upon by the development proposal. DECCW database atlas records are accurate to ± 1 km and therefore it is difficult to predict if the development may impact upon this species. Over 6 visits were made in the vicinity of this record to try to detect this particular record however, *Diuris praecox* is a difficult species to detect, as it does not flower every year.

Potential habitat exists for this species within both the Coastal Plains Smooth-barked Apple Woodland, Scribbly Gum and the Narrabeen Wallarah Sheltered Grassy Woodland vegetation communities and there are large areas of these three communities present within the conservation lands of the site.

Eucalyptus parramattensis subsp. decadens

Seventeen individuals of this species have been recorded within the Coastal Clay Heath in the north east of the site, with an additional 2 individuals located to the west of houses in Middle Camp (Figure 4-1). The two individuals in Middle Camp are only 20 m to the east of a proposed road, and care will need to be taken during construction to avoid these specimens. This species is usually restricted to Sand deposits from the Cessnock LGA and the Tomago Sand Beds, thus the local population is considered to be of high conservation value. So long as the two species within the vicinity of the development are retained the impact upon this species will be minimal.

Pultenaea maritima

This species has previously been detected on a headland to the north of Pinny Beach. Potential habitat for the species occurs within Coastal Clay Heath within the Catherine Hill Bay site. Searches for this species were conducted by RPS on the headlands and grassy areas within the Catherine Hill Bay site whilst undertaking vegetation surveys in late 2007. Two individuals located on the headlands in the north eastern portion of the conservation lands were suspected to be *Pultenaea maritima* and were sent to the Royal Botanic Gardens in Sydney for identification. The Royal Botanic Gardens in Sydney identified these two individuals as *Pultenaea villosa* (see Appendix 3). Further searches utilising the random meander technique across the headland did not result in the location of any further individuals suspected to be *Pultenaea maritima*. Whilst this species cannot be discounted as occurring within the conservation lands as targeted parallel searches have not been conducted all of the potential habitat (82.44 ha) for this species will be retained. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

Rutidosis heterogama

The potential for the existence of this species within the Coastal Clay Heath vegetation community within the Catherine Hill Bay site has been as part of the assessment process. Bell (2008) notes that this species tends to disappear from the above ground flora for months at a time and despite searches for the species during flora surveys, it is difficult to discount the possibility of this species occurring within the Coastal Clay Heath vegetation community at Catherine Hill Bay. Whilst this species cannot be discounted as occurring within the conservation lands, all of the potential habitat (82.44 ha) for this species will be

retained. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

Tetratheca juncea

A total of 8,042 *Tetratheca juncea* plants were located during the targeted surveys within the Catherine Hill Bay site (Figure 4-2 shows the distribution). Of these 7,057 (88%) will be retained within the conservation lands to the south and west of the development estate. The remaining 985 (12%) individuals will be removed as part of the proposal. Furthermore it is estimated that 350 ha of habitat, within the Catherine Hill Bay site, remains to be surveyed. Thus, it is considered that this population is significant due to the large size of the population and likely high content of genetic diversity. Other similar sized populations of 25,000 have been located within the Wallarah Peninsula by Conacher Travers (2007). Of these, over 9,900 have been conserved within Wallarah National Park, with more individuals to be retained within the bush parks within the development estates.

The work of Payne (2000) states that all sub-populations of 100 plants or more are of very high conservation significance within the South-East quadrant in which this site occurs. However, at the time the whole population of *Tetratheca juncea* was estimated to be only 10,000 (Payne, 2000). This figure is an underestimation of the entire population throughout its range, but due to the cryptic nature of this species and the lack of extensive surveys a conservative approach was taken. Further surveys since that time has increased the known numbers of this species and this is supported by the large numbers located on the Wallarah Peninsula alone.

Some of the elements of the life-cycle of Tetratheca juncea have recently been discovered although much of the ecology is still unknown. However, as this species is an outcrosser (i.e. cannot self pollinate) and utilises buzz pollination (Gross et al., 2003; Driscoll 2003) this type of reproduction leads to low fruit set. Buzz pollinators are highly specialized and require specific habitat requirements and this has been hypothised as one of the reasons for the species decline and fragmentation (Gross et al., 2003). As the population at Catherine Hill Bay is large and contains other species which utilise buzz pollination (e.g. *Hibbertia sp*. and *Dianella sp*.) it is considered that the habitat within the both the development estate and offset lands provides good quality habitat for the buzz pollinator of *Tetratheca juncea*. Thus, it is vital that conservation of good quality habitat for the pollinator is conserved to ensure sufficient seed is set to ensure the survival of this species. The populations located within the offset lands are densely spaced and may be more successful in attracting a pollinator than the population within the development estate.

In conclusion, it is estimated that the population within the Wallarah Peninsula is at least 49,000 to date (RPS (2010a, 2010b) and Conacher Travers (2007) data combined). Table 4-1 is a breakdown of the numbers of *Tetratheca juncea* currently within conservation lands that has been surveyed to date. This number is expected to be an underestimation as less than half of the habitat for this species has been surveyed at Catherine Hill Bay, and there are still some areas to be surveyed in the conservation lands at Gwandalan and Nords Wharf. In addition to these populations, Wildthing (2003) located further populations of *Tetratheca juncea* within Catherine Hill Bay area and the

lands to the south of Nords Wharf. Thus whilst the population within the development estate is large, over 12% of the known population within the Catherine Hill Bay site will be conserved within the conservation lands. Within the Wallarah Peninsula this will increase the current known conservation of *Tetratheca juncea* numbers from 10,225 (Conacher Travers 2007, Payne (2000)) to over 29,000. Thus the removal of 2% of the Wallarah Peninsula population from the Catherine Hill Bay site is unlikely to have a significant effect upon the population within the Wallarah peninsula. Such a large number of known plants protected in several disjunct but proximate conservation areas bodes well for the long term security of the species in this locality.

Table 4-1: Known Distribution of *Tetratheca juncea* within the Wallarah Peninsula within Conservation Reserves

Site at Wallarah Peninsula	Numbers of *Tetratheca juncea*
Wallarah National Park and Habitat Corridor at Murrays Beach*	9900
Munmorah State Conservation Area**	296
Lake Macquarie State Conservation Area**	29
Catherine Hill Bay Proposed Conservation Lands	7,596
Gwandalan Proposed Conservation Lands	8,222
Nords Wharf Proposed Conservation Lands	5,933
Total in Conservation Reserves at Wallarah Peninsula	**31,976**

* Data from Conacher Travers (2007)
** Data from Payne (2000)

Other Cryptic orchids

No other cryptic orchids were located during the targeted surveys within the development estate. The main genuses, which have habitat within the development estate, include *Diuris sp*., *Caladenia sp*. and *Genoplesium sp*. However sub-optimal habitat is present for a number of the undescribed and threatened orchids, which Therefore, these species cannot be discounted as not occurring within the development estate; however large areas of habitat is present within the offset lands which will be set aside for conservation.

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.
Note that this Vegetation Community Map depicts clearly defined boundaries between vegetation communities that are the product of individual interpretation and are not distinguished by clearly defined boundaries on the ground. Therefore, this map should only be treated as an indication of approximate peripheries between delineated vegetation communities. Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account for intergrading areas between delineated vegetation communities has been made.

LEGEND

- Site Boundary
- Development Estate
- Tetratheca juncea in Development Estate (417)
- Tetratheca juncea in Conservation Lands (7596)
- Area not surveyed during targeted surveys

N

0 250 500m

SCALE: 1: 8000 AT A3 SIZE

TITLE: FIGURE 4-2 DISTRIBUTION OF *TETRATHECA JUNCEA*

LOCATION: CATHERINE HILL BAY

DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 16/3/2010
PURPOSE: ECOLOGY

24530\DRAFTING\ECO\SOUTHERN\ALL WORK\2010TEMPLATE\
LAYOUT REF: CATHERINE H B\24530-1 FIG 4-3 DISTRIB OF TJ A A3
VERSION (PLAN BY): A (A.P-M.D)

CLIENT: COAL & ALLIED INDUSTRIES LTD
JOB REF: 24530-1

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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RPS

4.1.8 Regionally Significant Orchid Species

The following orchids which are listed in this section have not been listed under state (*TSC Act*) or federal (*EPBC Act*) legislation as threatened. However, these species have been addressed further to clarify their significance within the Catherine Hill Bay site.

Acianthus exertus

Jones (2006) describes this orchid as occurring in QLD, NSW, ACT and Victoria. It is widespread and locally common occurring in coastal areas in forest and woodlands on well drained soils. Jones (2006) also notes that this species rarely occurs with *Acianthus fornicatus*, which was found to be common in the forest and woodland communities within Catherine Hill Bay. Bell (2008) notes that there is a lack of records for this species along the coastal strip between Newcastle and the Hawkesbury River; however, Gunninah (2003) notes a record for this species at the Colongra Wetland near Doyalson. A submission to list an endangered population of this species has been submitted to the Scientific Committee (Bell 2008), but at the time of writing, this endangered population has not yet been listed as either a preliminary or a final determination on the DECCW web site. The location of this endangered population in the locality is also unknown in relation to published or informal literature at the time of writing. Potential habitat exists for this species occurs within the Coastal Plains Smooth-barked Apple Woodland, Coastal Plains Scribbly Gum Woodland, Coastal Foothills Spotted Gum Ironbark Forest and the Narrabeen Wallarah Sheltered Grassy Woodland vegetation communities within the Catherine Hill Bay lands. Approximately 7.99 ha (2%) of habitat will be removed within the Catherine Hill Bay development estate with over 367.23 ha (98%) to be retained within the conservation lands. Thus, it is considered unlikely that the proposal will have a significant impact upon this species.

Genoplesium ruppii

One public submission reports that this species has been located within the Wallarah Peninsula, however, no location information was provided with this submission. This species has been recorded at Wyee Road in Wyong and several other records exist from Paterson in the lower Hunter Valley. No targeted surveys for this species in particular have been undertaken within the development estate. The habitat within which the species has been previously recorded varies from open grassland, heathlands (Gunninah 2003) to moist swampy forests (Jones 2006). Potential habitats within the Catherine Hill Bay site include, Narrabeen Wallarah Sheltered Grassy Woodland, Coastal Scribbly Gum Woodland, Coastal Plains Smooth-barked Apple Woodland and Coastal Foothills Spotted Gum Ironbark Forest. Approximately 7.99 ha (2%) of habitat will be removed within the Catherine Hill Bay development estate. However, over 367.23 ha (98%) of potential habitat for the species will be retained within the conservation lands. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

Pterostylis alveata syn. Diplodium alveata

There may be potential for this species to occur within the development estate at Catherine Hill Bay. It is generally found within Teatree heathland on sand dunes (Bishop 2000). Bell (2008) suggests that an endangered population nomination has been submitted for this species. At the time of writing this report no preliminary to final determination for this species or population has been listed on either the TSC Act or the EPBC Act. Sub-optimal habitat for this species occurs within the Coastal Sand Wallum Heath, Coastal Sand Wallum Woodland and Coastal Sand Scrub within the Catherine Hill Bay site. These vegetation communities do not occur within the development estate at Catherine Hill Bay and therefore this species will not be impacted upon by the development and 24.72 ha of potential habitat will be retained within the Catherine Hill Bay conservation lands.

Pterostylis daintreana syn. Pharochilum daintreanum

This species has been found along the edges of sandstone outcrops growing under healthy vegetation or in moss and lichen fringing this vegetation (Bishop 2001). Habitats such as these are common within the Hawkesbury sandstone vegetation communities in the vicinity of the Hawkesbury River. The Catherine Hill Bay site may contain some habitat for this species on the edges of the vegetation where it adjoins the conglomerate headlands. The majority of this type of habitat occurs within the Coastal Clay Heath vegetation community. This community will be retained within the Catherine Hill Bay conservation lands in its entirety and thus the proposal is unlikely to have a significant impact upon this species.

4.1.9 Regionally Significant Undescribed Cryptic Orchids

Bell (2008) identified several undescribed orchids which may have habitat within the Catherine Hill Bay site. These orchids have been discussed below.

Caladenia sp. aff. fuscata

This species has been reported from three locations on the Central Coast with records also from the Wallarah Peninsula (Bell 2008). This species has wider petals than the common species, *Caladenia fuscata*. *Caladenia fuscata* was not detected by RPS during the vegetation surveys, however, as it is similar to *Caladenia carnea* it is possible that it occurs within the habitats within the Wallarah Peninsula and may have been overlooked during surveys due to similarities. Limited information is available on the habitat of this species to enable a full assessment of the suitable habitats for this species. Further taxonomic investigations are required to determine if this is indeed a new species. Thus a precautionary approach has been taken in this instance to assume that *Caladenia sp. aff fuscata* occurs within similar habitats to *Caladenia fuscata*. Potential habitats for this species within the Catherine Hill Bay area are considered most likely to be Coastal Plains Smooth-barked Apple Woodland, Coastal Plains Scribbly Gum Woodland, Coastal Foothills Spotted Gum Ironbark Forest and Narrabeen Wallarah Sheltered Grassy Woodland. Approximately 7.99 ha (2%) of potential habitat will be removed within the Catherine Hill Bay development estate with over 367.23 ha (98%) to be retained within the conservation lands. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

Caladenia catenata var. 'warnervalensis'

Records for this species occur on the Central Coast and have been reported from the Wallarah Peninsula (Bell, 2008). A nomination has been made for this species to be listed as endangered; however, at the time of writing this report a preliminary or final determination for this species had not yet been listed on either the TSC Act or the EPBC Act. Further taxonomic investigations are required to determine if this is indeed a new species. Thus a precautionary approach has been taken in this instance to assume that *Caladenia catenata var*. '*warnervalensis'* occurs within similar habitats to *Caladenia catenata*. Habitats within the Catherine Hill Bay area are most likely to be Coastal Plains Smooth-barked Apple Woodland, Coastal Plains Scribbly Gum Woodland, Coastal Foothills Spotted Gum Ironbark Forest and Narrabeen Wallarah Sheltered Grassy Woodland. Approximately 7.99 ha (2%) of habitat will be removed within the Catherine Hill Bay development estate with over 367.23 ha (98%) to be retained within the conservation lands. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

Calochilus sp. aff. paludosus

This species has been identified as occurring on the Wallarah Peninsula; however, no information on the exact location is known (Bell 2008). The similar species *Calochilus paludosus* is common and occurs in open forest, woodland and heathland (Bishop 2001). *Calochilus paludosus* has not been recorded within the Catherine Hill Bay site and surveys were conducted during the flowering period for this species. Thus a precautionary approach has been taken in this instance to assume that Calochilus sp. aff. paludosus occurs within similar habitats to *Calochilus paludosus*. Potential habitats within the Catherine Hill Bay site are most likely to be Coastal Plains Smooth-barked Apple Woodland, Coastal Plains Scribbly Gum Woodland, Coastal Foothills Spotted Gum Ironbark Forest and Narrabeen Wallarah Sheltered Grassy Woodland. Approximately 7.99 ha (2%) of habitat will be removed within the Catherine Hill Bay development estate with over 367.23 ha (98%) to be retained within the conservation lands. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

Diuris sp. aff. alba

Bell (2008) reports that this species has been recorded at several locations on the Central Coast and at Chain Valley Bay and Gwandalan. Little information is available on the description of this taxon and thus it is difficult to determine if this species is present. Thus a precautionary approach has been taken in this instance to assume that *Diuris sp*. *aff alba* occurs within similar habitats to *Diuris alba*. Potential habitat for this species within the Catherine Hill Bay site is most likely to be Coastal Plains Scribbly Gum Woodland. This vegetation community does not occur within the development estate at Catherine Hill Bay and therefore this species will not be impacted upon by the development and 36.08 ha of potential habitat will be retained within the Catherine Hill Bay conservation lands

Diuris sp. aff. aurea/Diuris sp. aff. chrysantha

The Taxonomy of this species is currently under investigation as it is unknown if the affinities of this species is closer to *Diuris aurea* or *Diuris chrysantha* (Bell 2008). This species has been recorded in the local area including Gwandalan, Chain Valley Bay, Charmhaven, Warnervale, Munmorah and Norah Head (Gunninah 2003). As taxonomy of

this species has not yet been determined for this species habitat has been assumed to be as for *Diuris aurea*. *Diuris aurea* was recorded within the Themeda Grassland on Coastal Headlands, Coastal Clay Heath and Narrabeen Wallarah Sheltered Grassy Woodland. Other vegetation communities which are present within the Catherine Hill Bay site which are considered to be potential habitat include Coastal Scribbly Gum Woodland, Coastal Plains Smooth-barked Apple Woodland, Coastal Foothills Spotted Gum Ironbark Forest. Approximately 7.99 ha (2%) of habitat will be removed within the Catherine Hill Bay development estate with over 450.84 ha (98%) to be retained within the conservation lands. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species

Thelymitra sp. aff. purpurata

This species shows affinities to both *Thelymitra purpurata* and *Thelymitra ixioides*. Neither of these common species have been located within the Catherine Hill Bay site. However, potential habitat and records exist for *Thelymitra ixioides* in the locality. Thus, a precautionary approach has been taken in this instance to assume that Thelymitra sp. aff. purpurata occurs within similar habitats to *Thelymitra ixoides*. Potential habitats within the Catherine Hill Bay site include, Narrabeen Wallarah Sheltered Grassy Woodland Coastal Scribbly Gum Woodland, Coastal Plains Smooth-barked Apple Woodland and Coastal Foothills Spotted Gum Ironbark Forest. Approximately 7.99 ha (2%) of habitat will be removed within the Catherine Hill Bay development estate with over 367.23 ha (98%) to be retained within the conservation lands at Catherine Hill Bay. Therefore, it is considered unlikely that the proposal will have a significant impact upon this species.

4.1.10 Groundwater Dependent Ecosystems

The potential presence of Groundwater Dependent Ecosystems (GDE's) within the Southern Lands was raised by DEWHA during the consultation stage of the project and is addressed in the following discussion.

GDE's is a broad definition covering all ecosystems which are dependent upon groundwater either permanently or occasionally to survive (DLWC, 2002). Several of the vegetation communities on the Catherine Hill Bay site have been identified as GDE's (Refer to Figure 4-3). Identification GDE's depends upon the location of the vegetation communities in relation to groundwater. GDE's are typically the communities which are located in drainage depression, swamps and creeklines, where groundwater comes up to the surface.

Douglas Partners (2008) have undertaken groundwater and soil studies within the Catherine Hill Bay development estate and surrounding area (Douglas Partners 2008). The alluvial soils which have been mapped by Douglas Partners (2008) surround Middle Camp Gully which is the main creekline which flows generally from west to east into the Pacific Ocean. These alluvial soils are expected to contain unconfined aquifers perched above the less permeable underling residual soils and rock. The source of recharge to the aquifers is from surrounding surface runoff and direct rainfall, with recharge from residual soils to be minor (Douglas Partners 2008). The majority of the development estate occurs on residual soils, thus currently recharge to the aquifers from within the

development estate is likely to be minor. However, surface runoff from Development Estate A will recharge the aquifer that occurs to the south within the alluvial soils of Middle Camp Gully. The vegetation communities located within Middle Camp Gully would be dependent upon this aquifer for a water source include Swamp Mahogany Paperbark Forest, Riparian Melaleuca Swamp Woodland and Swamp Oak Rushland Forest. Whilst only the Swamp Mahogany Paperbark Forest occurs within the development estate, the two remaining vegetation communities occur downstream and Douglas Partners (2008) note that groundwater will flow with the fall of the gully. In times of low rainfall, groundwater may provide base flow back into the gully and help maintain water levels. This base flow would be a vital water resource for these wetter vegetation communities to survive drought periods. Thus it is vital to ensure that surface water flow rates within Middle Camp Gully are maintained to ensure the survival and maintenance of ecosystem function of the GDE's downstream of the development estate.

The northern portion of the Riparian Melaleuca Swamp Forest located within Development Estate A is located in a shallow gully over residual soils and the presence of this moist community is likely to be attributed to surface runoff rather than any groundwater dependence (Douglas Partners, 2008). The Apple Palm Gully Forest vegetation community is located in a shallow gully over residual soils and the presence of most of this community is likely to be a result of surface runoff rather than groundwater dependence. However, in the north western portion of Development Estate B, this vegetation community occurs within alluvial soils which contains perched aquifers and as such is likely to be dependent upon groundwater. The Freshwater Wetland Complex does not occur within development estate and will not be affected by the proposal; however, it is most likely that this community occurs within alluvial soils (broad scale mapping by Murphy 1993) and therefore would be dependent upon groundwater.

GDE's have been classified into several different types according to DLWC (2006). These classes take into consideration aquifer, ecological and geomorphic types. The GDE's that have been identified on this site include Freshwater Wetland Complex, Swamp Mahogany - Paperbark Forest, Riparian Melaleuca Swamp Woodland, Apple – Palm Gully Forest and Swamp Oak- Rushland Forest (as shown in Figure 4-3).

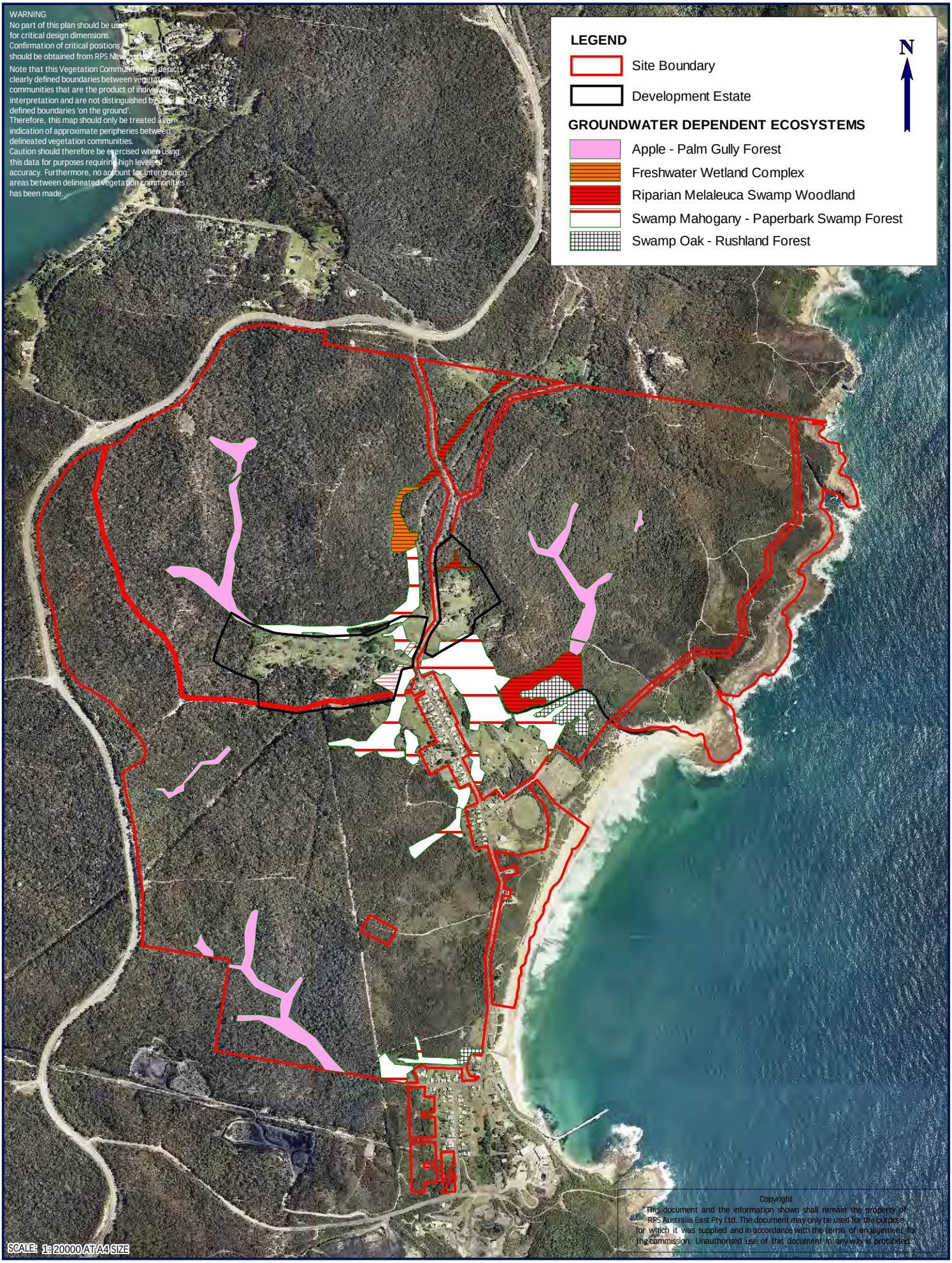
Table 4-2 below outlines the GDE types, classes and sub-classes which occur within the Catherine Hill Bay Site.

Table 4-2: GDE's Types and Classes

Vegetation Community at CHB	GDE TYPE	Class	Description of Class	Habitat
Freshwater Wetland Complex	Wetlands (W)	W6	Permanent Freshwater Pond	Epigean
Swamp Mahogany – Paperbark Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Riparian Melaleuca Swamp Woodland	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Apple – Palm Gully Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Swamp Oak Rushland Forest	Marine Estuarine Habitats (M)	M4	Tidal Freshwater swamp forests	Epigean

If existing surface water flow rates are maintained there will be minimal impact upon the GDE's present within the Catherine Hill Bay. As recommended by Douglas Partners (2008) this can be achieved by appropriate water sensitive design via the provision of surface water detention basins or swales to limit peak flows.

In conclusion several of the vegetation communities within the Catherine Hill Bay development estate have been classed as GDE's. However, it must be noted that whilst some communities are generally reliant on surface water runoff, when groundwater is available these communities would utilise this water source for their moisture requirements.



TITLE: FIGURE 4-3 GDE LOCATIONS	LOCATION: CATHERINE HILL BAY	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)

CLIENT: COAL & ALLIED INDUSTRIES LTD
JOB REF: 25430-1

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

RPS

4.2 Fauna

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

4.2.1 NPWS Threatened Species Database Search Results

The results of the above search indicated that thirty-one (31) threatened fauna species have been previously recorded within 10km (DECCW Wildlife Atlas 2010) of the site. Of these species, seven were recorded during the fauna survey (indicated by an asterisk '*'). 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
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
Ninox connivens	Barking Owl
Ninox strenua	Powerful Owl*
Tyto novaehollandiae	Masked Owl
Xanthomyza phrygia	Regent Honeyeater
Pomatostomus temporalis temporalis	Grey-crowned Babbler
Climacteris picumnus	Brown Treecreeper
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 adversus	Large-footed Myotis
Scoteanax rueppellii	Greater Broad-nosed Bat
Myotis macropus	Southern Myotis
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 those 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
Tyto tenebricosa	Sooty Owl
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.

The higher slopes, surrounding the village of Middle Camp, are characterised by open forest habitat offering opportunities for local fauna species including a number of threatened species as listed above. Hollow-bearing trees within these forest habitats may be used by hollow-dwelling Microchiropteran bats for roosting purposes, and the canopy would provide foraging habitat for threatened insectivorous species during the warmer months. There are hollows within the forest habitats of sufficient size to represent potential nesting sites for Glossy Black-Cockatoos and there are widespread areas containing both *Allocasuarina torulosa* and *A. littoralis*, which are feed tree species for these cockatoos. The forested areas of the site also contain hollows are of sufficient size to represent nesting and roosting sites for forest owl species and these habitats provide suitable foraging habitat for both Powerful and Masked Owls occurring in the area. The record of a Barking Owl in the wider locality is considered to be either a rare occurrence as this species is not common in coastal areas and this is supported by a general lack of records from the eastern Lake Macquarie locality.

Although Squirrel Gliders have been recorded from the wider locality this species appears to favour open woodland habitats within the south-eastern Lake Macquarie wooded habitats and this is reinforced by the species' absence from trapping surveys despite the frequent capture of Sugar Gliders within the site and adjacent areas.

Heathland habitats occurring as an understorey component of some forest areas and as the dominant habitat on the site's northeast coastal slopes provide potential habitat for Pygmy Possums. This species was not recorded during fauna surveys, but it is likely that

potential local populations are confined to these areas, which occur within proposed conservation lands.

Despite the occurrence of the Koala feed tree *Eucalyptus robusta* within drainage lines to the north of Middle Camp, records for Koalas are limited to offsite areas to the south and west of the site and there are no recent records of this species within the site.

Although a woodland and open forest species within its range, the local record of a Grey-crowned Babbler is considered unusual, due to the nearest populations of this sedentary species occurring to the north of the Watagan Mountains within the Hunter River Catchment.

Despite the widespread wooded habitats there is little winter-flowering *Eucalyptus sp*. apart from small stands of *E. robusta* along Middle Camp Gully's lower reaches. Through winter these stands would provide foraging resources for Flying-foxes, Swift Parrots and Regent Honeyeaters potentially using the site.

There are trees of sufficient size within the site's forests to represent nesting trees for the Osprey, however this species is likely to select nesting trees in forest closer to Lake Macquarie, which is more likely to represent foraging habitats than the open oceanic inshore habitats bordering the eastern boundary of the site.

Local records of the Spotted-tailed Quoll on the Gwandalan peninsular are considered unusual and the site's habitats are likely to be too isolated from large areas of high quality habitat and the site's habitats are unlikely to contain an inadequate 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 apart from intact Cabbage Tree Palm stands in the lower reaches of the site's gullies.

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

The site does not contain extensive estuarine habitats for the Black Bittern, although marginal habitat for this species occurs in the terminal wetlands of Middle Camp Creek. Furthermore, there is no suitable habitat within the site for a range of other estuarine bird species, Little Tern and Lesser Sand Plover despite their occurrence in the wider locality.
The ocean beaches and rockshelf habitats in the site's north east provide foraging and roosting habitat for Sooty and Pied Oystercatchers and the rockshelf habitats provide roosting and foraging for migratory wading bird species.

4.2.2 Regionally Significant Fauna Species

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

Amphibolurus muricatus	Jacky Lizard
Calyptrohynchus funereus	Yellow-tailed Black-Cockatoo
Falco peregrinus	Peregrine Falcon
Haliaeetus leucogaster	White-bellied Sea-Eagle
Morelia spilota	Diamond Python
Petaurus breviceps	Sugar Glider
Tachyglossus aculeatus	Short-beaked Echidna
Vespadelus pumilus	Eastern Forest Bat
Vespadelus regulus	Southern 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 and heath 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 in the west and south of the site. *Rattus lutreolus* (Swamp Rat) was recorded within and adjacent to wet habitats exhibiting dense understorey vegetation within the south of the site. *Mus musculus* (House Mouse) were found within heath situated to the east of Flowers Drive and likely to be associated with the adjacent residential areas of Middle Camp and Catherine Hill Bay. 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.

Tachyglossus aculeatus (Short-beaked Echidna) was observed during diurnal and nocturnal surveys within the north western area of the site within open forest and woodland. This species is likely to utilise this habitat across the site, where foraging opportunities, in the form of ant nests, occur. *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, through observations and heard to call within several locations. This species was identified to be utilising open forest habitat with a moderate to closed understorey.

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), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), *Chalinolobus gouldii* (Gould's Wattled Bat), *Chalinolobus morio* (Chocolate Wattled Bat) and *Vespadelus sp* (Forest Bat species). Note: *Miniopterus australis* and *Miniopterus schreibersii oceanensis* are 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) and *Corymbia maculata* (Spotted Gum) being of note during the survey period.

4.2.6 Avifauna

There is a wide range of habitat opportunities for avifauna within the Catherine Hill Bay lands due to the range of vegetation communities and its ocean front position. The lands are predominantly covered by forested lands, particularly on the western slopes and a range of common forest bird species were noted during fauna surveys. 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. Heathland habitat is also well represented, particularly in the eastern portions of the site and as understorey vegetation within some of the open forest and woodland habitats. The presence of nectar producing Eucalyptus and Proteaceous plant species throughout the heathlands and wooded areas 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 wooded and heathland 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 in the southwest of the site, indicating the presence of Glossy Black-Cockatoos and at least two individuals were heard in the vicinity of trapping transect 21 and *A*. *torulosa* (Forest Oak). Glossy Black-Cockatoos are listed as Vulnerable under the TSC Act 1995.

Apple – Palm Gully Forest communities within the site contain *Livistona australis* (Cabbage Tree Palm), which is a food resource for rainforest pigeon species such as Topknot Pigeons, White-headed Pigeons and Brown Cuckoo-doves. The presence of these fruit resources may attract threatened fruit-doves such as *Ptilinopus magnificus* (Wompoo Pigeon) or *Ptilinopus regina* (Rose-crowned Fruit-dove) if they are moving through the area. *P. magnificus* and *P. regina* are both 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 Catherine Hill Bay Site, *Ninox strenua* (Powerful Owl) and *Tyto novaehollandiae* (Masked Owl). A Powerful Owl was recorded on three occasions in southwest and northwest open forest habitats, and other records from the locality and vicinity of the site are recorded in the DECC 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 within 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.

The beaches on the eastern extremity of the site are foraging areas for coastal birds of prey, Corvids and inshore birds species such as gulls and terns. A pair of *Haematopus longirostris* (Pied Oystercatchers) were observed foraging on Catherine Hill Bay beach during fauna surveys. Pied Oystercatchers are listed as Vulnerable under the TSC Act 1995.

To the north of Catherine Hill Bay the site encompasses a number of rockshelves, which provide foraging and roosting habitats for migratory waders and inshore seabirds. Those species, which are likely to use these habitats, include, Grey-tailed Tattlers, Red-necked Stints, Ruddy Turnstones, White-faced Heron, Eastern Reef Egret and *Haematopus fuliginosus* (Sooty Oystercatcher), which is listed as Vulnerable under the TSC Act 1995.

4.2.7 Amphibians

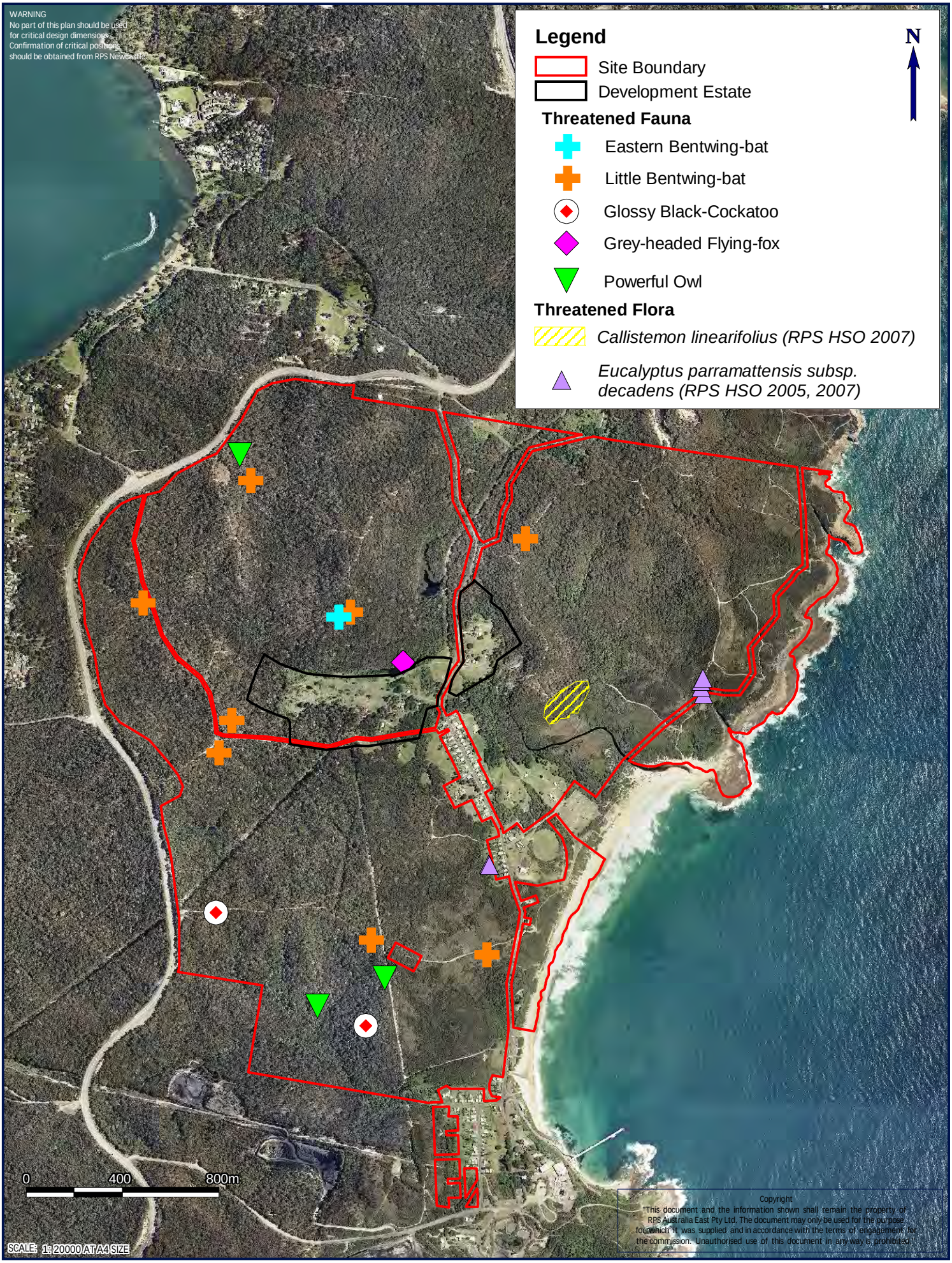
Crinia signifera (Common Froglet) were heard calling across the site within wetland environs and ephemeral ponds and creeks. *Litoria latopalmata* (Broad-palmed Frog) and *Lymnodynastes peronii* (Striped Marsh Frog) were heard calling within the wetland lagoon on the coast and within tributaries to the north.

Uperoleia fusca (Dusky Toadlet) were heard calling from several sites including a Paperbark Swamp in the south of the site, a woodland gully in the northeast of the site and also Middle Camp Dam.

4.2.8 Reptiles

Common skink species were found within ground debris active during the day and included *Lampropholis delicata* (Grass Skink), which was observed active in coastal hill-top grassland and *Saiphos equalis* (Three-toed Skink), found sheltering under dead vegetation in Wallum Woodland. *Ctenotus robustus* (Striped Skink) were found sheltering below dead vegetation within clay woodland.

Morelia spilota spilota (Diamond Python) was observed during a diurnal reptile search to be sunbathing within the top of a 2m high *Xanthorrhea sp*. along Trapping transect 21. This individual was noted to be of mature age with an approximate length of 1.8m.



TITLE: FIGURE 4-4 THREATENED FAUNA RESULTS	LOCATION: CATHERINE HILL BAY	DATUM: DATUM PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 16/3/2010 PURPOSE: EAR	LAYOUT REF: 24530\DRAFT\ECO WORK\2010\CHB FIG4-6 FAUNA A A4 VERSION (PLAN BY): A (A.P-M,D)

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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 Catherine Hill Bay site. These factors include the geology, soils, elevation, proximity to the sea and rainfall patterns. This range of geomorphological influences has produced a large number of vegetation communities (17). Freshwater Wetlands, Swamp Sclerophyll Forest, Swamp Oak Floodplain Forest and Themeda Grassland on Seacliffs and Coastal Headlands within the site are of significance. These vegetation communities are listed as Endangered Ecological Communities (EEC) under the TSC Act 1995. The unique communities of Coastal Wallum Heath/Woodland also occur on the coastal sands and whilst not listed as an EEC, have an unusual mix of native flora species.

The condition of the vegetation communities varies across the site and corresponds to close proximity to urban development, tracks and previous underground mining practices that ceased within the site in the 1960s.

The main disturbances within areas that are not adjoining urban development, are unformed tracks and associated erosion across the sites. These tracks are regularly used by 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 cleared areas to the south of Middle Camp Gully. This area was formerly the mine site and contains severe weed incursion throughout the vegetation communities bordering the cleared areas. The paddocks within the western portion of the site are currently being used as horse paddocks.

In the vegetation assemblages away from the cleared areas and tracks, good structural diversity is noted with the main weed incursion from Bitou and to a lesser extent Lantana. The heath communities offer a wide variety of potential flora habitats for threatened flora species including *Pultenaea maritima*, *Rutidosis heterogama* and *Tetratheca juncea*. The wide diversity of structures within this community provides good habitat diversity, with an average of 40 species being recorded within the 20 X 20m quadrats across this community. The coastal sand communities provides potential habitat for threatened flora species such as Chamaesyce psammogeton and within the wallum woodland areas Tetratheca juncea.

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 Coastal Plains Scribbly Gum Woodland community provides habitat for a wide diversity of species from the families of Proteaceae, Poaceae, Myrtaceae and a wide

variety of graminoid species. Potential habitat for a wide variety of threatened orchids, Eucalypts, and graminoids exist within this woodland habitat.

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. The Palm Gully vegetation community contains habitat for a suite of rainforest trees and shrubs as well as vines, ferns and sedges.

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 Coastal Clay 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 contained 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)	■											
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 and making up the majority of proposed developed land, 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 Open Forest communities provide suitable habitat for a number of terrestrial mammals. Habitat quality is dependent upon the amount of available groundcover, density and floristic diversity of shrubs and grasses and land use history (e.g. selective logging, clearing, grazing and understorey management practices).

The cleared areas with open understorey, sparse trees and occurrence of grasses and exotic species within the site provide limited suitable habitat for common native browsers, the eastern Grey Kangaroos and possibly other Macropod species. These areas also provide habitat for pest species such as rabbit and fox.

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.

Areas of open cleared areas and heath habitat with a low diversity and density of Eucalypt species hold limited habitat for arboreal species.

Bats

The wooded and adjacent open areas within the site provide extensive foraging habitat with dominant tree species having potential to supply nectar for the majority of the year and thus providing for a range of microchiropteran bats, due to insect populations they are likely to harbour. Potential roosting sites for those species that utilise tree hollows for roosting purposes is available in varying densities across the site.

Past mining activity within the Catherine Hill Bay area has lead to areas of open mine subsidence and uncovered mine openings that have the potential to provide roosting habitat for species preferring caves and similar manmade structures. One such site occurs within the western area of the site where an opening has been observed to have microchiropteran bats exiting on dusk by Coal & Allied personnel (pers. comm.). Notably these bats would forage across the Catherine Hill Bay and Nords Wharf sites. Other rocky outcrops were observed throughout the site and would be considered to offer potential roosting habitat for cave dwelling species.

Blossom of *Eucalyptus spp*. within the site may provide foraging opportunities for Grey-headed Flying-foxes. The presence of *E. robusta* on the site may constitute a significant

component of available winter blossom in the area, during some years, owing to the varying flowering reliability of different *Eucalypt spp*. from year to year.

Frogs

Permanent wetland habitats and creeklines with ephemeral pools that would persist after significant rain events within the site provide significant habitat opportunities for a variety of frog species. Adjacent wooded habitats are likely to provide foraging and shelter opportunities for a variety of tree dwelling frog species. More pristine areas of habitat exist across the site. It is within these areas that significant species such as C. tinnula would have potential to occur.

Reptiles

Habitat within the site has potential for representing significant shelter and foraging opportunities for a diversity of reptile species. This can be attributed to the diversity of onsite habitats that includes open forest / woodland habitats with associated wet areas / wetlands with a moderate to high floristic diversity within understorey strata.

Semi to permanent wetlands are likely to provide year round habitat, where creeklines and drainage lines with ephemeral ponds within the site provide intermittent foraging opportunities for common snake and turtle species. 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, Tree creepers, Parrots, Kingfishers and Woodswallows.

Areas of coastal sand scrub and coastal clay heath provide a variety of foraging opportunities that includes invertebrate resources and nectar providing Proteaceae species. Species likely to be regularly using these habitats includes a variety of Honeyeaters and small Wren and Finch species.

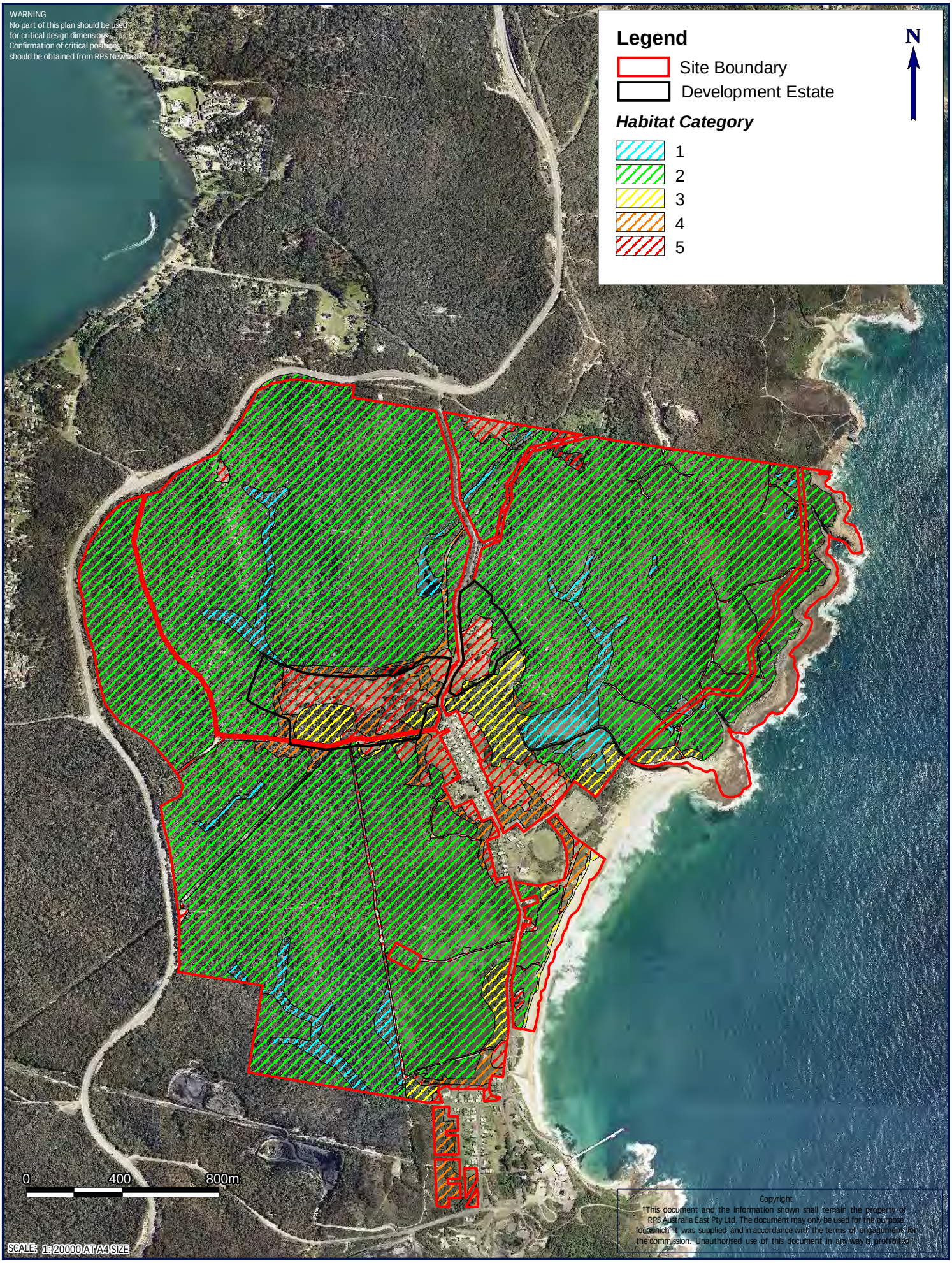
Habitat for nocturnal birds species and Forest Owl species occurs within open forest and woodland areas, particularly where main prey species, which includes arboreal and terrestrial mammals, reptile species and invertebrates are found to occur. Roost sites for these species preferably occur within dense forest areas particularly within areas of *Allocasuarina littoralis* and Eucalypt species.

4.3.3 Habitat Mapping

Habitat mapping (Figure 4-5) 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).



TITLE:	FIGURE 4-5 HABITAT MAPPING	LOCATION:	CATHERINE HILL BAY	DATUM:	DATUM	DATE:	16/3/2010
				PROJECTION:	MGA ZONE 56 (GDA 94)	PURPOSE:	EAR

LAYOUT REF: FIG 5-4 HAB MAP A-A4
VERSION (PLAN BY): A (A.P-M,D)

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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 the *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 wi9th due consideration to the Conservation Lands forming part of the proposal.

Table 5-1: Threatened Species Assessment

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Plants			
Acacia bynoeana Bynoe's Wattle (E)	Small, prostrate shrub found in low heath and open woodland, generally on loamy clays and sand. Occurs from the Lower Hunter south to the Southern Highlands. Within the Hunter Sub-bioregion it has been found in several locations within the Cessnock LGA where it has been found growing in Kurri Sand Swamp Woodland (KSSW). Has also been recently recorded as isolated populations within Yellow Bloodwood Woodland and Blue-leaved Stringybark Woodland near Ellalong. Locally, it is known to occur with Coastal Plains Scribbly Gum Woodland and a record exists to the southwest of the site within the Lake Macquarie State Recreation Area.	**Low – Moderate** Targeted surveys were unable to record this species within the development estate, despite a small amount of potential habitat at the northern end of the site. However, this cryptic species is relatively difficult to locate in the field and as such its presence within the site cannot be discounted.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of areas of potential habitat for this species.
Angophora inopina Charmhaven Apple (V, V*)	Small to medium tree found in shallow sandy soils in open woodland, swamp woodland and wet heath. The main occurrences of this species are in the Wyong and Lake Macquarie LGA's (from Charmhaven to Wyee and Morisset, and north to near Toronto), with disjunct populations also in Port Stephens LGA (south of Karuah).	**Low - Moderate** A small area of potential habitat for this species occurs in the north of the site, but this species was not recorded within this habitat.	**Low** The current proposal is unlikely to adversely impact upon this species, due to its absence from potential habitat and the retention of potential habitat as conservation lands 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 southwest of the site.	**Low – Moderate** Flora surveys were conducted out of the flowering season for this species and it was not recorded within the development estate or a 200m buffer around it. However, habitat assessment suggests that there is potential for this species to occur in woodland habitats with a heathy to grassy understorey of which there is a small area in the north of the site.	**Low** Due to the conservation of those areas representing potential habitat for this species it is unlikely that the current proposal will adversely impact upon this species.
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.	**High** This species was recorded in the Riparian Melaleuca Swamp Forest bordering the north-eastern side of the terminal wetlands of Middle Camp Gully.	**Low** If appropriate sediment and nutrient control measures are put in place to prevent urban runoff from the proposed development and the conservation of the current population and areas representing potential habitat for this species it is unlikely that the current proposal will adversely impact upon this species.
Chamaesyce psammogeton (E)	Perennial prostrate herb, which grows on sand dunes near the sea. Within the region records exist from Myall Lakes National Park and Wamberal Lagoon Nature Reserve.	**Low – Moderate** This species was not recorded during flora surveys, although potential habitat occurs for this species within foredune habitat along the western edge of Catherine Hill Bay Beach.	**Low – Moderate** Those areas where this species is likely to occur will be retained as conservation lands within the current proposal. However, this species may be indirectly impacted upon by increased residential development due to increased usage of the beach if measures to protect potential habitat from pedestrian traffic are not incorporated into the occupation phases of residential development.
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.	**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 wooded habitats, except those that are very wet or saline in nature.	**Low - Moderate** Large areas of potential habitat for this species will be conserved within the current proposal. The small area of potential habitat, which will be removed within the development estate, is highly weed infested and does not present as optimal habitat for this species. However small portions in the north eastern section of the development estate contain potential habitat for this species. The presence of this species cannot be discounted at this stage as targeted searches have yet to be performed within the appropriate flowering period for this species.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Cynanchum elegans White-flowered Wax Plant (E, E*)	Occurs scattered along the NSW Northern Coast south to Wollongong usually in dry, littoral or subtropical rainforest and occasionally Melaleuca scrub or woodland. A climbing or twining plant species that flowers from August to May with peak flowering in November. One record within the Atlas of NSW Wildlife data occurs within the Lower Hunter Region and Central Coast at Green Point to the north of Belmont.	**Moderate** Due to its potential to occur across a wide range of Wet sclerophyll habitats, the site represents a range of opportunities for this species. However, it was not recorded during flora surveys within the development estate and there are very few records for this species within the region.	**Low** Those areas representing the best potential habitat opportunities for this species will be conserved within the current proposal.
Dendrobium melaleucaphilum Spider Orchid (E)	Epiphytic orchid growing mostly growing on *Melaleuca styphelioides*, but occasionally on rainforest tress or rocks. Extends from south of the Blue Mountains to Queensland. Preferred habitat is coastal swamp forests.	**Low – Moderate** Although the favoured host plant for this orchid, *Melaleuca styphelioides*, was recorded within the site during flora surveys, there are no known records for this orchid species in the Lake Macquarie area and it was not recorded during flora surveys within the development estate. Nevertheless due to the occurrence of potential habitat its presence within the site cannot be totally discounted.	**Low** Unlikely to be adversely affected by the current proposal due to the setting aside of the majority of the wet sclerophyll forests of potential habitat for conservation purposes.
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 south east of Lake Macquarie.	**High** Records for this species occur to the west and southwest of the development estate (Atlas of NSW Wildlife data). Onsite habitat in the vicinity is commensurate with the sites of other records in the area. During flora surveys of the development estate and surrounds this species was not detected. However, due to the cryptic nature of this species (i.e. does not flower every year) the presence of this species within the development estate cannot be discounted.	**Low - Moderate** Those areas representing the most suitable habitat for this species will be retained as conservation lands within the current proposal. It is possible that proposal may remove some individuals of *Diuris praecox* as the DECCW record occurs within the development estate. However, it is unlikely to be adversely affected by the current proposal as there are vast tracts of potential habitat for this species to be retained within the development estate.
Eucalyptus camfieldii Camfield's Stringybark (V)	Tree or mallee to 10m high, but often less. Rare and localised, in coastal shrub heath on sandy soils on sandstone, often restricted drainage. Records from the Hunter Sub-bioregion are largely in near-coastal areas from the Port Stephens LGA to the Central Coast. An isolated stand of trees consistent with this species has been recorded near Kurri Kurri (K. Hill pers. comm.). A local record to the southwest of the site is reported in the Atlas of NSW Wildlife data.	**Moderate** Local status of this species is not clear, due to widespread presence of *Eucalyptus capitellata* within the site, a species to which *E. camfieldii* is very closely aligned. However, due to the abundance of potential habitat within the site and its known occurrence within the locality, the likelihood of it occurring within the site cannot be discounted.	**Low** Those areas representing the best potential habitat opportunities for this species will be conserved within the current proposal.
Eucalyptus parramattensis ssp. *decadens* Drooping Red Gum (V, V*)	Red Gum species that grows in dry sclerophyll woodland on sandy soils, often in low damp sites. Locally, this species occurs almost exclusively in association with Kurri Sand Swamp Woodland (KSSW) and ecotonal areas, but a small disjunct stand of stunted individuals have been recently recorded within coastal heath in the Lake Macquarie LGA (RPS pers. obs.).	**High** This species is usually restricted to the Aeolian sand communities of Tomago and Kurri Kurri, but 17 individuals have been recorded (Confirmation from RBGS) on a south-facing slope within the Coastal Clay Heath. A further two individuals have been located in the south west of the site adjoining the development estate. None of the individuals detected are present within the development estate and will be retained within the conservation lands.	**Low – Moderate** If appropriate sediment and nutrient control measures are put in place to prevent urban runoff from the proposed development and the conservation of the current population and areas representing potential habitat for this species it is unlikely that the current proposal will adversely impact upon this species.
Genoplesium insignis Variable Midge Orchid (E)	Occurs within a restricted distribution between Chain Valley Bay and Wyong in the Wyong LGA. Habitat is described as a *Themeda australis* ground cover layer with shrubs and *Eucalyptus haemastoma*, *Corymbia gummifera*, *Angophora costata* and *Allocasuarina littoralis* in the canopy layer. This species has been recorded within Lake Macquarie State Recreation Area to the south of the site.	**Low – Moderate** A small area of potentially suitable habitat occurs in the north of the site, but this species was not recorded during flora surveys. However, due to the noted occurrence of this species in the local area its presence within the site cannot be discounted.	**Low** Those areas representing the best potential habitat opportunities for this species will be conserved within the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Grevillea parviflora subsp. *parviflora (V, V*)*	Occurs in light, clayey soils in woodlands. Most plants appear capable of suckering from a rootstock. Relatively widespread within the Cessnock LGA. Occurs within Werakata National Park. Much confusion surrounds the taxonomy of this species and other similar *Grevillea* taxa (S. Bell *pers. comm.*), and a NPWS-funded study of the species is currently in progress.	**Low – Moderate** Potential habitat for this species occurs throughout the dry sclerophyll areas, particularly in the Coastal Foothills Spotted Gum Ironbark Forest and the Narrabeen Wallarah Sheltered Grassy Forest. Not all of the conservation lands have been surveyed but the entire development estate and this species was not detected.	**Low** Those areas representing the best potential habitat opportunities for this species will be conserved within the current proposal.
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** A small area of suitable habitat occurs in the north of the site, but a local observation of this species is only tentative. However, due to the possible occurrence of this species in the local area its presence within the site cannot be entirely discounted.	**Low** Those areas representing the best potential 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 development estate. 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.
Melaleuca groveana Grove's Paperbark (V)	Restricted to exposed heath and heath woodland, mainly at high altitudes in coastal and sub-coastal districts. Hunter Region records exist from the Tomaree and Yengo National Parks (Atlas of NSW Wildlife data).	**Low – Moderate** There are no local records for this species, the nearest coastal records occurring on the Tomaree Peninsula. This species was not recorded during flora surveys conducted within the site. The most likely habitat onsite occurs within heathlands and stunted woodland in the northwest of the site.	**Low** Those areas representing the best potential habitat opportunities for this species will be conserved within the current proposal.
Pultenaea maritima Coast Headland Pea (V)	A prostrate shrub species with foliage similar to *P. villosa* of which it was previously considered a subspecies. Occurring on headlands between Newcastle and Byron Bay.	**Moderate** Although this species was not recorded during flora surveys there are opportunities for it to occur in exposed seaside heathlands in the northeast of the site.	**Low** Those areas representing the best potential habitat opportunities for this species will be conserved within the current proposal.
Rutidosis heterogama (V, V*)	Small asteraceous herb occurring in the Hunter Region growing in disturbed areas and adjacent parcels of bushland within the Cessnock LGA. This species is also noted as occurring within coastal heathland habitats between Wyong and Evans Head on sandy substrates or moist areas within open forest.	**Moderate** There is opportunity for this species to occur within heathland and stunted woodland habitats in the northeast of the site, as coastal records for this species occur to the south of the site. Targeted surveys did not detect this species within the development estate.	**Low** Whilst a small area of potential habitat will be removed as part of the development proposal, large areas of potential habitat for this species will be conserved within the current proposal.
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).	**Moderate – High** Potential habitat for this species occurs within the drainage flats and associated mesic vegetation assemblages of mid to lower slope drainage lines in the west of the site. This species was not recorded within the development estate, but due to local records plants may occur elsewhere within the site.	**Low** Those areas representing the best potential habitat opportunities for this species will be conserved within the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
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 local area including several records from the northern slopes of the site (Atlas of NSW Wildlife data).	**High** This species was recorded at a number of sites on the western slopes of the site during its very early flowering season. A large population of this species (over 8,000) was recorded throughout the Coastal Plains Scribbly Gum Woodland, Coastal Plains Smooth-barked Apple Woodland and the Narrabeen Wallarah Sheltered Grassy Forest within the 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. However, this figure is likely to be significantly lower due to over 350 ha of habitat for this species yet to be surveyed. In addition, large populations are currently reserved within conservation lands within the Wallarah Peninsula (approx 29,000). 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 / Port Stephens (Atlas of NSW Wildlife data).	**Moderate – High** Although this species was not recorded within the site, habitat assessment suggests that it may occur in small numbers along the lower reaches of drainage lines within Swamp Sclerophyll vegetation assemblages.	**Low – Moderate** Those habitats within which this species occurs will be retained within areas dedicated to conservation lands. However, minimisation of potential impacts to the population occurring within the lower reaches of drainage lines will be dependent upon careful management of stormwater from surrounding residential development represented by the proposed 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).	**Moderate** Due to its generalist habitat requirements, this species could potentially exist in any of the tall open forest habitats associated with the surrounding slopes of the site.	**Low** The habitats within which this species potentially occurs 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).	**Moderate** Due to its generalist habitat requirements, this species could potentially exist in any of the tall open forest habitats associated with the surrounding slopes of the site.	**Low** The habitats within which this species potentially occurs 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 – Moderate** Wetland habitats within the site are commensurate with potential habitat for this species, but the marked decline of this species from those areas which it once frequented and the absence of records from the locality suggest that this species is unlikely to occur within the site. However, this species is known to persist in wetland areas adjacent to saline environments and such habitats exist in the lower reaches of drainage lines near the northern end of Middle Camp so its presence cannot be entirely discounted. This species was not recorded within the site during fauna surveys encompassing potential habitat.	**Low** The occurrence of this species within the site is relatively 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.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
Mixophyes balbus Southern Barred Frog (E, V*)	A relatively large and muscular frog, growing to about 8 cm in length. Southern 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** Despite the presence of moderately suitable habitat within the lower drainage slopes of the site, there are no records for this species in the vicinity of the site and this species is 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** Despite the presence of moderately suitable habitat within the lower drainage slopes of the site, there are no records for this species in the vicinity of the site and 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.
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.	**Low - Moderate** An Osprey record occurs to the south of the site, but this species is more suited to closed or protected estuarine waters than open beach habitats as occur on the eastern side of the site. Pairs are known from southern Lake Macquarie, which is more suited to their hunting technique, but are more likely to nest in forest adjacent to the lake than to fly over to the site's forests for nesting purposes. This species was not recorded during fauna surveys, however it would not be considered unusual to see an occasional individual over the site.	**Low** Potential nesting habitat within the site for this species will be retained during the process of development, therefore it is unlikely that the current proposal will adversely impact upon this species.
Haematopus fuliginous Sooty Oystercatcher (V)	Marine, usually rock shoreline, high rocky islets, boulders below cliffs, wave-cut platforms and reefs. Also inhabits sandy beaches and coves between rocky headlands (Morcombe, 2000). Also occurs within closed estuarine habitats where rocky substrates are present (e.g. Hunter Estuary).	**High** This species was observed from the shoreline flying between the rocky headlands at the north and south of Catherine Hill Bay.	**Low** This species forages, roosts and nests on rocky shoreline habitats and these areas habitats that lie within the north-eastern extremities of the site will be protected as conservation lands under the current proposal.
Haematopus longirostris Pied Oystercatcher (V)	This species prefers undisturbed sandy shell-grit or pebble beaches, sandspits and sandbars, tidal mudflats and estuaries, coastal islands. Occasionally rocky reefs, shores rock-stacks, brackish or saline wetlands. Also grassy paddocks, golf-courses or parks near coast. Forages for molluscs, crustaceans, polychaetes, ascidians, echinoderms and small fish, probes for worms in short wet grass.	**High** This species was observed on the beach of Catherine Hill Bay during fauna surveys.	**Low** This species forages and nests on sand beaches and inlets and sometimes roosts on rocky shorelines. These habitats will be protected as conservation lands under the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
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.	**Low** Essentially an estuarine and riparian species, there is limited opportunity for this species within the site.	**Low** Considered unlikely to be affected by the 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** Those areas representing potential foraging habitat for this species will be retained within the current proposal.
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 west of the site.	**High** This species was recorded within the site during fauna surveys and the chewed cones of *Allocasuarina littoralis* were noted elsewhere in the site.	**Low** Those areas where this species was recorded and those areas assessed as potential habitat for this species will be retained within the current proposal.
Climacteris picumnus subsp. *victoriae* Brown Treecreeper (V)	Occurs through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Range in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. Frequents drier forests and woodlands, particularly open woodland lacking a dense understorey, but also grasslands where there are sufficient logs, stumps and dead trees nearby. Within the Lower Hunter Valley, this species is known from Werakata National Park, Rothbury, the HEZ and Ellalong (Atlas of NSW Wildlife).	**Low** This species was not recorded within the site during fauna survey. Birds southeast of the Sugarloaf population are rare and as such the chance of occurrence is low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of records within the vicinity of the development estate. Habitat will retained within the proposed Conservation Estates
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 *E. robusta*. Therefore its seasonal presence within the site on at least an intermittent basis cannot be discounted.	**Low – Moderate** Some areas representing potential foraging habitat for this species may be lost within the current proposal as remnant *E. robusta* stands occur within the development estate in Middle Camp. Therefore, it is possible that the current proposal will represent at least an incremental loss of potential foraging habitat for this species. Appropriate landscaping associated with development may help reduce impacts of incremental loss.
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 Point Wollstonecraft and Nord's Wharf to the west (Atlas of NSW Wildlife data).	**Moderate – 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* within the site, it is likely that this species occurs within the site on at least an intermittent basis.	**Low – Moderate** Some areas representing potential foraging habitat for this species may be lost within the current proposal as remnant *E. robusta* stands occur within the development estate in Middle Camp. Therefore, it is possible that the current proposal will represent at least an incremental loss of potential foraging habitat for this species. Appropriate landscaping associated with development may help reduce impacts of incremental loss.
Glossopsitta pusilla Little Lorikeet (V)	*Glossopsitta pusilla* extends from Cairns to Adelaide coastally and to inland locations. Commonly found in dry, open eucalypt forests and woodlands. Can be found in roadside vegetation to woodland remnants. *G. pusilla* feeds on abundant flowering Eucalypts, but will also take nectar from, *Melaleuca* sp and *Mistletoe* sp. *Eucalyptus albens* (White Box) and *E. melliodora* (Yellow Box) are favoured food sources on the western slopes in NSW. On the eastern slopes and coastal areas favoured food sources are *Corymbia maculata* (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. robusta* (Swamp Mahogany) and *E. pilularis* (Blackbutt). Nesting takes place in hollow bearing trees.	**High** This species was recorded within the site. Habitat within the site is considered suitable for both foraging and roosting and records occur within the locality.	**Low – Moderate** Although it is likely that a small amount of potential habitat for this species may be lost during the process of development. Extensive areas of high quality foraging and nesting habitat for this species will be retained as Conservation Lands.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
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 in the northwest and in the southwest of the site during nocturnal fauna surveys. Habitat assessment noted hollows of sufficient size to represent potential breeding sites for this species.	**Low** Those areas containing the highest quality foraging habitat and nesting habitat for this species will be retained as conservation lands under the current proposal.
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 elsewhere on the Wallarah Peninsula and within the site near the northern and southern boundaries.	**High** There are a number of records for this species within the site and its vicinity 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** 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 excellent 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.).	**Low – Moderate** Despite the presence of mesic vegetation assemblages within the forested drainage lines of the site, these communities cannot be classified as wet sclerophyll and are not considered to be of sufficient extent or structural complexity to support this species. However, due to the presence of a record for this species to the north on the Wallarah Peninsula, the site may represent itinerate habitat for this species.	**Low** The current proposal is unlikely to impact upon this species due to a lack of suitable habitat within the site, however those areas that are most suited to this species will be retained as conservation land within the current proposal.
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 – Moderate** 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 relatively unlikely to occur within the site.	**Low** Those areas within the site likely to be of greatest importance to potential populations of this species will be retained as conservation lands within the current 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 within the site.	**Low** Considered unlikely to be resident although those areas likely to represent the greatest habitat potential 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 to the west of the site.	**Low – Moderate** This species was not recorded within the site during fauna surveys, although the closely related Sugar Glider (*Petaurus breviceps*) was recorded on a regular basis. Trapping results and local records suggest that this species may prefer woodland habitats to the south and west more than the open forest habitats that occur within the site.	**Low** Considered unlikely to occur within the site, but those areas containing the most suitable habitat for this species will be retained as conservation lands within the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
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 as recent as 2003 (Atlas of NSW Wildlife data), but 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.
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 heathy habitat, particularly in the northeast of the site, which appears to contain suitable habitat for this species. Heathy habitat within the southern area of the site, which is proposed as part of the development estate exhibits low structural and floristic diversity that is considered relatively poor habitat for this species.	**Low** Those areas representing the highest quality potential habitat for this species will be retained within the current proposal.
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 within the site associated with flowering *E. robusta.* There are no roosting camps for this species in the vicinity of the site.	**Low – Moderate** Some areas representing potential foraging habitat for this species may be lost within the current proposal as remnant *E. robusta* stands occur within the development estate in Middle Camp. Therefore, it is possible that the current proposal will represent some impact upon local populations of this species. Appropriate landscaping associated with development may help reduce impacts of incremental loss.
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 and was recorded during fieldwork. Potential roosting habitat is known within the site in the form of old mine workings.	**Low** Although it is likely that a small amount of foraging habitat for this species will be modified during the process of development, large areas containing foraging habitat will be retained as conservation lands under the current proposal. Potential roosting habitat within the site will not be affected by the current proposal and foraging opportunities will continue to exist within the development estate.
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 within the site and is likely to use the site regularly as part of its foraging range. Potential roosting habitat is known within the site in the form of old mine workings.	**Low** Although it is likely that a small amount of foraging habitat for this species will be modified during the process of development, large areas containing foraging habitat will be retained as conservation lands under the current proposal and foraging opportunities will continue to exist within the development estate. Potential roosting habitat within the site will not be affected by 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).	**Moderate – 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** Although it is likely that a small amount of foraging habitat for this species will be modified during the process of development, large areas containing foraging and roosting habitat will be retained as conservation lands within the current proposal and foraging opportunities will continue to exist within the development estate.
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** Although it is likely that a small amount of foraging habitat for this species will be modified during the process of development, large areas containing foraging and roosting habitat will be retained as conservation lands within the current proposal and foraging opportunities will continue to exist within the development estate.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within 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 northwest (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** Although it is likely that a small amount of foraging habitat for this species will be modified during the process of development, large areas containing foraging and roosting habitat will be retained as conservation lands within the current proposal and foraging opportunities will continue to exist within the development estate.
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 potential foraging habitat will be retained as conservation areas within the current proposal.
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).	**Moderate – High** This species has been recorded within the locality of the site and there are foraging opportunities within dams in the northern section of the site. No known roosting sites occur within the site for this species.	**Low** Those areas representing potential foraging habitat for this species will be retained within the current proposal.
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 is relatively widespread within the Lower Hunter Region and 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** Although it is likely that a small amount of foraging habitat for this species will be modified during the process of development, large areas containing foraging and roosting habitat will be retained as conservation lands within 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			
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions	Associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands. They typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Wetlands or parts of wetlands that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including *Paspalum distichum*, *Leersia hexandra* and *Carex appressa*. Wetlands or parts of wetlands subject to regular inundation and drying may include large emergent sedges over 1 metre tall, such as *Baumea articulata, Eleocharis equisetina* and *Lepironia articulata*. Correlates with LHCCREMS Map Unit (MU) 46 – 'Freshwater Wetland Complex'.	**High** This community occurs in one location to the north west of Middle Camp. This wetland is a man made dam which was used for previous underground mining activities which ceased in the 1960's. However, the wetland has currently evolved to include a wide diversity of native aquatic species and provides habitat for a number of fauna species.	**Low** Those areas where this community exists will be retained as conservation lands within the current proposal.
Themeda Grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner bioregions	Community occurring on sandstone, old sand dunes and basalt, which is characterised by *Themeda australis* (Kangaroo Grass). *T. australis* within the community is sometimes limited to only a few metres square, but on some substrates, such as old sand dunes the community can be relatively extensive in size. *T. australis* within the community is often stunted and prostrate as are the shrubs and trees occurring within the community. In the Lower Hunter and Central Coast regions this community occurs on coastal landforms with *Pimelea linifolia*, *Westringia fruticosa*, and *Banksia integrifolia* the most commonly associated species.	**High** This community occurs within the site as widely scattered patches in the heathland facing the ocean in the northeast of the site and as a small grassy remnant on the front of the lookout between Middle Camp and Catherine Hill Bay. A small patch of this community occurs within the development estate as a consequence of previous disturbance.	**Low** A small patch of this community occurring on a previously disturbed area will be removed within the current proposal. However, the majority of those areas where this community exists will be retained as conservation lands within the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Site	Likely Level of Impact within Development Estate
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. Within the site this community correlates with LHCCREMS MU 40 'Swamp Oak – Rushland Forest'.	**High** This community occurs within the site as vegetation associated with the terminal flats and lagoon of Middle Camp Gully, to the north east of Middle Camp and the lower drainage reaches of the creek on the northern side of the Catherine Hill Bay Village.	**Low - Moderate** Those areas where this community occurs within the site will be retained as conservation lands within the current proposal. Therefore it is unlikely that this community will be directly impacted upon by the current proposal. However, indirect threats to the long-term retention of this community may potentially exist without appropriate sediment and water management control measures incorporated into 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 42 'Riparian Melaleuca Swamp Woodland' and MU 37 'Swamp Mahogany - Paperbark Forest'.	**High** This community occurs within the site along the lower reaches, dams and tributaries associated with Middle Camp Gully and the lower drainage reaches of the creek on the northern side of the Catherine Hill Bay Village. These areas of EEC are highly disturbed with thickets of Lantana and Bitou within the understorey. Small area of this community to the south of Middle Camp will be impacted upon by the proposed development.	**Moderate** A small area of this EEC will be removed as part of the development proposal (2 ha), with over 22 ha to be retained within the conservation lands. The retained areas in the vicinity of the proposed development may be the subject of indirect threats such as urban runoff, there appropriate sediment and water management control measures are recommended to be incorporated into planning and construction phases of the development. Appropriate landscaping associated with development may help reduce impacts of incremental loss of *E. robusta*.

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*.