TITLE:
Figure 2-2
Field Survey Locations

CLIENT:
Rosecorp Pty Ltd

PLANNING SURVEYING ECOLOGY

HARPER SOMERS O'SULLIVAN

SCALE: 1: 18900 at A4 Size **DRAWN:** E. Graham **APPROVED:** D. Landenberger
DATUM: MGA Zone 56 (GDA 94) **DATE:** 23/11/2007
LAYOUT REF: J:\JOBS\24k\24619 - Gwandalan\Draftin .... nfo \Workspaces\24619.FIG10.Filed Survey Locations A-A4.221107.WOR
CONTOUR INTERVAL: N/A
JOB REF: 24619

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T: 02 4961 6500 F: 02 4961 6794 E: survey@hso.com.au W:www.hso.com.au ABN 11 093 343 858

2.2.3 Targeted Eastern Pygmy Possum Survey

Potential Eastern Pygmy Possum (*Certaceus nanus*) habitat was identified within the CHB development lands by EcoBiological (2006a; 2006b). To further investigate the potential occurrence of the species, a targeted trapping survey using 45 Elliott 'E' size traps was undertaken within the CHB development lands. Traps were placed within shrubs and small trees within suitable habitat for four nights giving a total of 180 trap nights undertaken within the CHB development lands. Traps were baited with rolled oats, peanut butter and honey, and a honey and water mix was sprayed around each trap as a lure each day. Targeted Eastern Pygmy Possum surveys were undertaken 12-16 November 2007. Location of trapping sites is indicated in Figure 2-2.

2.2.4 Opportunistic observations

Opportunistic flora and fauna observations were made within the site whilst undertaking all other field activities. Such observations were noted and added to the base dataset to ensure completeness.

In particular, searches were made around the bases of potential Masked Owl (*Tyto novaehollandiae*) roost trees encountered for evidence of use by the species such as whitewash, owl pellets, prey remains etc within the Gwandalan development lands.

2.3 Survey Dates, Type and Prevailing Conditions

Table 2-2 depicts the dates, survey type and prevailing weather during the ecological investigations conducted by RPS HSO Ecologists during the November 2007 survey period.

Table 2-2 Survey Dates, Type & Prevailing Weather

DATE	SURVEY TYPE	WEATHER					
		Temp	*Rain (24 hrs to 9:00am)*	*Sun*		*Moon*	
				Rise	*Set*	*Rise*	*Set*
12/11/2007	Targeted Eastern Pygmy Possum trapping (set traps) Targeted *Tetratheca juncea* counts within CHB development lands Targeted *Cryptostylis hunteriana* searches within CHB development lands	15.9-24^{0}C	0mm	5:46	19:29	6:42	21:49
13/11/2007	Targeted Eastern Pygmy Possum trapping (check traps) Targeted *Tetratheca juncea* counts within CHB development lands Targeted *Cryptostylis hunteriana* searches within CHB development lands	15.9-22.4^{0}C	0mm	5:45	19:30	7:29	2242
14/11/2007	Targeted Eastern Pygmy Possum trapping (check traps) Vegetation mapping and *Tetratheca juncea* reconnaissance within offset lands	15.9-22^{0}C	0mm	5:44	19:31	8:22	23:30
15/11/2007	Targeted Eastern Pygmy Possum trapping (check traps) SEPP 14 wetland boundary mapping Vegetation mapping and *Tetratheca juncea* reconnaissance within offset lands	18.2-21.8^{0}C	0mm	5:44	19:32	9:21	-
16/11/2007	Targeted Eastern Pygmy Possum trapping (remove traps) Vegetation mapping within offset lands	19.1 – 22.6^{0}C	0mm	5:43	19:33	10:23	00:13
19/11/2007	Vegetation mapping within offset lands	18.6-24.8^{0}C	0mm	5:41	19:36	13:34	01:54
20/11/2007	Targeted *Cryptostylis hunteriana* searches at Gwandalan development lands Searches under potential Masked Owl roost trees for signs of evidence	18.8-22.5^{0}C	0mm	5:41	19:37	14:39	02:23

Source:
Australian Government – Geoscience Australia [http://www.ga.gov.au/geodesy/]
Daily weather observations – Newcastle Weather Station [http://www.bom.gov.au]

2.4 Limitations

Limitations associated with the EAR are presented herewith. The limitations have been taken into account throughout this assessment specifically in relation to threatened species assessments, results and conclusions.

In these instances, a precautionary approach has been adopted; as such 'assumed presence' of known and expected threatened species, populations and ecological communities has been made where relevant and scientifically justified to ensure a holistic assessment.

Seasonality

Most notably, several threatened flora species, particularly cryptic orchids, should be surveyed within their respective flowering periods. Reliance on previous surveys (Wildthing, 2003a; 2003b; 2004a; 2004b; 2004c; EcoBiological, 2006a; 2006b; and RPS HSO, 2007d) has occurred as these surveys have provided most of the cryptic orchid seasonal surveys. The survey of the Gwandalan lands for cryptic orchids has been undertaken by RPS HSO (2007a) and during the current survey.

The flowering and fruiting plant species that attract some nomadic or migratory threatened species, often fruit or flower in cycles spanning a number of years. Furthermore, these resources might only be accessed in some areas during years when resources more accessible to threatened species fail. As a consequence threatened species may be absent from some areas where potential habitat exists for extended periods and this might be the case for the above-mentioned species. Again, this has been taken into account in the habitat assessment phase, although ongoing surveys, conducted during a range of seasonal periods, are designed to elucidate any potential significance the Rosegroup lands might represent for seasonal species.

In addition, the seasonality of the surveys also places limits on the number of flora species identified in the site as the survey occurred in late Spring the some species may have stopped flowering and are difficult to detect. Thus the flora species cannot be considered to be complete when one survey has been completed due to seasonality of flowering.

Data Availability & Accuracy

- The collated threatened flora and fauna species records provided by the NPWS for the region are known to vary in accuracy and reliability. Traditionally this is due to the reliability of information provided to the NPWS for collation and/or the need to protect specific threatened species locations. For the purposes of this assessment this information has been considered to have an accuracy of ± 1km.

- Threatened flora and fauna records within the region were predominantly sourced from the DECC Atlas of Wildlife Database and a DEWR Protected Matters Search. Other sources such as Birdata and HBOC were also utilised. Limitations are known to exist with regards to these data sources and their accuracy.

Note: Data recorded by RPS HSO during the survey period, has been undertaken with a Trimble GeoXH GPS unit, which is capable of sub-metre accuracy following post processing.

Vegetation Mapping

The vegetation mapping which has been undertaken within the site (Figure 2-1) has been a collation of the previous mapping (Wildthing 2003a, 2003b, 2004a, 2004b, 2004c and EcoBiological 2006b) and aerial photograph interpretation. Some targeted groundtruthing of previously unmapped areas occurred; however no groundtruthing of areas previously mapped by other consultants has been completed by RPSHSO during the current survey.

Access

The survey was limited by access and size of the site; in some areas the topography or density of flora (i.e. closed heath) restricted access to some parts of the site.

Fauna

The presence of fauna within a particular area is not static over time, may be seasonal or in response to the availability of a particular resource. As such, where survey effort targeting particular threatened fauna species has not specifically met guidelines recommended by DECC, habitat assessment and prediction of the occurrence of threatened fauna species has been applied. In saying that, it is considered that the combined survey effort and datatset from all of the investigations undertaken to date provide a substantial picture of the fauna species and habitat values occurring within the site.

3 RESULTS OF SUPPLEMENTARY FIELD INVESTIGATIONS - RPS HSO NOV 2007

3.1 Flora

A total of 347 flora species were identified during the survey period over the Catherine Hill Bay site within the quadrats and random meander surveys. A complete list of the flora species identified is provided in Appendix C of this report.

3.1.1 Description of Vegetation Communities

A description of each community and classification into both adopted regional vegetation classification, being LHCCREMS (NPWS 2000; House 2003) and the Natural Vegetation of the Wyong Local Government Area (Bell, 2002), is provided below. Please note that descriptions for the Gwandalan development lands have not been included within the vegetation descriptions as they were not delineated during the current survey. These were previously delineated by Wildthing (2003b).

The following fifteen vegetation communities were delineated within the Catherine Hill Bay site as shown in Figure 3-1 and listed below:

1. Munmorah Palm-Apple Dry Drainage Line Forest;
2. Coastal Plains Smooth-barked Apple Woodland;
3. Coastal Sand Wallum Heath Scrub;
4. Narrabeen Foreshore Redgum-Ironbark Forest;
5. Narrabeen Wallarah Sheltered Grassy Woodland;
6. Narrabeen Doyalson Coastal Woodland;
7. Coastal Headland Complex (Grassland & Shrubland);
8. Coastal Holocene Banksia Scrub;
9. **Coastal Sand Mahogany-Paperbark Swamp Forest (EEC Swamp Sclerophyll Forest);**
10. **Estuarine Swamp Oak Forest (EEC Swamp Oak Floodplain Forest);**
11. **Estuarine Mangrove-Saltmarsh Complex (EEC Saltmarsh);**
12. **Freshwater Wetland Complex (EEC Freshwater Wetlands on Coastal Floodplains);**
13. Regenerating Vegetation;
14. Weeds and Cleared Areas; and
15. Dams.

1 Munmorah Palm-Apple Dry Drainage Line Forest

This vegetation community was located within the drainage lines and gullies within the site and covers an area of approximately 9.5ha. 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 Palm). This vegetation community 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 provide distinction and it is considered not to be commensurate with this EEC.

Upper Stratum – 15 to 20m with a Percent Foliage Cover (PFC) of 40 to 60%, the dominant species being *Livistonia australis* (Cabbage Tree Palm), *Angophora costata* (Smooth-barked Apple), *Eucalyptus resinifera* subsp. *resinifera* (Red Mahogany) and occasionally *Eucalyptus robusta* (Swamp Mahogany).

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

Mid Stratum 2 – 2 to 3m 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 1m 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).

2 Coastal Plains Smooth-barked Apple Woodland

This vegetation community occupies a large area within the five portions throughout the offset portions of the site and encompasses 12.36ha. 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 30 Coastal Plains Smooth-barked Apple Woodland as described by LHCCREMS (NPWS 2000; House 2003). The threatened flora species *Tetratheca juncea* was recorded within this community. The Scribbly Gum *Eucalyptus signata* also occurs sporadically throughout this vegetation community. This community has been delineated from the Narrabeen Wallarah Sheltered Grassy Woodland by the dominance of *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood) within the canopy.

Upper Stratum – 20 to 25m with a PFC of 40 to 50%, the dominant species being *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood),

Eucalyptus piperita (Sydney Peppermint), *Eucalyptus capitellata* (Brown Stringybark), and occasionally *Eucalyptus resinifera* subsp. *resinifera* (Red Mahogany).

Mid Stratum 1 – 4 to 8m with a PFC of 20 to 40%, the dominant species being *Allocasuarina littoralis* (Black She-oak), *Exocarpus cupressiformis* (Ballart Cherry), juvenile *Eucalyptus capitellata* (Brown Stringybark) and *Corymbia gummifera* (Red Bloodwood).

Mid Stratum 2 – 1 to 2m with a PFC of 10 to 30%, the dominant species being *Banksia spinulosa* var. *collina* (Hairpin Banksia), *Dillwynia retorta* (Eggs and Bacon), *Dodonea triquetra* (Common Hop Bush), *Leptospermum trinervium* (Paperbark Tea-tree), *Pultenaea villosa* and *Acacia myrtifolia* (Myrtle Wattle).

Lower Stratum – to 1m with a PFC of 20 to 60%, the dominant species being *Lepidosperma laterale, Xanthorrhoea latifolia* subsp. *latifolia* (Forest Grass Tree), *Poa labillardieri* var. *labillardieri* (Tussock Grass), *Joycea pallidea* (Silver-top Wallaby Grass), *Lomandra obliqua* (Fishbones), *Themeda australis* (Kangaroo Grass), *Entolasia stricta* (Wiry Panic), *Tetratheca juncea* (Black-eyed Susan) and *Dianella caerulea var. producta* (Blue Flax Lily).

3 Coastal Sand Wallum Heath Scrub

This vegetation community occurs in three sections in the eastern portion of the Catherine Hill Bay site on the exposed south facing slopes on Aeolian sands. The unique presence of Grass Trees (*Xanthorrhoea resinifera*), which normally have no trunk, occurs within this community. This vegetation community encompasses approximately 6.28ha. 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 10m with a Projected Foliage Cover (PFC) of 30 to 60%, the dominant species being *Banksia aemula* (Wallum Banksia), *Banksia serrata* (Old Man Banksia), *Leptospermum trinervium* (Paperbark Tea-tree), *Angophora costata* (Smooth-barked Apple), *Eucalyptus umbra* subsp. *umbra* (Broad-leaved Mahogany) and *Corymbia gummifera* (Red Bloodwood).

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

Lower Stratum – to 1.5m 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).

4 Narrabeen Foreshore Redgum-Ironbark Forest

This vegetation community occurs on the foreshore of Lake Macquarie, adjoining the Estuarine Swamp Oak Forest and encompasses 0.91ha. This vegetation community

is commensurate with MU 24 Narrabeen Foreshore Redgum-Ironbark Forest as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002) however; this community is not commensurate with any vegetation communities as described by LHCCREMS (NPWS 2000; House 2003). This community had severe incursions of *Lantana camara* (Lantana) and *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) throughout.

Upper Stratum – to 20m with a PFC of 30% to 50%, the dominant species being *Eucalyptus tereticornis* (Forest Redgum), *Eucalyptus paniculata* subsp. *paniculata* (Grey Ironbark) and occasionally *Angophora costata* (Smooth-barked Apple).

Mid Stratum 1 – 4 to 6m with a PFC of 10 to 20%, the dominant species being *Allocasuarina littoralis* (Black She-Oak) and *Exocarpus cupressiformis* (Cherry Ballarat).

Mid Stratum 2 – 1 to 3m with a PFC of 80%, the dominant species being *Acacia longifolia var. longifolia* (Sydney Golden Wattle), *Bursaria spinosa, Notelaea longifolia* (Mock Olive), *Acrotriche divaricata, Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush), *Lantana camara* (Lantana), *Dodonaea triquetra* (Common Hop Bush), *Acacia falcata* (Sickle Wattle) and *Acacia irrorata* subsp. *irrorata.*

Lower Stratum – to 1m with a PFC of 40 to 80%, the dominant species being *Imperata cylindrica* var. *major* (Blady Grass), *Oplismenus aemulus* (Basket Grass), *Hardenbergia violacea* (Native Sarsaparilla), *Pratia purpurescens* (Whiteroot), *Centella asiatica* (Swamp Pennywort) and *Cassytha pubescens* (Common Devil's Twine).

5 Narrabeen Wallarah Sheltered Grassy Woodland

This vegetation community occupies the southwestern portion of the site and encompasses 219.19ha. This vegetation community is commensurate with MU 33 – Narrabeen Wallarah Sheltered Grassy Forest as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002). However, this vegetation community is not commensurate with any vegetation units as described by LHCCREMS (NPWS 2000; House 2003). This community was difficult to delineate due to the variable canopy layer in which no species was dominant. The presence of *Eucalyptus globoidea* (White Stringybark) and *Eucalyptus paniculata* subsp. *paniculata* (Grey Ironbark) separates this community from the Coastal Plains Smooth-barked Apple Woodland. Variations of a dominance of *Eucalyptus propinqua* (Small-fruited Grey Gum) and *Eucalyptus acmenoides* (White Mahogany) occurs within the southern drainage lines of the offset lands. In contrast, the ridgelines within the western portion (Crangan Bay) of the vegetation community were dominated by a combination of *Angophora costata* (Smooth-barked Apple) and *Eucalyptus signata* (Scribbly Gum).

Upper Stratum – 20 to 25m 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 to 10m with a PFC of 20%, the dominant species being *Allocasuarina torulosa* (Black She-oak) and juvenile *Eucalyptus* species.

Mid Stratum 2 – 1 to 2m 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 1m 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).

6 Narrabeen Doyalson Coastal Woodland

This vegetation community covers approximately 23.88ha with the Catherine Hill Bay Site. 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). This community varied considerably within the site. The portion which is within the southern most section of the site has a dense understorey of *Banksia serrata* (Old Man Banksia) in combination with *Eucalyptus haemastoma* (Scribbly Gum) and *Corymbia gummifera* (Red Bloodwood). The sections on the ridgetops have a more open woodland habitat dominated by *Eucalyptus haemastoma* (Scribbly Gum), *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood) with a heathy understorey.

Upper Stratum – 15 to 18m 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 – 5 to 15m with a PFC of 5%, the dominant species being, *Leptospermum trinervium* (Paperbark Tea-tree), *Xylomelum pyriforme* (Woody Pear) and *Banksia serrata* (Old Man Banksia).

Mid Stratum 2 – 1 to 5m with a PFC of 30 to 40%, the dominant species being, *Banksia aemula* (Wallum Banksia), *Leptospermum polygalifolium* (Lemon-scented Tea-tree), *Hakea dactyloides, Hakea bakeriana, Persoonia levis* (Broad-leaved Geebung), *Lambertia formosa* (Mountain Devil), *Ricinocarpos pinifolius* (Wedding Bush) and *Isopogon anemonifolius* (Drumsticks).

Lower Stratum – to 2m with a PFC of 70 to 80%, the dominant species being *Epacris pulchella* (NSW Coral Heath), *Ptilothrix deusta, Tetratheca thymifolia, Philotheca salisolifolia, Lomandra obliqua* (Fishbones), *Xanthorrhoea resinifera* (Forest Grass Tree), *Themeda australis* (Kangaroo Grass) and *Entolasia stricta* (Wiry Panic).

7 Coastal Headland Complex (Grassland & Shrubland)

This vegetation community encompasses the coastal headland areas and comprises of both open and closed heath structure. The community encompasses 12.94ha. 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 portions surveyed during the current study were highly disturbed by weeds. Stunted Eucalypts occurred throughout the community which was interspersed with heath vegetation.

Upper Stratum – 4 to 10m with a Projected Foliage Cover (PFC) of 5%, scattered trees of *Corymbia gummifera* (Red Bloodwood).

Mid Stratum 2 – 2 to 4m with a PFC of 30 to 90%, the dominant species being *Westringia fruiticosa* (Coast Westringia), *Banksia spinulosa* var. *collina* (Hairpin Banksia), *Allocasuarina distyla, Leptospermum laevigatum* (Coastal Tea Tree), *Melaleuca nodosa* (Ball Everlasting), *Banksia oblongifolia*, *Acacia longifolia* var. *longifolia* (Sydney Golden Wattle) and *Lambertia formosa* (Mountain Devil).

Lower Stratum – to 1.5m with a PFC of 40 to 90%, the dominant species being *Lomandra obliqua* (Fish Bones), *Patersonia sericea* (Purple Flag Flower), *Patersonia glabrata, Austrostipa sp., Pultenaea elliptica, Xanthorrhoea latifolia* subsp. *latifolia* (Grass Tree), *Gonocarpus teucrioides* (Raspwort), *Ptilothrix deusta, Cassytha glabella* forma *glabella* (Slender Devil's Twine) and *Themeda australis* (Kangaroo Grass).

8 Coastal Holocene Banksia Scrub

This vegetation community occurs on the fore dunes along the coastline and on the hind dunes within the Coastal Headland Complex. This vegetation community encompasses approximately 5.44ha. 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). This vegetation community is highly disturbed with a high number of weeds occurring throughout.

Mid Stratum 1 – 4 to 6m 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 2m with a PFC of 20 to 30%, the dominant species being *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 – to 1m with a PFC of 20 to 30%, the dominant species being *Themeda australis* (Kangaroo Grass), *Lomandra longifolia* (Mat Rush) and *Cassytha glabella* forma *glabella* (Slender Devil's Twine).

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

This vegetation community occurs in the low lying estuarine drainage lines and encompasses 11.22ha. 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 community has only minor weed incursions with generally a good diversity of natives throughout.

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

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

Mid Stratum 2 – 3 to 5m with a PFC of 30 to 90%, the dominant species being *Elaeocarpus reticulataus* (Blueberry Ash), *Synoum glandulosum* subsp. *glandulosum* (Scentless Rosewood), *Cryptocarya microneura* (Murrogun), *Cyathea cooperi* (Straw Treefern) and *Pittosporum undulatum* (Sweet Pittosporum).

Lower Stratum – to 1.5m with a PFC of 10 to 50%, the dominant species being *Gahnia clarkei* (Tall Saw Sedge), *Blechnum indicum* (Swamp Water Fern), *Baloskion tetraphyllum* subsp. *meiostachyum* (Tassel Cord Rush), *Empodisma minus* (Spreading Rope Rush), *Hydrocotyle peduncularis, Viola hederacea* (Native Violet), *Dioscoria transversa* (Pencil Yam), *Marsdenia suaveolens* (Scented Marsdenia), *Hemarthria uncinata* (Matt Grass), *Oplimenus aemulus* (Basket Grass) and *Smilax glyciphylla* (Native Sarsaparilla).

10 Estuarine Swamp Oak Forest (EEC – Swamp Oak Floodplain Forest)

This vegetation community occurs along the foreshore of Lake Macquarie within Crangan Bay. 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 – 5 to 12m with a PFC of 10 to 20%, the dominant species are *Casuarina glauca* (Swamp Oak) and *Eucalyptus tereticornis* (Forest Red Gum).

Mid Stratum – 1 to 5m with a PFC to 80%, the dominant species being, *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Avicennia marina* (Grey Mangrove).

Lower Stratum – to 1m with a PFC to 50 to 80%, the dominant species being *Juncus kraussii* subsp. *australiensis* and *Baumea juncea*.

11 Mangrove Estuarine – Saltmarsh Complex

This vegetation community occurs along the foreshore of Lake Macquarie within the site. This vegetation community covers approximately 3.35ha and is commensurate with MU 2 – Estuarine Mangrove-Saltmarsh Complex as described by the Natural Vegetation of the Wyong Local Government Area (Bell, 2002) and MU 47 Mangrove Estuarine Complex as described by LHCCREMS (NPWS 2000; House 2003).

Upper stratum – 4 to 5m with a PFC to 80%, with no mid-storey. The dominant species was *Avicennia marina* (Grey Mangrove) and occasionally *Casuarina glauca* (Swamp Oak).

Lower Stratum – to 1m with a PFC of 80 to 90%, the dominant species being *Stenotaphrum secundatum* (Buffalo Grass), *Juncus kraussii* subsp. *australiensis* (Sea Rush), *Baumea juncea, Sporobolus virginicus* (Salt Couch), *Tetragonia tetagonioides* (New Zealand Spinach), *Samolus repens* (Creeping Brookweed), *Atriplex prostrata* (Orache), *Suaeda uastralia* (Austral Seabite) and *Lobelia alata.*

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

This vegetation community occurs in several locations within the offset lands all of which either adjoin or are part of the SEPP 14 wetland located to the south of the Catherine Hill Bay site. A dam which was previously located within the south of the site has been included in this community due to the high diversity of natives located therein. This community was floristically diverse and provides habitat for a range of native flora and fauna. This vegetation community covers approximately 1.78 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 – 5 to 10m with a Projected Foliage Cover (PFC) of 10 to 20%, the dominant species being *Eucalyptus robusta* (Swamp Mahogany), *Callistemon salignus* (Willow Bottlebrush), *Melaleuca styphelioides* (Prickly-leaved Melaleuca) and *Melaleuca ericifolia* (Swamp Paperbark).

Mid Stratum – 1.5 to 3m with a PFC of 30 to 40%, the dominant species being, *Melaleuca thymifolia, 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)*, Leptocarpus tenax, Lepyrodia scariosa, Carex appressa*, *Adiantum aethiopicum* (Common Maidenhair), *Gleichenia dicarpa* (Pouched Coral Fern), *Baloskion tetraphyllum* subsp. *meiostachyum* (Tassel Cord Rush), *Blechnum indicum, Entolasia marginata* (Bordered Panic), *Persicaria hydropiper* (Water Pepper), *Hydrocotyle peduncularis,* and *Dichondra repens* (Kidney Weed).

Emergents – *Phagramities australis, Typha orientalis* (Bull Rush), *Baumea articulata* (Jointed Twig-Rush), *Eleocharis sphacelata, Juncus usitatus*, and *Philydrum lanuginosum* (Woolly Frogmouth).

13 Regenerating Vegetation

This vegetation community occurs within the previously cleared areas and edges of native vegetation. Rehabilitation of the old coal dumps is currently occurring within the CHB development lands. This vegetation community encompasses approximately 20.1ha. This community 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).

Upper Stratum – 8 to 10m with a PFC of 40 to 50%, the dominant species being *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood).

Mid Stratum – 2 to 4m with a PFC to 60 to 80%, the dominant species being, *Acacia longifolia* var. *sophorae* (Coastal Wattle), *Acacia longifolia* var. *longifolia* (Sydney

Golden Wattle), *Chrysanthemoides monilifera* subsp*. rotundata* (Bitou Bush), *Kunzea ambugia* (Tick Bush) and *Leptospermum laevigatum* (Coastal Tea Tree).

Lower Stratum – to 2m with a PFC of 5 to 10%, the dominant species being *Acrotriche divaricata, Austrodanthonia linkii* (Wallaby Grass), *Epracis pulchella* (NSW Coral Heath), *Astroloma humifusum* (Cranberry Heath), *Entolasia stricta* (Wiry Panic), and *Chloris gayana* (Rhodes Grass).

14 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. This community encompasses approximately 50.47ha 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.

Upper Stratum – 15 to 18m 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 2m 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 1m 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).

15 Dam

This vegetation community occurs adjoining the cleared areas within the north of the site. This community encompasses approximately 0.95ha 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 – 10 to 15m with a PFC of 40 to 50%, the dominant species being *Angophora costata* (Smooth-barked Apple) and *Eucalyptus signata* (Scribbly Gum).

Mid Stratum – 2 to 4m with a PFC of 30 to 40%, the dominant species being, *Acacia longifolia* var. *longifolia* (Sydney Golden Wattle), *Dodonea triquetra* (Common Hop Bush), *Pultenaea villosa*, *Pittosporum undulatum* (Sweet Pittosporum) and *Chrysanthemoides monilifera* subsp*. rotundata* (Bitou Bush).

Lower Stratum – to 1m with a PFC of 80 to 90%, the dominant species being *Pennisetum clandestinum* (Kikuyu), *Pteridium esculentum* (Bracken Fern), *Hydrocotyle bonariensis* (Pennywort), *Imperata cylindrica* var. *major* (Blady Grass), *Hardenbergia violacea* (False Sarsaparilla), *Andropogon virginicus* (Whisky Grass), and *Hypochaeris radicata* (Flatweed).

Emergents – *Schoenoplectus validus, Phragmites australis* (Native Rush), *Typha orientalis* (Bull-rush), *Juncus subsecundus* (Finger Rush) and *Cyperus sp. Juncus mollis, Juncus usitatus* (Common Rush).

WARNING

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 interpreting areas between delineated vegetation communities has been made.

LEGEND

- Site Boundary
- Catherine Hill Bay Development Boundary

Vegetation Communities

- Coastal Holocene Banksia Scrub
- Regenerating Vegetation
- Coastal Headland Complex
- Freshwater Wetlands (EEC)
- Coastal Sand Wallum Heath-Scrub
- Dam
- Narrabeen Wallarah Sheltered Grassy Forest
- Coastal Plains Smooth-barked Apple Woodland
- Munmorah Palm-Apple Dry Drainage Line Forest
- Narrabeen Doyalson Coastal Woodland
- Weeds and Cleared Areas
- Estuarine Swamp Oak Forest (EEC)
- Narrabeen Foreshore Redgum-Ironbark Forest
- Estuarine Mangrove-Saltmarsh complex
- Coastal Sand Mahogany-Paperbark Swamp Forest (EEC)
- Narrabeen Coastal Sheltered Peppermint-Apple Forest
- Narrabeen Snappy Gum Forest
- Disturbed Open Woodland
- Established Native Garden

Please Note: This vegetation map is a combination of RPSHSO vegetation survey of the offset lands and the remainder of the site has been mapped by EcoBiological 2006b and Wildthing (2003a, 2003b, 2004a, 2004b).

0 0.5 1
kilometres

TITLE: Figure 3-1
Vegetation Communities

CLIENT: Rosecorp Pty Ltd

SCALE: 1: 22000 at A3 Size **DRAWN:** D. Landenberger **APPROVED:**

DATUM: MGA Zone 56 (GDA 94) **DATE:** 26/11/2007

LAYOUT REF: J:\JOBS\24k\24619 - Gwandalan\Drafting\Mapinfo\Workspaces\24619.FIG3-1 Vegetation Communities A-A3.221107

CONTOUR INTERVAL: N/A

JOB REF: 24619

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3.1.2 Conservation Status of Vegetation Communities

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

- The vegetation community delineated as Estuarine Swamp Oak Forest is commensurate with 'Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregions';
- The vegetation community delineated as Coastal Sand Mahogany - Paperbark Swamp Forest is commensurate with 'Swamp Sclerophyll Forest on Coastal Floodplains in the NSW North Coast, Sydney Basin and South East Corner Bioregions';
- Freshwater Wetlands is commensurate with 'Freshwater Wetlands on Coastal Floodplains in the NSW North Coast, Sydney Basin and South East corner Bioregions'; and
- The Mangrove Estuarine – Saltmarsh Complex vegetation community present on site contains small areas of saltmarsh which represents 'Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions'. Additionally, this community is protected under the *Fisheries Management Act 1994.*

3.1.3 Regionally Significant Flora Species in the Lake Macquarie LGA

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

- *Asplenium aethiopicum;*
- *Conospermum ericifolium;*
- *Eucalyptus robusta;*
- *Eucalyptus signata;*
- *Hakea bakeriana;*
- *Gompholobium pinnatum;* and
- *Xanthorrhoea resinifera* (Tree Form).

3.1.4 Regionally Significant Communities within the 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 (2001) within the Lake Macquarie LGA:

- Munmorah Palm-Apple Dry Drainage Line Forest;
- Coastal Headland Complex;
- Narrabeen Doyalson Coastal Woodland;

- Coastal Holocene Banksia Scrub;
- Coastal Wallum Heath Scrub;
- **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).**

3.1.5 Regionally Significant Vegetation Communities within Wyong LGA

The following vegetation communities, which occur within the site, are considered to be regionally significant by Bell (2002) within the Wyong LGA:

- Coastal Headland Complex (Naturally restricted distribution and prone to weed infestation);
- Coastal Sand Holocene Banksia Scrub (Naturally restricted and prone to invasion by Bitou Bush);
- Narrabeen Foreshore Redgum-Ironbark Forest (Highly restricted distribution);
- Narrabeen Wallarah Sheltered Grassy Forest (Restricted distribution); and
- Munmorah Palm-Apple Dry Drainage Line Forest (Restricted distribution).

3.1.6 Regionally Significant Flora Species

No ROTAP listed species (Briggs and Leigh, 1996) were identified within the site. However, Bell (2002) contains a list of regionally significant flora species and 15 of these were identified within the site, and are listed as follows:

- *Asplenium aethiopicum;*
- *Astroloma humifusum;*
- *Avicennia marina* subsp. *australasica;*
- *Blechnum nudum;*
- *Bossiaea rhombifolia;*
- *Callistemon rigidus;*
- ***Cryptostylis hunteriana (listed under TSC Act and EPBC Act);***
- *Cyathea australis;*
- *Melaleuca hypericifolia;*
- *Oxalis perennans;*
- *Persicaria hydropiper;*
- *Pultenaea daphnoides;*

- *Schizaea dichotoma;*
- ***Tetratheca juncea (listed under TSC Act and EPBC Act*); and**
- *Xylomelum pyriforme.*

3.1.7 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 5km (DECC Wildlife Atlas 2007) of the site (Refer to

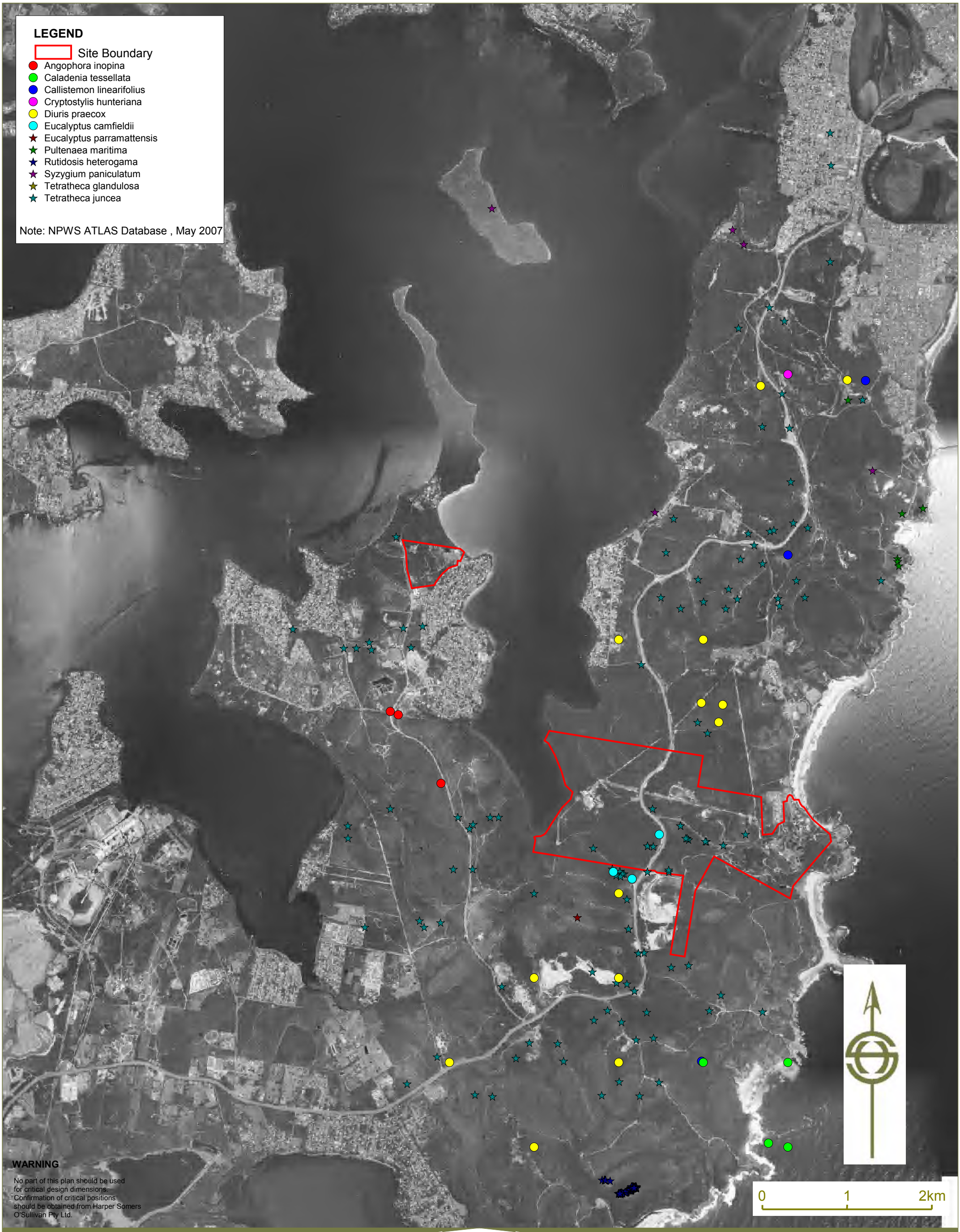
Figure 3-2):

- *Angophora inopina* (Charmhaven Apple);
- *Caladenia tessellata* (Thick Lip Spider Orchid);
- *Callistemon linearifolius* (Netted Bottle Brush);
- *Cryptostylis hunteriana* (Leafless Tongue Orchid);
- *Diuris praecox* (Rough Double Tail);
- *Eucalyptus camfieldii* (Camfield's Stringybark);
- *Eucalyptus parramattensis* subsp. *decadens* (Drooping Red Gum);
- *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 site and therefore has not been assessed further within this report.

In addition to the above threatened flora species recorded on the DECC Wildlife Atlas, it was considered the following species have some 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);
- *Genoplesium insignis* (Variable Midge Orchid);
- *Grevillea parviflora ssp parviflora* (Little-flower Grevillea);
- *Melaleuca groveana* (Grove's Paperbark); and
- *Microtis angusii* (Angus's Onion Orchid).



TITLE:

Figure 3-2
NPWS Atlas Flora Records

CLIENT:
ROSECORP PTY LTD

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SCALE: 1: 40000 at A3 Size
DRAWN: S. Bishop
APPROVED: D. Landenberger
DATUM: MGA Zone 56 (GDA 94)
DATE: 22/11/2007
LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\Draft ... ology\Southern Lands\ALL WORKSPACES\Catho Report Figures\24530 FIG.4-2 NPWS FLORA MAP A-A3.wor
CONTOUR INTERVAL: N/A
JOB REF: 24619

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3.1.8 Targeted Threatened Flora Species Survey Results

This section lists the results of the targeted threatened flora surveys. Two threatened flora species were located within the site, being *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Tetratheca juncea.* No other threatened flora species were detected within the site.

Tetratheca juncea

A total of 583 *Tetratheca juncea* plants were located during the targeted surveys within the site (Figure 3-3 and Figure 3-4 show the distribution). A total of 369 *T.juncea* clumps would be removed as part of the proposal (189 recorded within the CHB development lands and 180 recorded by Wildthing (2003b) within the Gwandalan development lands). A summary of the T. juncea records within the site is presented in Table 3-1 below.

Table 3-1: Tetratheca juncea recorded within the site

Site	**Survey**	***T.juncea* clumps**
CHB development lands	RPS HSO Nov 2007	189
Gwandalan development lands	Wildthing (2003b)	180
Total in development lands		*369*
Offsets	RPS HSO Nov 2007	159
Offsets	Wildthing (2003a)	55
Total in offsets (extreme underestimate due to low survey effort)		*214*
TOTAL		***583***

Previous surveys undertaken by EcoBiological (2006) within the CHB development lands identified *T. juncea* in several more locations than were detected during the current survey (see Figure 3-3). *Tetratheca juncea* spot flowers throughout the year and November is considered to be late in the flowering season. Therefore, since some individuals are likely to have been missed, the population within CHB development lands may be larger than currently estimated.

A total of 214 *T.juncea* clumps were located within the offset lands (calculated from data from current survey and data collected by Wildthing, 2003a). However, this estimate of *T.juncea* population within the offset lands is considered to be an extreme underestimation of the population since no detailed targeted survey including parallel transects was undertaken across the entire offset lands. It is expected that the population within the offset lands would be quite large as other surveys within the Wallarah Peninsula have located populations in the thousands in similar and proximate habitats (Table 3-1). Additionally, other large 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 of Lake Macquarie in which this site occurs. However, at the time the total population of *T. juncea* was estimated to be only 10,000 (Payne, 2000). This figure given by Payne (2000) is an underestimation of the entire population throughout its range, since a conservative approach was taken due to the cryptic nature of this species and the lack of extensive survey data at the time. 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 *T. 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 the site is large and contains other species which utilise buzz pollination (e.g. *Hibbertia sp. and Dianella sp.*) it is considered that the habitat within 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 occurs to ensure sufficient seed is set to ensure the survival of this species. The populations located within the offset lands are estimated to be larger than those within the development lands 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 (RPSHSO [2007c; 2007d] and Conacher Travers [2007] data combined). Table 3-2 is a breakdown of the numbers of *T. juncea* currently within lands that are dedicated to conservation or are proposed to be dedicated to conservation and have been surveyed to date. This number is expected to be an underestimation as targeted surveys within the offset lands were not undertaken and there are large areas of land owned by Coal & Allied which are yet to be surveyed. Thus, whilst the population within the CHB and Gwandalan development lands would be removed, this conservatively represents only 0.3% of the population within the Wallarah Peninsula and large areas of the known populations would be conserved within the proposed offset lands. Within the Wallarah Peninsula there is currently over 30,000 *T. juncea* clumps that would be conserved (RPS HSO, 2007d; 2007e; Conacher Travers, 2007; Payne, 2000). Thus the removal of 189 (0.3%) *T. juncea* clumps from the Wallarah Peninsula population is unlikely to have a significant effect upon the local population. 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 3-2 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
Coal & Allied Catherine Hill Bay Proposed Offset lands	7,057
Coal & Allied Gwandalan Proposed Offset lands	6,591
Coal & Allied Nords Wharf Proposed Offset lands	5,933
Rosegroup Offset lands***	214
Total in Conservation Reserves at Wallarah Peninsula	**30,020**

* Data from Conacher Travers (2007)
** Data from Payne (2000)
***Data from RPSHSO (2007) and Wildthing (2003a)

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from Harper Somers O'Sullivan Pty Ltd.

LEGEND

- CHB Development Lands
- *Tetratheca juncea (RPSHSO 2007)*
- *Tetratheca juncea (EcoBiological 2006b)*

0 200 400
metres

TITLE: Figure 3-3
Tetratheca juncea Records
CHB Development Lands

CLIENT: Rosecorp Pty Ltd

SCALE: 1: 4800 at A3 Size **DRAWN:** E.Graham **APPROVED:** D. Landenberger
DATUM: MGA Zone 56 (GDA 94) **DATE:** 23/11/2007
LAYOUT REF: J:\JOBS\24k\24619 - Gwandalan\Draftin ... nfo \24619.FIG4.TJ OccurenceA-A4.221107.wor
CONTOUR INTERVAL: N/A
JOB REF: 24619

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WARNING

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LEGEND

- Site Boundary
- Tetratheca juncea Extent (RPSHSO 2007)
- Tetratheca juncea extent (Wildthing 2004a)

0 500 1,000

metres

TITLE:

Figure 3-4
Tetratheca juncea occurrence within offset lands

CLIENT: Rosecorp Pty Ltd

SCALE: 1: 14000 at A3 Size **DRAWN:** E. Graham **APPROVED:** D. Landenberger

DATUM: MGA Zone 56 (GDA 94) **DATE:** 23/11/2007

LAYOUT REF: J:\JOBS\24k\24619 - Gwandalan\Draftin .... nfo\Workspaces\24619.FIG5.TJ OccurenceA-3.221107.wor

CONTOUR INTERVAL: N/A

JOB REF: 24619

HARPER SOMERS O'SULLIVAN

PLANNING SURVEYING ECOLOGY

241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
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