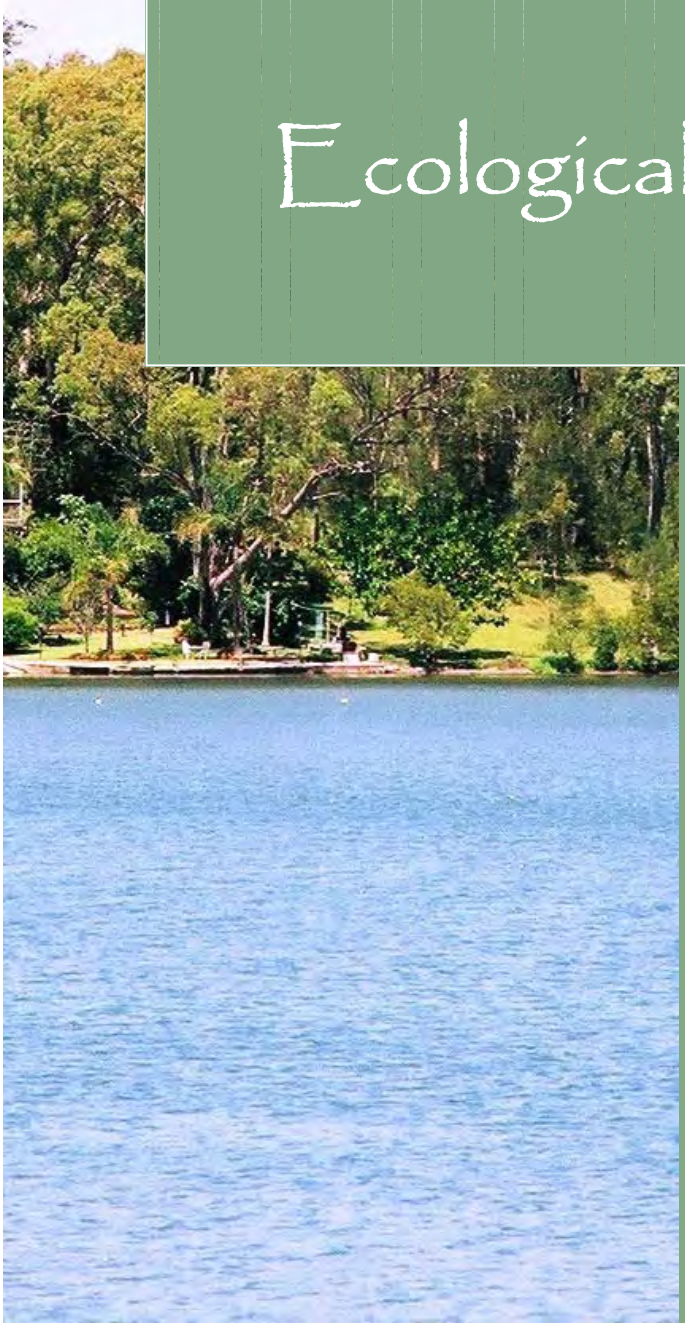
Travers environmental

Ecological Assessment



RAMSGATE ESTATE
DP 1596, WYEE POINT

JANUARY 2009
(REF: 8108F)

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ECOLOGICAL ASSESSMENT

RAMSGATE ESTATE
DP 1596, WYEE POINT

JANUARY 2009

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Checked by:	John Travers
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File:	8108F

Disclaimer:

This report has been prepared to provide advice to the client on matters pertaining to the particular and specific development proposal as advised by the client and / or their authorised representatives. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person including the client then this firm advises that the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be relied upon as meaning it reflects any advice by this firm.

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EXECUTIVE SUMMARY

This Flora and Fauna Assessment Report has been prepared by *Travers environmental* to identify the flora and fauna characteristics at Ramsgate Estate DP 1596, Wyee Point. This survey was undertaken having regard to previous Flora and Fauna Assessments carried out on the site by *Travers environmental* (formerly *Conacher Travers*) between 2000 and 2009.

The current development concept plan contains development precincts and possible road layouts. Figure 8 displays the conceptual development proposal within the precinct plan inclusive of proposed bushfire asset protection zones including a widened road alignment adjacent to the corridor to allow an APZ to occur without impacting a proposed conservation zoning. This development area extends marginally into areas of EEC due to the low condition of this area of EEC and it possible use as a bushfire asset protection zone. A wildlife corridor of approximately 50m in width and 380m in length runs through the centre of the site to link hinterland vegetation with the foreshores of Lake Macquarie.

The potential ecological impacts on this site relate to tree removal, functioning of watercourses, construction and implementation of asset protection zones, and the potential impacts on the identified threatened flora and fauna species and Endangered Ecological Communities (EEC's).

Each identified issue has been taken into consideration during the design of this development to ensure that there are no short or long term ecological impacts to this site. Upon implementation of the recommendations from each of the reports prepared for this proposal, there is potential on this site to achieve a better environmental outcome than the current situation.

In June of 2008, *Forest Fauna Surveys* and *Eastcoast Flora Survey* performed a peer review of our Ecological Assessment for Ramsgate Estate DP1596, Wyee Point (January, 2008). A response to the peer review was prepared for discussion with *Lake Macquarie City Council* in July 2008 indicating that the peer review was undertaken on draft documentation not suitable for external review. Council had requested a review of the available documentation and was provided with same to allow an observation of project status.

The accompanying preliminary draft Species Impact Statement was in the same vein in that it was not prepared for any specific development option and was a draft document awaiting an updated development plan so that further works could be completed. In the carriage of this approach by Council, *Woromar* and *Travers environmental* were awaiting a meeting with Council's Environmental planner Robbie Economos. No meeting eventuated despite several attempts. Thus the process of engaging with Council had failed as a result of the informal provision of information as requested only to find that an external peer review had been undertaken.

Subsequent to that process and the report being made available to *Travers environmental* a meeting was held with Council and it was agreed that *Travers environmental* should complete the works outlined within the peer review. Thus it was agreed that additional targeted survey was required to clarify matters affecting threatened orchid species, additional EEC's onsite, potential habitat for the Powerful Owl / Masked Owl and a comprehensive habitat tree survey.

This report has been updated to address the findings of this additional survey. The additional targeted fauna survey has been incorporated into this report with the main findings being that

the Powerful Owl and Masked Owl were not recorded to be utilising suitable breeding hollows or foraging areas within the subject site.

Additional flora surveys were undertaken during the peak flowering period for *Diuris praecox* in 2008 although none were sighted. The survey located two additional specimens of *Tetratheca juncea* in a different location to what had been previously found. In addition, all habitat trees were located and mapped. Survey was undertaken in January 2009 to target *Cryptostylis hunteriana.* Several *Cryptostylis* were sighted by no threatened species.

Further survey occurred to identify the presence, or not, of vegetation that could be River-flat Eucalypt Forest. A grid based survey incorporated sampling of 51 quadrats within MU31 that resulted in vegetation community boundary adjustments to incorporate the presence of the EEC River-flat Eucalypt Forest within the north-eastern portion of the subject site. This is shown in Figure 4b. The methodology to undertake this determination was correlated with East Coast Flora Surveys Stephen Bell.

Targeted survey has been incorporated into this report with the main findings being that;

- No threatened orchid species were recorded within the subject site during the additional survey period of August to September for *Diuris praecox* and in January for *Cryptostylis hunteriana.*

- No observations, calls, call-response or indicative signs (such as whitewash below potential breeding trees) were recorded for the threatened large forest owls (specifically Powerful Owl and Masked Owl) following the breeding period.

- 253 hollow-bearing trees were identified across the subject site. These contained a total of 740 hollows. These were broken down as 208 at <5cm, 220 hollows at 5-10cm, 141 hollows at 10-15cm, 83 hollows at 15-20cm, 37 hollows at 20-25cm, 15 hollows at 25-30cm, and 36 hollows at >30cm. All hollow tree data is provided in Appendix 2, where hollow sizes greater than 30cm are indicated.

- Vegetation communities within the north-eastern portion of the site have been re-defined. This area had been originally mapped as Forest Red Gum Woodland which under LHCCREMS (as map unit 38) would be classed as the endangered ecological community (EEC) River-flat Eucalypt Forest on Coastal Floodplains. A grid based system was applied (the methodology of which is explained in section 2) with the results suggesting that a portion of the original vegetation community – Forest Red Gum Woodland is in fact commensurate with the EEC River-flat Eucalypt Forest on Coastal Floodplains.

- Two additional specimens of *Tetratheca juncea* were found near the southern boundary in the south-western corner of the subject site.

Environmental Planning & Assessment Act 1979 & Threatened Species Conservation Act 1995

In respect of matters required to be considered in the *Environmental Planning & Assessment Act* (1979) and relating to the species / provisions of the *Threatened Species Conservation Act* (1995),

- Five (5) threatened fauna species Squirrel Glider (*Petaurus norfolcensis*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Brown Treecreeper (*Acanthiza pusilla)* and the Glossy Black-Cockatoo (*Calyptorhynchus* lathami);

- One (1) threatened flora species *Tetratheca juncea;* and

- Three (3) endangered ecological communities, Swamp Sclerophyll Forest on Coastal Floodplains, River-flat Eucalypt Forest on Coastal Floodplains and Coastal Saltmarsh, were recorded within or in close proximity to the subject site.

The draft 7 part test of significance (Section 5 of this report) has identified two EEC's as being affected by incremental loss of habitat. No final opinion on the level of significance has been proffered at this point in time given the rezoning process and no actual development plan available to comment upon.

Environment Protection and Biodiversity Conservation Act 1999

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act* (1999);

- One (1) threatened fauna species, Grey-headed Flying Fox;

- One (1) threatened flora species, *Tetratheca juncea;* and

- Two (2) endangered ecological communities Swamp Sclerophyll Forest on Coastal Floodplains, River-flat Eucalypt Forest on Coastal Floodplains and Coastal Saltmarsh were recorded within or in close proximity to the subject site.

Fisheries Management Act 1994

In respect of matters relative to the *Fisheries Management Act 1994*, no suitable habitat for marine/aquatic species was observed within the subject site and as there are no matters requiring further consideration under this Act.

John Travers B.App.Sc. / Ass. Dip.
Managing Director
Travers environmental

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SECTION 1 – INTRODUCTION

Travers environmental has been requested to carry out an ecological assessment at Ramsgate Estate, DP 1596 Wyee Point within the Lake Macquarie Local Government Area.

Figure 1 provides a locality map,
Figure 2 provides an aerial appraisal of the subject site,
Figure 3 provides the indicative Development Concept Plan,
Figures 4A & 4B provide the flora survey locations,
Figure 5 provides fauna survey locations,
Figure 6 provides the threatened species locations,
Figure 7 provides hollow-bearing tree locations,
Figure 7C (within text) depicts the likely connectivity for local flora and fauna, and
Figure 8 provides the ecological and bushfire constraints.

1.1 Aims of the assessment

The aims of the flora & fauna assessment are to:

- Carry out a botanical survey to describe the vegetation communities and their condition;
- Carry out a fauna survey for the detection and assessment of fauna and their habitats;
- Complete target surveys for threatened species, populations and ecological communities;
- Assess the conservation value of the site;
- Undertake survey and prepare a flora and fauna impact assessment in accordance with the requirements of the *Environmental Planning and Assessment (EP&A) Act* (1979), *Threatened Species Conservation (TSC) Act* (1995) and guidelines issued by the National Parks and Wildlife Service and Lake Macquarie City Council; and
- Identify development constraints for future development of the subject site.

As a result of the peer review and discussions held between *Travers environmental* and staff of Lake Macquarie City Council the following additional survey has been undertaken:

- Targeted flora survey for threatened species *Tetratheca juncea* and *Diuris praecox*.
- Detailed quadrat sampling to micro map the edge of River-flat Eucalypt Forest vegetation.
- Targeted fauna survey of potential habitat for Powerful Owl and Masked Owl.
- Redefine vegetation community boundaries within the north-eastern portion of the subject site to ensure accurate mapping of the boundary of the River-flat Eucalypt Forest in line with the discussions on site with the client and peers.
- Targeted flora survey for *Cryptostylis hunteriana.*

The client has also requested the following:

- Identify areas for possible environmental rehabilitation and management.

1.2 Information collation

To achieve the above aims *Travers environmental* (formerly *Conacher Travers Pty Ltd*) carried out field survey across the site on the dates listed in Table 1. In addition the survey undertaken by *Woodward & Clyde* has been included.

Table 1: Dates of field survey undertaken within the site

Year - Month	***Travers environmental* (*formerly Conacher Travers*)**	***Woodward & Clyde***
1996-July		13th, 16th
2000-February	2nd, 7th, 8th, 9th, 10th, 11t	
2000-March	20th & 28th	
2000-May	3rd, 18th, 19th & 30th	
2000-June	23rd	
2000-July	20th	
2000-August	22nd, 23rd & 28th	
2000-September	5th, 6th, 7th, 8th & 14th	
2000-October	9th	
2000-December	7th	
2002-January	2nd, 3rd, 4th , 24th	Unknown dates
2002- March	20th,21st,22nd,23rd,24th,25th, 26th	
2004-June	18th	
2007-February	14th	
2007-March	2nd, 7th	
2008–January	8th	
2008–August	14th, 22nd & 28th	
2008–September	5th	
2008–October	2nd, 8th, 9th, 13th, 14th, 15th, 16th & 17th	
2008–November	4th & 5th	
2009-January	23rd, 25th & 28th	

A review of the relevant information pertinent to the subject site was undertaken prior to the initiation of field surveys as background to the study. Information sources reviewed include the following:

- Aerial photographs (scale 1:25000) and Topographical maps (scale 1:25000)
- Atlas of NSW Wildlife (DECC 2008) for the relevant 1:100,000 scale map sheets
- The schedules of the *Threatened Species Conservation Act* (1995)
- The schedules of the *Fisheries Management Act* (1994)
- Lists of threatened species and communities in the *Environment Protection and Biodiversity Conservation Act* (1999)
- Rare or Threatened Australian Plants (ROTAP)
- Lower Hunter Central Coast Regional Environmental Mapping System (LHCCREMS), 2003

- Previous reports and surveys within the local area

In addition, *Travers environmental* has prepared the following reports for this submission;

- Bushfire Protection Assessment (October 2008).

1.3 Statutory requirements

1.3.1 State

Threatened Species Conservation Act (1995)
The specific requirements of the *Threatened Species Conservation (TSC) Act* (1995) must be addressed in the assessment of flora and fauna matters. This requires the consideration of potential impacts on threatened species, populations and ecological communities.

The factors to be taken into account in deciding whether there is a significant effect are set out in Section 5A of the *Environmental Planning & Assessment (EP&A) Act* (1979) and are based on a 7 part test of significance.

Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a Species Impact Statement (SIS) is required to be prepared.

Fisheries Management Act (1994)
The *Fisheries Management Act* (1994) provides a list of threatened aquatic species, which require consideration when addressing the potential impacts of a proposed development.

Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a Species Impact Statement (SIS) is required to be prepared.

1.3.2 National

The *Environment Protection and Biodiversity Conservation (EPBC) Act* (1999) requires that Commonwealth approval be obtained for certain actions. The Act provides an assessment and approvals system for actions that have a significant impact on matters of national environmental significance (NES). These may include:

- Wetlands protected by international treaty (the Ramsar Convention)
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species

Actions are projects, developments, undertakings, activities, series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on a NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, the matter needs to be referred to the *Department of Environment & Water Resources.*

1.4 Development proposal

The proposed 'development precinct plan' (Figure 3) contains a precinct plan which includes the proposed road layout, precincts for residential development and the location of the foreshore reserve and wildlife corridor. This corridor is approximately 50m in width and 380m in length and runs through the centre of the site linking hinterland vegetation to the foreshores of Lake Macquarie.

The main access to the Estate is from the south east and runs along the eastern side of the wildlife corridor. This then joins to a long avenue at the north of the Estate which follows the approximate line of the foreshores of Lake Macquarie.

One cul-de-sac road and a loop road branching from the foreshore avenue will service the north-western side. The eastern side of the development will be serviced by a variety of roads, including three cul-de-sac roads, and additional roads ending in 'Y' shaped hard-stand turning areas.

Access across the riparian zone will be via a raised bridge structure or an in situ causeway.

1.5 Peer review

In June of 2008, *Forest Fauna Surveys* and *Eastcoast Flora Survey* performed a peer review of the Flora and Fauna Report for Ramsgate Estate DP1596, Wyee Point (January, 2008). A response to the peer review was prepared for discussion with *Lake Macquarie City Council* in July 2008 where it was agreed that additional targeted survey was required to clarify the issues raised within the peer review. This related specifically to the presence or not of threatened orchid species, an additional EEC and potential habitat for the Powerful Owl and Masked Owl. A detailed and comprehensive habitat tree survey was also undertaken in association to this work.

The additional targeted survey has been incorporated into this report with the main findings being that;

- No threatened orchid species were recorded within the subject site during the additional survey period of August to September (2008).

- No observations, calls, call-response or indicative signs (such as whitewash below potential breeding trees) were recorded for the threatened large forest owls (specifically Powerful Owl and Masked Owl) following the breeding period.

- 253 hollow-bearing trees were identified across the subject site. These contained a total of 740 hollows. These were broken down as 208 at <5cm, 220 hollows at 5-10cm, 141 hollows at 10-15cm, 83 hollows at 15-20cm, 37 hollows at 20-25cm, 15 hollows at 25-30cm, and 36 hollows at >30cm. All hollow tree data is provided in Appendix 2, where hollow sizes greater than 30cm are indicated.

- Vegetation communities within the north-eastern portion of the site have been re-defined. LHCCREMS mapping identified this area as Map Unit 31 (MU31) which was inconsistent with previous reports by *Travers environmental* which had referred to this area as Forest Red Gum Woodland and more commensurate with MU38. In such instance, MU38 is equivalent to River-flat Eucalypt Forest (EEC). A grid based system was applied (the methodology of which is explained in Section 2) with the results suggesting that only a portion of the original vegetation community – Forest Red Gum Woodland is in fact commensurate with the EEC River-flat Eucalypt Forest on Coastal Floodplains.

- Two additional specimens of *Tetratheca juncea* were found near the southern boundary in the south-western corner of the subject site.

- *Cryptostylis hunteriana* was not recorded on site during targeted threatened flora surveys in January 2009.

Following a meeting with *Lake Macquarie City Council* in July 2008, this report has been updated to address the findings of the peer review which were deemed relevant. A full response to each of the issues raised within the peer review report is provided at section 5.

1.6 Site description

The subject site adjoins the western side of the township of Wyee Point, with frontage of approximately 300m to Lake Macquarie and an unnamed tidal creek and is approximately 36ha in size. The subject site is bounded by residential development to the east, natural bushland to the west, a mosaic of natural bushland and rural holdings to the south and Lake Macquarie to the north. The eastern half of the southern boundary adjoins a cleared electricity transmission line easement with natural bushland on the opposite side. An indent of approximately 200x400 metres in the south-western corner contains several rural residences in moderately disturbed bushland. The approximate coordinates for the site are 361250E and 6332000N.

Geology

The geology of the subject site is predominantly characterised by Teralba Conglomerates of the Newcastle Coal Measures, which are within the Permian Period. As is typical of that sequence, the soils are shallow and gravelly. A strip of Quaternary alluvium occurs along the foreshore with moderately heavy and salty soil. From the soil mapping of the Gosford and Lake Macquarie 1:100000 map sheet, it is apparent that the soils of the subject site are characterised by the Awaba, Wyong and Doyalson Soil Landscapes.

Topography

The subject site has a generally northerly aspect with gradients between 2-10%. Steeper gradients occur where the Awaba Soil Landscape adjoins the Wyong Soil Landscape, while the Wyong Soil Landscape is generally characterised by near level gradients. The approximate elevation of the subject site is between 0-35 metres Australian Height Datum (AHD).

Drainage

A number of small, poorly defined, drainage lines cross the study area in a generally south to north direction, passing through the centre of the subject site, the west of the subject site and the north east of the subject site. These poorly defined drainage lines (together with overland flow) direct all runoff from the subject site into Lake Macquarie, the edge of which adjoins the northern boundary of the subject site. Approximately 15-20% of this runoff would flow into the unnamed creek that adjoins the north western boundary of the subject site and flows into Lake Macquarie.

Vegetation

The whole of the subject site is covered by open forest with a variable shrub layer and dense groundcover of herbs and grasses. The low-lying area adjoining Lake Macquarie contains a mosaic of overlapping open woodland, mangrove, herb-field and grassland communities.

The vegetation of the subject site is part of a vegetation corridor extending from Wyee Point to Morisset.

Conservation Reserves

The nearest conservation reserve is the Morisset section of *Lake Macquarie State Recreation Area (SRA)*, located on the opposite side of a tidal creek that makes up part of the north-western boundary. Other nearby conservation reserves are the Chain Valley Bay section of *Lake Macquarie SRA* (approximately 5 km to the east), the Point Wollstoncroft section of *Lake Macquarie SRA* (approximately 5 km to the north east) and *Munmorah State Recreation Area* (approximately 7 km to the south east).

Land Use

The subject site was subdivided for residential development in the 1880's, but after clearing and preliminary development of roads the development was abandoned. Since then the land does not appear to have been used for any purpose.

The study area landscape has been affected by the following impacts:

- *Improvements:* Residential development has been undertaken to the east and rural residential development occurs to the south-west of the subject site.

- *Clearing:* Previous road construction occurred in the late 1800's and has since regenerated. Smaller trees together with a scattered arrangement of larger trees dominate most of the site. This indicates that a substantial amount of the area may have been cleared during the abandoned development and allowed to regenerate.

- *Bushfire:* There is evidence of recent wildfire in the western half of the subject site, while variations in the understorey of the eastern half are commensurate with hazard reduction or back-burning activities.

- *Agriculture:* There are no signs of recent agriculture.

- *Earthworks:* No major earthworks have been conducted within the subject site.

- *Introduced weeds:* The subject site has been impacted by a variety of introduced weeds adjacent to; the residential areas, within the Forest Red Gum Woodland community and along the foreshore and Open Forest community immediately above. The remainder of the subject site is relatively free of weeds.

- *Feral, Introduced and Domestic Fauna:* Native fauna within the subject site is likely to have been impacted upon by the predation of European Red Fox (*Vulpes vulpes*), Cats (*Felis catus*) and Dogs (*Canis familiaris*).

- *Habitat Disturbance:* In general, the previously listed impacts have not impacted upon the habitat quality of the subject site for species of flora and fauna.

SECTION 2 – SURVEY TECHNIQUES

Licences –

Individual staff members are licensed under Clause 20 of the National Parks and Wildlife (Land Management) Regulation 1995 and Section 120 & 131 of the National Parks and Wildlife Act, 1974 to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: S10359 & S10618.

The staff of Travers environmental are licensed under an Animal Research Authority issued by the Department of Agriculture. This authority allows Travers environmental staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

2.1 Flora survey techniques

Literature Review - A review of available literature for the area was undertaken to obtain reference material and background information for this survey. These documents are listed in the Bibliography section of this report.

Database Searches - The Atlas of NSW Wildlife (DECC 2008) threatened flora records for the Gosford and Lake Macquarie 1:100,000 Scale Map Sheets were analysed to provide a predictive list of threatened flora species that occur locally and could possibly occur throughout the habitats identified within the subject site.

Aerial Photograph Interpretation - Aerial photographs at 1:25,000 scale were utilised to identify the extent of vegetation with respect to the site and surrounding areas.

Targeted Threatened Flora Surveys

- *Tetratheca juncea:* An intensive targeted survey of two hours duration by two teams of two botanist / ecologists was completed on 11 February 2000 (a total of eight person hours) to search for *Tetratheca juncea* throughout the Scribbly Gum Open Forest – Dry Understorey and parts of the Scribbly Gum Open Forest – Moist Understorey. The survey for *Tetratheca juncea* also targeted the threatened species *Cryptostylis hunteriana* on 28 August 2000. Additional targeted surveys were also undertaken on 14 September and 9 October 2000 and 2, 3, 4 and 24 January 2002 for these species over the entire subject site. As a response to the peer review, further additional survey for *Tetratheca juncea* was undertaken on 14, 22 and 28 August, 5 September and 8 and 9 October 2008. Total survey effort was 64.5 hours.

- *Acacia bynoeana*: An intensive targeted survey of two hours duration by two teams of two botanist / ecologists (i.e. 8 person hours) was completed on 11 February 2000 to search for *Acacia bynoeana* throughout the Scribbly Gum Open Forest – Dry Understorey. Additional survey was also undertaken on 2, 3, 4 and 24 January 2002. Total survey effort was 26.0 hours.

- *Diuris praecox:* An intensive targeted survey was completed on 28 August 2000 and 2, 3, 4 and 24 January 2002 to search for *Diuris praecox* within the subject site. Additional survey of this species was undertaken in 2008 after the peer review. This included approximately 10.5 hours of searches over 14, 22 and 28 August and 5 September 2008. Total survey effort was 32.5 hours.

- *Caladenia tessellata:* An intensive targeted survey by botanists (totalling 22 hours) was completed on 14 September 2000 and 2, 3, 4 and 24 January 2002 to search for *Caladenia tessellata* within the subject site.

- *Cryptostylis spp*.: An intensive targeted survey of two hours duration by botanists (totalling 4 hours) was completed on 14 September 2000. Additional targeted survey was also undertaken on 11 February 2001, 2, 3, 4 and 24 January 2002. Additional survey of this species was undertaken in 2009 after the peer review. This included approximately 3.17hrs on 28 January 2009. Total survey effort was 33.17 hours.

- *Additional Botanical Survey*: Additional botanical survey including targeted searches for *Angophora inopina*, *Callistemon linearifolius*, *Grevillea parviflora* subsp. *parviflora*, *Melaleuca biconvexa*, *Rutidosis heterogama* and *Syzygium paniculatum* that were undertaken on 2, 3, 4 and 24 January 2002.

- EEC's: A field survey to ascertain the boundaries of the endangered ecological communities Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF), Coastal Saltmarsh and River-flat Eucalypt Forest (RFEF) was undertaken on 7 December 2000 and again in October 2008 to January 2009.

Systematic Flora Survey - Flora survey was undertaken using a systematic stratified sampling regime within each of the identified vegetation communities. This comprised the placement of nineteen (19) 20x20 metre quadrats, twenty-one (21) walking transects and observations of 100 metre transects on 2 & 7 February 2000, 28 August and 14 September 2000, 26 March 2002, 18 June 2004 and 7 March 2007. The flora survey targeted all vegetation communities present within the subject site. Random meanders (Cropper 1993) were undertaken throughout the site. The locations of flora survey transects are shown in Figure 4. A grid based survey was conducted in October 2008 within the north-east portion of the subject site as described above to clarify the vegetation communities.

Field survey incorporating a grid based assessment of the Forest Red Gum Woodland was undertaken on 8, 9 & 13 October 2008. The first step in the grid based assessment was to overlay points separated by 50m onto a *Trimble* GPS unit within the area marked as Forest Red Gum Woodland and immediate surrounds. This was taken into the field where 10x10metre quadrats were performed at each 50m location, totalling 30 quadrats which were done over 8 & 9 October. Assessment of these quadrats found seven (7) to be highly consistent with the EEC – River-flat Eucalypt Forest on Coastal Floodplains, whilst the remainder of quadrats had less indicative species, some of which in the western portion of survey (centre of site) indicated Swamp Sclerophyll Forest on Coastal Floodplains as previously shown in figures on the Flora and Fauna Assessment dated January 2008. The second step of the grid based survey dissected the grid so that additional quadrats were assessed at 25m spacings in areas thought to be near the boundary of the EEC. This resulted in an additional 21 quadrats of 10x10m to be assessed, or 51 in total during October 2008. The result of this intensive survey resulted in vegetation boundary changes and redefinition to show a community representative of River-flat Eucalypt Forest.

Whilst undertaking grid based surveys, two lines were plotted to show the extent of both *Casuarina glauca* (October 2008) and *Eucalyptus tereticornis* (January 2009). Discussions on methodology were discussed between *Travers environmental* and peer reviewer Stephen Bell. Mr Bell undertook analysis of the grid based quadrat data via split window statistical methodology. This resulted in a small vegetation community boundary inconsistency which was discussed on site in January 2009. Mr Bell advised that the vegetation boundary of the River-flat Eucalypt Forest would be better defined by the overstorey presence of *Eucalyptus tereticornis* because of the disturbance to the ground layer by way of dominance of *Lomandra longifolia* due to a lack of fire. Mr Bell advised that if there was an individual of *Eucalyptus tereticornis* well outside of a more clumped area of this species, it would be inappropriate to name it as part of the EEC. Consequently, *Travers environmental* used a *Trimble* GPS (25th Jan, 2009) to plot the extent of the *Eucalyptus tereticornis.* The result of which extended the River-flat Eucalypt Forest EEC uphill by a few metres in most instances. In addition, the Scribbly Gum Open Forest with Moist Understorey adjoining to this EEC was redefined because of the moderate influence of both *Eucalyptus tereticornis* and *Eucalyptus robusta.* As such the area for both River-flat Eucalypt Forest and Swamp Sclerophyll Forest on Coastal Floodplains was extended, and henceforth, the ecotonal vegetation community (7 in the December report) was removed.

Targeted orchid survey for *Diuris praecox* was undertaken in August-September 2008 and for *Cryptostylis hunteriana* in January 2009 following the peer review *Murray and Bell.*

Accuracy of Identification - Specimens of plants not readily discernible in the field were collected for identification. Structural descriptions of the vegetation where relevant were made according to Specht *et. al.* (1995).

Table 1: Survey Methods For Target Flora Species

COMMON NAME **Scientific Name**	**Survey Method Used**	**Flowering Period**	**Survey Effort**
Acacia bynoeana	Field traverses (Random Meander Method)	Summer Difficult to identify without flowers	11/02/00 – 8 pers hrs 2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs
Angophora inopina	Field traverses (Random Meander Method)	Summer/Autumn Identifiable without flowers	2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs
Caladenia tessellata	Field traverses (Random Meander Method)	Spring/Summer Difficult to identify without flowers	14/09/00 – 4 pers hrs 2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs
Callistemon linearifolius	Field traverses (Random Meander Method)	Spring/Summer identifiable without flowers	2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs
Cryptostylis hunteriana	Field traverses (Random Meander Method)	November - February Not possible to identify without flowers	14/09/00 – 4 pers hrs 11/02/01 – 8 pers hrs 2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs 28/01/09 – 3.17pers hrs
Diuris praecox	Field traverses (Random Meander Method)	August Difficult to identify without flowers	28/08/00 – 4 pers hrs 2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs 14/08/08 – 3.42 pers hrs 22/08/08 – 2.17 pers hrs 28/08/08 – 2.25 pers hrs 5/09/08 – 2.67 pers hrs
Grevillea parviflora	Field traverses	Spring/Summer	2/01/02 – 6 pers hrs

Table 1: Survey Methods For Target Flora Species			
COMMON NAME **Scientific Name**	**Survey Method Used**	**Flowering Period**	**Survey Effort**
subsp. *parviflora*	(Random Meander Method)	Identifiable without flowers	3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs
Melaleuca biconvexa	Field traverses (Random Meander Method)	Summer Identifiable without flowers	2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs
Rutidosis heterogama	Field traverses (Random Meander Method)	Spring / Summer Not possible to identify without flowers	2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs
Syzygium paniculatum	Field traverses (Random Meander Method)	Summer Identifiable without flowers	2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs
Tetratheca juncea	Field traverses (Random Meander Method)	July - December Difficult to identify without flowers	11/02/00 – 8 pers hrs 28/08/00 – 8 pers hrs 14/09/00 – 8 pers hrs 9/10/00 – 8 pers hrs 2/01/02 – 6 pers hrs 3/01/02 – 6 pers hrs 4/01/02 – 4 pers hrs 24/01/02 – 2 pers hrs 14/08/08 – 3.42 pers hrs 22/08/08 – 2.17 pers hrs 28/08/08 – 2.25 pers hrs 5/09/08 – 2.67 pers hrs 8/10/08 – 2 pers hrs 9/10/08 – 2 pers hrs

2.2 Fauna survey techniques

Literature Review - A review of available literature for the area was undertaken to obtain reference material and background information for this survey. These documents are listed in the bibliography of this report.

Database Searches - The Atlas of NSW Wildlife (DECC 2008) threatened fauna records for the Gosford and Lake Macquarie 1:100,000 Scale Map Sheet were analysed to provide a predictive list of threatened fauna species that occur locally and could possibly occur throughout the habitats identified within the subject site.

Field Survey - Survey dates, times, weather conditions and methods employed are shown in Table 2 below. The location of fauna survey is presented in Figure 5.

TABLE 2 - Fauna Survey Details / Effort				
Target Group	**Date**	**Weather Conditions**	**Survey Method**	**Survey Effort / Time**
Diurnal Birds				
Broad-billed Sandpiper *Limicola falcinellus*	07/02/00	Fine 0/8 cloud 23°C, 2km wind no rainfall	Diurnal Observation	1hr 6.00pm – 7.00pm
	08/02/00	Fine 0/8 cloud 26°C, 1km wind no rainfall	Diurnal Observation	2.5hrs 6.30am – 9.00am 2hrs 5.00pm – 7.00pm
Diamond Firetail *Stagonopleura guttata*	09/02/00	Fine 1/8 cloud 25°C, no wind no rainfall	Diurnal Observation	2.5hrs 6.30am – 9.00am 2 hr 5.00pm – 7.00pm
Grey-crowned Babbler Pomatstomus temporalis temporalis	03/05/00	Fine 0/8 cloud 15°C, 2km SW wind no rainfall	Diurnal Observation *	1.5 hr 9.25am – 10.55am
	18/05/00	Fine 0/8 cloud 18°C, no wind no rainfall	Diurnal Observation *	1.5hrs 3.45pm – 5.15pm
	19/05/00	Fine 0/8 cloud 12°C, no wind no rainfall	Diurnal Observation *	1.5hrs 7.30am – 9.00am
	30/05/00	Overcast 5/8 cloud 15°C, 3km SE wind no rainfall	Diurnal Observation / Tree Survey*	4hrs 11.00am - 3.00pm
Hooded Robin *Melanodryas ucullate cucullata*	23/06/00	Fine 0/8 cloud 16°C, no wind no rainfall	Diurnal Observation *	1.5hrs 7.30am – 9.00am
	20/07/00	Fine 2/8 cloud 18°C, 2km NW wind no rainfall	Diurnal Observation *	1.5hrs 1.00pm – 2.30pm
Painted Honeyeater *Grantiella picta*	20/03/02	Fine 0/8 cloud 25°C, no wind no rainfall	Diurnal Observation*	1.5hrs 4.30pm – 6.00pm
	21/03/02	O/cast 6/8 cloud 20°C, no wind no rainfall	Diurnal Observation*	1hr 7.30am – 8.30am
Pied Oystercatcher *Haematopus longirostris*	21/03/02	Fine 4/8 cloud 25°C, no wind no rainfall	Diurnal Observation for Glossy Black-Cockatoo, Brown Treecreeper & all birds	2hrs 10.30pm – 12.30pm
	22/03/02	O/cast 7/8 cloud 20°C, 5k wind no rainfall	Black-Cockatoo, Brown Treecreeper & all birds	1hr 9.30am - 10.30am
Black-chinned Honeyeater *Melithreptus gularis gularis*	26/03/02	Fine 2/8 cloud 20°C, no wind no rainfall	Black-Cockatoo, Brown Treecreeper & all birds	1hr 7.00am – 8.00am
	14/02/07	0/8 cloud, light NE wind, temp 29°C, no rainfall	Diurnal Bird Census, Opportunistic	5.5hrs 12.30 – 1800
Sooty Oystercatcher Haematopus fuliginosus	02/03/07	0/8 cloud, no wind, temp 25°C, no rainfall	Diurnal Bird Census, Opportunistic	2hrs 50mins 9.10 – 1200
Speckled Warbler *Pyrrholaemus sagittata*				
Turquoise Parrot *Neophema pulchella*				

TABLE 2 - FAUNA SURVEY DETAILS / EFFORT (cont'd)				
Targeted Diurnal Bird Survey				
	03/05/00	Fine 0/8 cloud 15°C, 2km SW wind no rainfall	Diurnal Observation *	1.5hrs 9.25am – 10.55am
	18/05/00	Fine 0/8 cloud 18°C, no wind no rainfall	Diurnal Observation *	1.5hrs 3.45pm – 5.15pm
	19/05/00	Fine 0/8 cloud 12°C, no wind no rainfall	Diurnal Observation *	1.5hrs 7.30am – 9.00am
	30/05/00	Overcast 5/8 cloud 15°C, 3km SE wind no rainfall	Diurnal Observation / Tree Survey*	4hrs 11.00am - 3.00pm
Target surveys for Glossy Black-Cockatoo, Regent Honeyeater and Swift Parrot.	23/06/00	Fine 0/8 cloud 16°C, no wind no rainfall	Diurnal Observation *	1.5hrs 7.30am – 9.00am
	20/07/00	Fine 2/8 cloud 18°C, 2km NW wind no rainfall	Diurnal Observation *	1.5hrs 1.00pm – 2.30pm
(opportunistic recordings of other birds also made)	20/03/02	Fine 0/8 cloud 25°C, no wind no rainfall	Diurnal Observation*	1.5hrs 4.30pm –6.00pm
	21/03/02	O/cast 6/8 cloud 20°C, no wind no rainfall	Diurnal Observation*	1hr 7.30am – 8.30am
	21/03/02	Fine 4/8 cloud 25°C, no wind, no rainfall	Diurnal Observation for Glossy Black-Cockatoo, Brown Treecreeper & all birds	2hrs 10.30pm – 12.30pm
	22/03/02	O/cast 7/8 cloud 20°C, 5k wind no rainfall		1hr 9.30am - 10.30am
	26/03/02	Fine 2/8 cloud 20°C, no wind no rainfall	Black-Cockatoo, Brown Treecreeper & all birds	1hr 7.00am – 8.00am
Target surveys for Osprey, Black-necked Stork and Black Bittern	20/03/02	Fine 0/8 cloud 25°C, no wind no rainfall	Diurnal Observation*	1.5hr 4.30pm – 6.00pm
	21/03/02	O/cast 6/8 cloud 20°C, no wind no rainfall	Diurnal Observation*	1hr 7.30am – 8.30am
	21/03/02	Fine 4/8 cloud 25°C, no wind, no rainfall	Diurnal Observation for Glossy Black-Cockatoo, Brown Treecreeper & all birds	2hrs 10.30pm – 12.30pm
(opportunistic recordings of other birds also made)	22/03/02	O/cast 7/8 cloud 20°C, 5k wind no rainfall		1hr 9.30am - 10.30am
	26/03/02	Fine 2/8 cloud 20°C, no wind no rainfall	Black-Cockatoo, Brown Treecreeper & all birds	1hr 7.00am – 8.00am
	07/02/00	Fine 0/8 cloud 23°C, 2km wind no rainfall	Diurnal Observation	1hr 6.00pm – 7.00pm
	08/02/00	Fine 0/8 cloud 26°C, 1km wind no rainfall	Diurnal Observation	2.5hrs 6.30am – 9.00am 2hrs 5.00pm – 7.00pm
	09/02/00	Fine 1/8 cloud 25°C, no wind no rainfall	Diurnal Observation	2.5hrs 6.30am – 9.00am 2hrs 5.00pm – 7.00pm
	03/05/00	Fine 0/8 cloud 15°C, 2km SW wind no rainfall	Diurnal Observation *	1.5hrs 9.25am – 10.55am
	18/05/00	Fine 0/8 cloud 18°C, no wind no rainfall	Diurnal Observation *	1.5hrs 3.45pm – 5.15pm
	19/05/00	Fine 0/8 cloud 12°C, no wind no rainfall	Diurnal Observation *	1.5hrs 7.30am – 9.00am
Target survey for Brown Treecreeper *Climacteris picumnus victoriae*	30/05/00	Overcast 5/8 cloud 15°C, 3km SE wind no rainfall	Diurnal Observation / Tree Survey*	4hrs 11.00am - 3.00pm
	23/06/00	Fine 0/8 cloud 16°C, no wind no rainfall	Diurnal Observation *	1.5hrs 7.30am – 9.00am
	20/07/00	Fine 2/8 cloud 18°C, 2km NW wind no rainfall	Diurnal Observation *	1.5hrs 1.00pm – 2.30pm
	20/03/02	Fine 0/8 cloud 25°C, no wind no rainfall	Diurnal Observation*	1.5hrs 4.30pm – 6.00pm
	21/03/02	O/cast 6/8 cloud 20°C, no wind no rainfall	Diurnal Observation*	1hr 7.30am – 8.30am
	21/03/02	Fine 4/8 cloud 25°C, no wind no rainfall	Diurnal Observation	2hrs 10.30pm – 12.30pm
	22/03/02	O/cast 7/8 cloud 20°C, 5km wind no rainfall	Diurnal Observation	1hr 9.30am - 10.30am
	26/03/02	Fine 2/8 cloud 20°C, no wind no rainfall	Diurnal Observation	1hr 7.00am – 8.00am

TABLE 2 - TARGETED THREATENED FAUNA SURVEY DETAILS / EFFORT (cont'd)				
Nocturnal Birds				
Masked Owl	07/02/00	Fine 0/8 cloud 23°C, 2km wind no rainfall	Owl call playback	1hr 8.00 - 9.00pm
Tyto novaehollandiae	08/02/00	Fine 0/8 cloud 26°C, 1km wind no rainfall	Owl call playback	1hr 8.00 - 9.00pm
	22/08/00	4/8 cloud, temp 14°C, 11-19kph NW wind, no rain	Owl call playback	30mins 6.30 – 7.00pm
Powerful Owl	23/08/00	1/8 cloud, temp 13°C, 6-11kph N wind	Owl call playback	30mins 6.15 – 6.45pm
Ninox strenua	20/03/02	0/8 cloud, 23^0 C, no wind, no rain, 50% moon	Owl call playback	45mins 7.30 pm - 8.15pm
			Spotlight (x2 person)	2hrs 8.00 pm - 9.00pm
Barking Owl	25/03/02	0/8 cloud 20^0 -28^0 C, 5-10k wind, no rain	Hollow Tree Assessment	6hrs 11.30am - 5.30pm
Ninox connivens	25/03/02	0/8 cloud,20^0 C, 5-10k wind, no rain, 75% moon	Owl call playback	40mins 7.40pm – 8.20pm
			Spotlight (x2 person)	3hrs 7.40pm - 9.10pm
Eastern Grass Owl	26/03/02	-	Owl call playback	30mins 9.00pm – 9.30pm
Tyto capensis			Spotlight (x2 person)	4hrs 7.30 pm - 9.30pm
	18/06/04	-	Habitat Search	6hrs 11.30am - 5.30pm
	14/02/07	0/8 cloud, no wind, temp 23°C	Owl Call Playback, Spotlighting	1.45hrs 8.15pm – 10.00pm
	02/10/08	0/8 cloud, 26-24.5^0 C, no wind, no rain, 25% moon	Stag-watching x5	6hr15mins 6.00 pm–7.15pm
	08/10/08	1/8 cloud, 16^0 C, no wind, no rain, 50% moon	Stag-watching x6	8hrs30min 7.00pm-8.25pm
	15/10/08	7/8 cloud, 16.5^0 C, no wind, no rain, late 4/4 moon	Stag-watching x3	6hrs 6.50pm – 8.50 pm
	16/10/08	0/8 cloud, 16^0 C, no wind, no rain, late 4/4 moon	Stag-watching x4	6hrs 40min 7.00pm-8.40pm
	04/11/08	8/8 cloud, 17^0 C, light SE wind, no rain, 25% moon	Stag-watching x5	4hrs 35min 7.40pm-8.35pm
	05/11/08	0/8 cloud, 19^0 C, no wind, no rain, 50% moon	Stag-watching x1	50min 7.45pm – 8.35pm
Arboreal Mammals	07/02/00	Fine 0/8 cloud 23°C, 2km wind no rainfall	Type A and B Elliott Trapping	28 trap nights
			Spotlighting	1.5hrs 7.00 - 8.30 pm
Squirrel Glider	08/02/00	Fine 0/8 cloud 26°C, 1km wind no rainfall	Type A and B Elliott Trapping	28 trap nights
Petaurus norfolcensis			Spotlighting	1.5hrs 7.00 - 8.30 pm
	09/02/00	Fine 1/8 cloud 25°C, no wind no rainfall	Type A and B Elliott Trapping	28 trap nights
Yellow-bellied Glider	10/02/00	Fine 0/8 cloud 27°C, no wind no rainfall	Type A and B Elliott Trapping	28 trap nights
Petaurus australis	22/08/00	4/8 cloud, temp 14°C, 11-19kph NW wind, no rain	Spotlighting	1hr 6.00 – 7.00pm
	23/08/00	1/8 cloud, temp 13°C, 6-11kph N wind	Spotlighting	1hr 6.00 – 7.00pm
Common Planigale	05/09/00	2/8 cloud, temp 15°C, no wind	Type A and B Elliott Trapping	40 trap nights
Planigale maculata	06/09/00	Fine 0/8 cloud 13°C, no wind	Type A and B Elliott Trapping	40 trap nights
	14/02/07	0/8 cloud, no wind, temp 23°C	Spotlighting, Call Playback	1hr 45mins 20.15 – 2200
Koala	14/2–2/3/07	Variable	Hair Tubes	16nights x 5tubes x 7lines
Phascolarctos cinereus				= 560 Trap nights
	02/10/08	0/8 cloud, 26-24.5^0 C, no wind, no rain, 25% moon	Stag-watching x5	6hr15mins 6.00 pm–7.15pm
	08/10/08	1/8 cloud, 16^0 C, no wind, no rain, 50% moon	Stag-watching x6	8hrs30min 7.00pm-8.25pm
	15/10/08	7/8 cloud, 16.5^0 C, no wind, no rain, late 4/4 moon	Stag-watching x3	6hrs 6.50pm – 8.50 pm
	16/10/08	0/8 cloud, 16^0 C, no wind, no rain, late 4/4 moon	Stag-watching x4	6hrs 40min 7.00pm-8.40pm
	04/11/08	8/8 cloud, 17^0 C, light SE wind, no rain, 25% moon	Stag-watching x5	4hrs 35min 7.40pm-8.35pm
	05/11/08	0/8 cloud, 19^0 C, no wind, no rain, 50% moon	Stag-watching x1	50min 7.45pm – 8.35pm

Terrestrial Mammals Long-nosed Potoroo *Potorous tridactylus* Southern Brown Bandicoot *Isoodon obesulus* Spotted-tailed Quoll *Dasyurus maculatus*	07/02/00 08/02/00 09/02/00 10/02/00 05/09/00 06/09/00 07/09/00 08/09/00	Fine 0/8 cloud 23°C, 2km wind no rainfall Fine 0/8 cloud 26°C, 1km wind no rainfall Fine 1/8 cloud 25°C, no wind no rainfall Fine 0/8 cloud 27°C, no wind no rainfall 2/8 cloud, temp 15°C, no wind Fine 0/8 cloud 13°C, no wind Overcast, 8/8 cloud, 25°C, no wind, no rainfall Fine 0/8 cloud 15°C, 19-26kph NE wind	Type A and B Elliott Trapping Type A and B Elliott Trapping Type A and B Elliott Trapping Type A and B Elliott Trapping Type A and B Elliott Trapping Type A and B Elliott Trapping Type A and B Elliott Trapping Type A and B Elliott Trapping Type A and B Elliott Trapping	42 trap nights 42 trap nights 42 trap nights 42 trap nights 20 trap nights 20 trap nights 20 trap nights 20 trap nights
	20/03/02 21/03/02 22/03/02 25/03/02 26/03/02 21-27/03/02	2/8-6/8 cloud, 23°C-32° C, no wind, overnight rainfall, 50% moon. Fine 0/8 cloud 22°C, no wind, no rainfall O/cast 7/8 cloud 20°C,10k wind no rainfall Fine 0/8 cloud 20°C, 5-10k wind no rainfall 75% moon Fine 0/8 cloud 20°C, 5-10k wind no rainfall 75% moon Variable, Fine to Rainy, Temp 20°C-32° C Wind 0-10k.	Type A and B Elliott Trapping Spotlighting (x2 person) Type A and B Elliott Trapping Type A and B Elliott Trapping Spotlighting (x2 person) Spotlighting (x2 person) Hair Tubes	35 trap nights 2hrs 8.00pm - 9.00pm 35 trap nights 35 trap nights 3hr 7.40pm - 9.10pm 4hrs 7.30 - 9.30pm Total Trap Nights 105 6 nights X 5traps x 7lines = 210 Trap Nights
	14/02/07 14/02 – 02/03/07	0/8 cloud, no wind, temp 23°C Variable	Spotlighting Hair Tubes	1hr 45mins 20.15 – 2200 16nights x 5tubes x 7lines = 560 Trap nights
Bats Grey-headed Flying-fox *Pteropus poliocephalus* Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* Eastern False Pipistrelle *Falsistrellus tasmaniensis* *Eastern Freetail-bat* *Mormopterus norfolkensis* Greater Broad-nosed Bat *Scoteanax rueppellii*	07/02/00 08/02/00 22/08/00 23/08/00 20/03/02 25/03/02 26/03/02 14/02/07 02/10/08 08/10/08 15/10/08 16/10/08	Fine 0/8 cloud 23°C, 2km wind no rainfall Fine 0/8 cloud 26°C, 1km wind no rainfall Fine 1/8 cloud 14°C, no wind Fine 0/8 cloud 15°C, 10kph NW wind 0/8 cloud, 23° C, no wind, no rain, 50% moon 0/8 cloud,20° C, 5-10k wind, no rain, 75% moon 6/8 cloud,21°C, no wind, no rain , 85% moon 0/8 cloud, no wind, temp 23°C 0/8 cloud, 26-24.5° C, no wind, no rain, 25% moon 1/8 cloud, 16° C, no wind, no rain, 50% moon 7/8 cloud, 16.5° C, no wind, no rain, late 4/4 moon 0/8 cloud, 16° C, no wind, no rain, late 4/4 moon	Anabat II Anabat II Anabat II x 2 Anabat II x 2 Harp Trapping x 3 traps Anabat II x 2 Harp Trapping x 3 traps Anabat II x 2 Harp Trapping x 3 traps Anabat II x 2 Spotlighting, Call Detection Stag-watching x5 Stag-watching x6 Stag-watching x3 Stag-watching x4	3hrs 7.00 - 8.30 pm 3hrs 5.30 - 7.00 pm 2hrs 45mins 5.30 - 6.45 pm & 7.15 - 8.45pm 3hrs 7.40 - 9.10pm 3 Harp Trap nights 3hrs 7.15 - 8.45pm 3 Harp Trap nights 4hrs 7.30 - 9.30pm 3 Harp Trap nights 4hrs 7.50 – 9.50pm 1hr 45mins 8.15 – 10.00pm 6hr15mins 6.00 pm–7.15pm 8hrs30min 7.00pm-8.25pm 6hrs 6.50pm – 8.50 pm 6hrs 40min 7.00pm-8.40pm

TABLE 2 - TARGETED THREATENED FAUNA SURVEY DETAILS / EFFORT (cont'd)				
Bats (Cont'd) Greater Long-eared Bat *Nyctophilus timoriensis* Large-footed Myotis *Myotis adversus* Large-eared Pied Bat *Chalinolobus dwyeri* Little Bentwing-bat *Miniopterus australis* and Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	04/11/08 05/11/08	8/8 cloud, 17^0 C, light SE wind, no rain, 25% moon 0/8 cloud, 19^0 C, no wind, no rain, 50% moon	Stag-watching x5 Stag-watching x1	4hrs 35min 7.40pm-8.35pm 50min 7.45pm – 8.35pm = 9 Harp Trap nights
Reptiles Stephen's Banded Snake *Hoplocephalus stephensii* White-crowned Snake *Cacophis harriettae*	07/02/00 08/02/00 22/08/00	Fine 0/8 cloud 23°C, 2km wind no rainfall Fine 0/8 cloud 26°C, 1km wind no rainfall 4/8 cloud, temp 14°C, 11-19kph NW wind, no rain	Habitat search Habitat search Habitat search	1hr 6.00pm – 7.00pm 1hr 7.00am – 8.00am & 1hr 6.00pm – 7.00pm 1hr 35mins 4.10pm - 5.45pm
	22/03/02 25/03/02	O/cast 7/8 cloud 25°C, 10k wind, o/night rainfall Fine 2/8 cloud, 25°C, 5k wind, no rainfall	Habitat search Habitat search	1 hr 10.00am – 11.00am 1.5hrs 4.00am – 5.30am
	14/02/07 02/03/07	0/8 cloud, light NE wind, temp 29°C 0/8 cloud, no wind, temp 23°C 0/8 cloud, no wind, temp 25°C, no rainfall	Habitat Search, Opportunistic Spotlighting Habitat Search, Opportunistic	5.5hrs 12.30 – 6.00pm 1hr 45mins 8.15-10.00pm 2hrs 50min 9.10am – 1200pm
Amphibians Green and Golden Bell Frog *Litoria aurea* Green Thighed Frog *Litoria brevipalmata* Wallum Froglet *Crinia tinnula*	07/02/00 08/02/00 22/08/00	Fine 0/8 cloud 23°C, 2° wind no rainfall Fine 0/8 cloud 26°C, 1° wind no rainfall 4/8 cloud, temp 14°C, 11-19kph NW wind, no rain	Call Detection Call Detection Habitat search/Call Detection	2.5hrs 6.00pm – 8.30pm 2.5hrs 6.00pm – 8.30pm 1hr35min 4.10pm-5.45pm
	20/03/02 22/03/02 23/03/02 24/03/02 25/03/02 26/03/02 27/03/02	0/8 cloud, 23^0 C, no wind, no rain,50%moon 7/8 cloud,18-20^0C, heavy o/night rain 7/8 cloud, 23°C, slight rain, 5k wind 2/8 cloud, 28°C, no rain, 5k wind Fine 0/8 cloud 20°C, 5-10k wind no rainfall 75% moon " " Fine 4/8 cloud, 25^0C, 5k wind, o/night rain.	Call Detection/ Spotlight Pitfall traps x 2 Pitfall traps x 2 Pitfall traps x 2 Call Detection/ Spotlight Pitfall traps x 2 Call Detection/ Spotlight Pitfall traps x 2 Pitfall traps x 2	3hr 7.40-9.10pm x 2 per set all day and night set all day and night set all day and night 3hr 7.40-9.10pm x 2 per set all day and night 4hrs 7.30-9.30pm x 2 per set all day and night set all day and night
	14/02/07	0/8 cloud, no wind, temp 23°C	Spotlighting, Call Detection	1hr45mins 8.15-10.00pm

2.2.1 Diurnal birds

Diurnal bird surveys were carried out over the whole of the subject site in February, May, June and July of 2000, March 2002, February and March 2007 and August to October 2008. Visual observation and call identification of birds was carried out during visits to the site on all other days of the survey periods.

Targeted surveys for the Glossy Black-Cockatoo, Brown Treecreeper, Black Bittern, Black-necked Stork, Regent Honeyeater, Swift Parrot and Osprey were also undertaken as described below:

Glossy Black-Cockatoo: Diurnal bird census was carried out by *Conacher Travers* in February, May, June and July of 2000, and March 2002. Targeted survey for breeding Glossy Black-Cockatoo was undertaken during the breeding period (May to July 2000) and March 2002. Surveying consisted of searching for chewed cones of *Allocasuarina spp;* within the site as well as visual and aural observation. Potential nesting trees of the subject site were systematically located, mapped and described for the purpose of assessing the sites potential breeding habitat for Glossy Black-Cockatoo. Diurnal visual observations at each of these suitable nesting trees were then undertaken for the purpose of identifying breeding activities. Identified areas of *Allocasuarina littoralis* were also targeted.

Conacher Travers found chewed cones of *Allocasuarina littoralis* during target surveys conducted in 2000 with no visual observation of Glossy Black-Cockatoo made. The chewed cones were consistent with the foraging of Glossy Black-Cockatoos.

Visual observations of Glossy-black Cockatoo were made by *Travers environmental* during recent surveys on 15 October 2008, where three individuals flew into the south eastern corner of the site late in the afternoon at the High Street entry point. These individuals were not observed to forage on-site at this location but later flew off site nearby to forage on street trees (locations shown on Figure 5). There have also been several local reports of Glossy Black-Cockatoos foraging on the site.

Black Bittern and Black-necked Stork: Surveying for Black Bittern and Black-necked Stork were undertaken in the Swamp Oak/ Salt Marsh vegetation community on 20, 21, 22 and 26 March 2002. A Spotting Scope (80mm, 20x60 zoom) was used to survey the creekline and adjoining mudflats. Taped recordings of the call of the Black Bittern were played along the creekline in the late afternoon of 20 March 2002 and in the early morning of 21 March 2002. Despite the presence of suitable habitat for this species no records were obtained. No results of this species occurred in the 2008 survey period.

Osprey: The Swamp Mahogany Open Forest vegetation was surveyed on 20, 21, 22 and 26 March 2002 for evidence of Osprey nesting and roosting. The survey involved visual observation and foot traverses. Despite the presence of suitable habitat for Osprey none have been recorded in surveys; however an adult and juvenile White-bellied Sea Eagle were observed roosting within and above the subject site. No results of this species occurred in the 2008 survey period.

Brown Treecreeper: A Brown Treecreeper record was obtained from surveys in May 2000 by *Conacher Travers*. The location of the recording of this species within the subject site was not depicted on Figure 3 as the Brown Treecreeper was not listed as a threatened species in the *Threatened Species Conservation Act* (1995) until 2001. In light of the change in status of this species, target surveying for Brown Treecreeper was undertaken on 22 and 26 of March 2002 in the Scribbly Gum Open Forest communities. This survey involved visual observation as well as call identification. No Brown Treecreepers were recorded in the 2002 and 2007 surveys. No results of this species occurred in the 2008 survey period.

Swift Parrot and Regent Honeyeater: Despite extensive surveys carried out by *Conacher Travers* in February, May, June and July of 2000, and March 2002, no observations of the Regent Honeyeater or Swift Parrot were made during surveys. No results of this species occurred in the 2008 survey period.

2.2.2 Nocturnal birds

1996 - Woodward Clyde (1996) broadcasted calls of the Powerful Owl and Masked Owl on two nights for 1 hour each night.

2000-2008 - The presence of threatened owls, Sooty Owl (*Tyto tenebricosa*), Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Barking Owl (*Ninox connivens*) were targeted by broadcasting taped calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played for 5 minute periods at 5 minute intervals for 40 minutes. This was followed by 20 minutes of quiet listening and spotlighting during the evenings of February and August 2000, March 2002 June 2004, February 2007 and October 2008.

2004 - Visual inspections of suitable hollow bearing trees were undertaken on 18 June 2004. These inspections targeted "whitewash" and any regurgitated remains near all suitable tree hollows within the site.

2008 - Hollow trees were inspected for owl activity. All hollow trees on the subject site have had their dimensions, number and size of hollows present, and the position of the tree recorded via a GPS. Hollows larger than 40cm entry with other characteristics suitable for the threatened large forest owls were stag-watched during recent 2008 surveys. Additional trees with hollows larger than 30cm entry and indicative signs indicating potential use by other owl species were also stag-watched. A total of 20 trees were stag-watched during recent 2008 surveys.

2.2.3 Arboreal and terrestrial mammals

Elliott type A and B traps were used for trapping small mammals. Both arboreal and terrestrial trap-lines were used. Trapping consisted of a total of 520 trap nights, comprising 272 arboreal trap nights and 248 terrestrial trap nights during surveys conducted by *Conacher Travers* in February and September 2000. A further 210 trap nights were conducted by *Conacher Travers* in March 2002, comprising 105 arboreal trap nights and 105 terrestrial trap nights. Seventy (70) Hair Tubes were also set by *Conacher Travers* for six (6) nights during March 2002, comprising of 210 arboreal and 210 terrestrial tubes making a total of 420 trap nights. A further 70 hair tubes comprising 35 arboreal and 35 terrestrial tubes were set by *Conacher Travers* for sixteen (16) nights for a total of 1120 trap nights from February – March 2007. Spotlighting and Owl call playback were undertaken on 14 February 2007.

In addition, Woodward Clyde (1996) set 50 Elliott type A traps over three nights making a total of 150 terrestrial trap nights. Woodward Clyde also set 20 Hair Tubes over three nights making a total of 60 sample nights.

A terrestrial trap line using 5-metre separation was placed in the most suitable habitat zones throughout the subject site. Arboreal trap-lines using 10 metre separations were placed in the most suitable trees along 100m transects. Elliott type A traps were placed onto platforms that were attached to the trunks of trees 2-3 metres above the ground at an incline of 10 degrees to facilitate drainage during inclement weather. Arboreal hair tubes were attached directly to the trunk of trees facing down by use of elastic bands. A mixture of honey and water was then sprayed onto the trunk 3-5 metres above the trap and around the platform as a lure. The traps were baited with a mixture of rolled oats, honey and peanut butter.

Stag-watching of 20 trees containing hollows suitable for large forest owls were undertaken by *Travers environmental* as part of recent 2008 surveys. This technique simultaneously provides additional survey for arboreal mammals.

Figure 5 depicts arboreal and terrestrial trapping efforts in 2000, 2002 and 2007 as well as stag-watching locations undertaken in 2008.

Assessment was made of 'found' scats, hair samples, markings, diggings, runways and scratches during visits to the site. Habitat was also assessed to determine the likelihood of threatened native species of fauna occurring within the subject site.

Spotlighting for nocturnal fauna was carried out using a hand held lamp of 750,000 candlelight power (100W halogen globe). This technique involved walking amongst the forested parts of the subject site so that a maximum number of trees could be observed.

Woodward Clyde (1996) also spotlighted for a total of three hours.

The subject area was assessed for activity by Koalas using the following methods.

i. A search of the Atlas of NSW Wildlife (DECC 2008) database.

ii. The site was surveyed on foot, with Koala food trees being inspected for signs of Koala usage. Trees were inspected and identified for the presence of Koalas, characteristic scratch and claw marks on the trunk and scats around the base of each tree. The proportion of trees showing signs of Koala use was calculated. Additionally the location and density of droppings if found were documented.

iii. Koalas were also targeted during spotlight surveys.

iv. Identification and an assessment of the density of tree species listed as Koala feed trees in State Environmental Protection Policy No. 44 - Koala Habitat Protection was undertaken across the site. An estimate of the percentage density of each tree species across the site was determined by averaging the percentage of stems counted.

2.2.4 Bats

Microchiropteran bats were surveyed by echolocation using an Anabat Mk 2 detector in positions throughout the entire subject site representing each vegetation community and varying foraging structures.

Harp trapping was undertaken on the nights of 20, 25 & 26 March 2002 with a total of 9 Harp trap nights.

Spotlighting targeting flowering eucalypts was undertaken in order to target megachiropteran bats.

Stag-watching of 20 trees containing hollows suitable for large forest owls have been undertaken by *Travers environmental* as part of recent 2008 surveys. This technique simultaneously provides additional survey for micro-chiropteran bat roost locations.

Woodward Clyde (1996) also set an Anabat for a total of 1.5 hours over two nights.

2.2.5 Amphibians

Amphibians were surveyed by vocal call identification, by using a tape recorder to record male calls in suitable places and then comparing these to known calls. Amphibians were also surveyed by habitat searches.

Any amphibians found are visually identified and when required to be examined are handled with Latex gloves and kept moist until release.

2.2.6 Reptiles

Searches for reptiles in likely localities such as under logs, rubbish debris, and in deep leaf litter were carried out during diurnal visits to the site. Spotlighting of terrestrial habitats suitable for reptiles occurred during nocturnal surveys.

SECTION 3 – SURVEY RESULTS

3.1 Flora results

Observations

A total of 290 species of plants were observed within the subject site during *Conacher Travers* surveys (2000), (2002), (2007) and recent *Travers environmental* surveys (2008). Of these, 230 species were native plants and 60 species were exotic. The native species observed consisted of 20 trees, 50 shrubs, 20 vines, 134 herbs and 6 ferns. The plants observed are listed in Table 3. Methodology utilised throughout the duration of field surveys is presented in Section 2. Survey locations are depicted in Figure 4A and 4B.

Six (6) vegetation communities were identified within the subject site using aerial photographic interpretation and extensive ground truthing:

- Scribbly Gum Open Forest – Dry Understorey
- Scribbly Gum Open Forest – Moist Understorey
- Forest Red Gum Woodland
- Swamp Mahogany – Smooth-barked Apple – Scribbly Gum Woodland
- Swamp Mahogany Woodland
- Swamp Oak Woodland / Saltmarsh

The previous flora and fauna assessment (December 2008) of the subject site identified seven (7) vegetation communities.

A discussion with representatives from *Travers environmental, Woromar Pty Ltd, East Coast Flora Surveys* and *Lake Macquarie City Council* was held onsite on 22 October 2008 to discuss the proposed boundary of the River-Flat Eucalypt Forest (EEC) based on the new flora assessment quadrat data. The outcome of the meeting was a practical methodology and assessment used to define the EEC boundary was deemed adequate.

Discussions of the newly defined boundary of the River-flat Eucalypt Forest (Forest Red Gum Woodland – vegetation community 3) were analysed by Stephen Bell of *East Coast Flora Surveys.* The statistical analysis he undertook showed some minor discrepancies between the data provided to him and the figure (4b). An on site meeting with the client or *Woromar Pty Ltd*, Stephen Bell and staff of *Travers environmental* was undertaken in January 2009 to finalise the EEC boundary mapping and as a response to the boundary review in late 2008 (Appendix 3). The boundary of the River-flat Eucalypt Forest was defined by Mr Bell (*pers. comm.*) to be the line of *Eucalyptus tereticornis* as these are representative of the overstorey nature of this community. The ground layer shows considerable disturbance and would poorly represent this community hence the overstorey nature of existing Eucalypt species were needed to be taken into consideration. *Travers environmental* agreed with Mr Bell on his field interpretation and additional plotting was undertaken of the *Eucalyptus tereticornis* extent which led to the most recent change of the EEC boundaries which were moved slightly

uphill to incorporate the extent of this species. Also as a result, the 7th vegetation community which was described as an ecotone between vegetation communities 1 and 3 – referred to as Open Forest (Smooth-barked Apple & Redgum Forest) was deleted due to the line separating the *Eucalyptus tereticornis* was defined as the boundary of the River-flat Eucalypt Forest.

3.2 Fauna results

Observations

A total of 128 species were observed within the subject site during *Conacher Travers* surveys (2000), (2002), (2007), recent *Travers environmental* surveys (2008) and *Woodward & Clyde* surveys in 1996 and 2000. This number comprised 86 bird, 27 mammal, 6 reptile, 8 amphibian, and 1 mollusc species. The majority of the species listed in Table 5 are considered to be relatively common in the local area. Five (5) threatened species were detected within the subject site during surveys. These species were Squirrel Glider (*Petaurus norfolcensis*), Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Brown Treecreeper (*Climacteris picumnus*) and Eastern Freetail-bat (*Mormopterus norfolkensis*). The location of the Grey-headed Flying-fox observations by Woodward & Clyde (1996) are unknown. The location of the Brown Treecreeper was not recorded at the time of survey as this species was not listed as threatened at the time of recording.

Species observed throughout the duration of fauna surveys are listed in Table 5.

SECTION 4 – ECOLOGICAL ASSESSMENT

4.1 Previous surveys reviewed

This report has identified species of flora and fauna and habitat that have been recorded within the subject site. The results have indicated that there are seven vegetation communities and habitat types throughout the subject site and a variety of flora and fauna species (including one threatened flora species and five threatened species of fauna).

- A survey of the natural vegetation throughout the Gosford & Lake Macquarie 1:100,000 map sheet classified the vegetation within and adjacent to the subject site as 9g - Open Forest 27a – Sedgeland, Closed Scrub or Open Forest (Benson, 1992). The 9g Open Forest vegetation is mapped as occurring on the higher ridges in the south of the site, while the 27a vegetation is mapped as occurring within the lower lying sections of the site in the north, north west and north east. The 27a vegetation unit is identified in the Determination of the Endangered Ecological Community Swamp Sclerophyll Forest on Coastal Floodplains under Part 3, Schedule 1 of the *TSC Act* (1995).

- *Lake Macquarie City Council Flora and Fauna Survey Guidelines - Version 2.0 (2001)* The Guidelines provide information on known locations for threatened species throughout the *Lake Macquarie City Council* area, as well as techniques for surveying those species.

    - *Acacia bynoeana* (less than 1km to the south west);
    - *Cryptostylis hunteriana* (2.5 km to the south west);
    - *Tetratheca juncea* (3km to the south);
    - Regent Honeyeater (*Xanthomyza phrygia*) (4km north west);
    - Wallum Froglet (*Crinia tinnula*) (less than 1 km to the east);
    - Barred River Frog (*Mixophes balbus*) (4km north west);
    - Black Bittern (*Ixobrychus flavicollis*) (less than 1 km to the east);
    - Glossy Black-Cockatoo (*Calyptorhynchus lathami*) (3 km to the north east and south east);
    - Squirrel Glider (*Petaurus norfolcensis*) (5km north west);
    - Eastern Freetail-bat (*Mormopterus norfolkensis*) (2km east); and
    - Large-footed Myotis (*Myotis adversus*) (4km south west).

    The potential for these species to occur within the subject site is assessed within Table 6

- *Lower Hunter and Central Coast Regional Environment Management Strategy Vegetation Survey, Classification and Mapping; Lower Hunter and Central Coast Region (LHCCREMS) (NPWS 2003).* An extensive vegetation mapping survey of the

Lower Hunter and Central coast in which the vegetation within the subject site was identified as a combination of the following map units.

Map Unit	Community Name
30	Coastal Plains Smooth-barked Apple Woodland
31	Coastal Plains Scribbly Gum Woodland
38	Redgum Rough Barked Apple Forest
40	Swamp Oak – Rushland Forest
41	Swamp Oak – Sedge Forest
42	Riparian Melaleuca Swamp Woodland
47	Mangrove-Estuarine Complex
47a	Saltmarsh

The peer review undertaken in June 2008 identified that Map Unit 38 Redgum Rough Barked Apple Forest is equivalent to the EEC – River-flat Eucalypt Forest on Coastal Floodplains.

To clarify this issue, a grid based system was set up whereby 10x10m quadrats were sampled within the questionable area at 50m separations. After initial analysis of these quadrats (30), another 21 quadrats were undertaken at 25m intervals to determine a boundary could be drawn that separates what is now acknowledged as River-flat Eucalypt forest, and an ecotonal area between vegetation on the upper slopes and lower slopes that has a partly moist soil structure. The result is that approximately 60% of that described as Forest Red Gum Forest would become River-flat Eucalypt Forest, with the remaining 40% becoming Open Forest (Smooth-barked Apple & Forest Red Gum). A discussion with representatives from *Travers environmental, Woromar Pty Ltd, East Coast Flora Surveys* and *Lake Macquarie City Council* was held onsite on 22 October 2008 to discuss the proposed boundary of the River-Flat Eucalypt Forest (EEC) based on the new flora assessment quadrat data. The outcome of the meeting was the methodology and assessment used herein to define the EEC boundary was deemed adequate.

The quadrat results were sent to Mr Bell of *East Coast Flora Surveys* who undertook statistical analysis (split window) which after the December report was submitted showed a deviation between the EEC vegetation communities (see Appendix 3). A further site inspection between Mr Bell, staff or *Travers environmental* and *Woromar Pty Ltd* took place on 23rd January 2009 to discuss these deviations. The result of the discussion led to a further redefinition of the EEC boundaries and removal of vegetation community 7. This is shown on Fig 4A/B.

Map Unit 38 described as Redgum Rough Barked Apple Forest in LHCCREMS for this area is not entirely correct. There were no Rough Barked Apple (*Angophora floribunda*) trees observed. The LHCCREMS document states for Map Unit 38 that “this Map Unit is poorly sampled” and “further sampling of this assemblage will tighten the floristic definition and provide more reliable estimations of its distribution”. Only two sites have been sampled to come up with the predictive list for this Map Unit, and a brief look at this indicates that approximately 50% of the shrubs listed and approximately 75% of the ground layer species exist for the subject site as a whole, however quadrat sampling would generally produce lower percentages as not all species within a community would occur in any one quadrat.

- *Flora and Fauna Assessment Study for the Proposed Redevelopment of the Ramsgate Estate Wyee Point (Woodward-Clyde 1996)*

The flora survey of the subject site by *Woodward-Clyde* (1996) recorded the presence of 83 species of flora, including 77 natives and 6 exotics. Furthermore, *Woodward-Clyde* also provided a vegetation community classification for the subject site, identifying six separate vegetation communities. It would appear that the property has been affected by bushfire since the date of the flora survey in 1996, a disturbance factor that is likely to have resulted in the variation of mapped boundaries of the identified vegetation communities. This report stated that five of the identified vegetation Communities were of low-medium conservation status, with the sixth vegetation community (Saline Wetland Complex) being of medium conservation status.

- *Biannual Regent Honeyeater and Swift Parrot Survey Team*

Surveys of Swamp Mahogany's 4.5km to the south east of the subject site, adjacent to the eastern shoreline of Mannering Lake have been conducted twice yearly every year for the past six years. Both Regent Honeyeaters and Swift Parrots have been detected by this survey team within this locality, foraging in Swamp Mahogany trees.

4.2 Vegetation communities

Six (6) vegetation communities were identified within the study area using aerial photographic interpretation and extensive ground truthing. These communities included;

- Vegetation Community 1 – Scribbly Gum Open Forest – Dry Understorey
- Vegetation Community 2 – Scribbly Gum Open Forest – Moist Understorey
- Vegetation Community 3 – Forest Red Gum Woodland
- Vegetation Community 4 – Swamp Mahogany – Smooth-barked Apple – Scribbly Gum Woodland
- Vegetation Community 5 – Swamp Mahogany Woodland
- Vegetation Community 6 – Swamp Oak Woodland / Saltmarsh

Cleared land off the end of Short Street surrounding an existing house occupies approximately 0.3ha (less than 1%) within the subject site.

A brief description of each of these communities is provided below;

Vegetation Community 1 – Scribbly Gum Open Forest – Dry Understorey:

This community, dominated by *Eucalyptus racemosa* (and *haemastoma* near the southern site boundary), occurs at higher elevations and differs from the Scribbly Gum Open Forest – Moist Understorey vegetation community (no. 2) by having a less dense and more diverse understorey. *Melaleuca sieberi* is less common and seldom exceeds 1.5 metres. *Allocasuarina litoralis* is less common and is generally less than 5 metres. The threatened species *Tetratheca juncea* was observed within a small section of this vegetation community (see Figure 4A).

Occurrence - This community occurs in the higher elevation areas, principally in the south-east and south-west of the subject site and covers approximately 52% or 18.6ha of the subject site.

Structure - Open Forest with a canopy cover of approximately 50% and height of approximately 15-25 metres. The understorey consists of a generally sparse shrub layer and moderately dense groundcover of herbs and grasses.

Disturbances - This community appears to have a distant history of at least partial clearing and has been affected by recent fire, particularly to the west.

Classification - This vegetation community is most similar to Map Unit 30 – Coastal Plains Smooth Barked Apple Woodland as described by the Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) vegetation mapping project (NPWS 2003).

Common Species

Trees: *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus resinifera* (Red Mahogany) and *Eucalyptus haemastoma* (Scribbly Gum).

Shrubs: *Acacia myrtifolia* (Red-stem Wattle), *Allocasuarina littoralis* (Black She-oak), *Dodonaea triquetra* (Hop Bush), *Epacris pulchella*, *Gompholobium latifolium* (Golden Glory Pea), *Leptospermum polygalifolium* (Yellow Tea Tree) and *Pimelea linifolia* (Slender Rice Flower).

Groundcovers: *Centella asiatica* (Swamp Pennywort), *Entolasia stricta* (Wiry Panic), *Gonocarpus tetragynus*, *Imperata cylindrica* (Blady Grass), *Lepidosperma laterale* (Variable Sword-sedge), *Panicum simile* (Two Colour Panic), *Pteridium esculentum* (Bracken), *Themeda australis* (Kangaroo Grass) and *Xanthorrhoea latifolia*.

Vegetation Community 2 – Scribbly Gum Open Forest – Moist Understorey:

This community, dominated by *Eucalyptus haemastoma*, occurs at lower elevations and differs from Scribbly Gum Open Forest – Dry Understorey (no. 1) by having a denser and less diverse understorey. *Melaleuca sieberi* is more common and often exceeds 2 metres. *Melaleuca nodosa* is more prevalent and *Gahnia sieberiana* becomes a dominant species. *Allocasuarina littoralis* is more common, often reaching a height of more than 5 metres.

Occurrence - This community occurs in lower elevations, principally toward the centre of the subject site and covers approximately 20% or 7.3ha of the subject site.

Structure - Open forest with a canopy cover of approximately 50% and height of approximately 15-20 metres. The understorey consists of a variable shrub layer from sparse to dense and dense groundcover of herbs and grasses.

Disturbances - This community appears to have a distant history of at least partial clearing and has been affected by a recent bush fire.

Classification - This vegetation community is moister than the above vegetation unit. It is similar to a combination of Map Unit 31 – Coastal Plains Scribbly Gum Woodland and Map Unit 30 Coastal Plains Smooth-barked Apple Woodland as described by the Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) vegetation mapping project (NPWS 2003).

Common Species

Trees: *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus resinifera* (Red Mahogany) and *Eucalyptus haemastoma* (Scribbly Gum).

Shrubs: *Allocasuarina littoralis* (Black She-oak), *Dodonaea triquetra* (Hop Bush), *Leptospermum polygalifolium* (Yellow Tea Tree), *Melaleuca nodosa* and *Melaleuca sieberi*.

Groundcovers: *Centella asiatica* (Swamp Pennywort), *Gahnia sieberiana* (Saw Sedge), *Gonocarpus teucrioides*, *Imperata cylindrica* (Blady Grass) and *Lepyrodia scariosa*.

Vegetation Community 3 – Forest Red Gum Woodland:

Occurrence - This community occurs in the north-eastern corner of the subject site and covers approximately 7% or 2.4ha of the subject site.

Structure - Woodland with a canopy cover of approximately 20% and height of approximately 20 metres. The understorey consists of a very sparse shrub layer and dense, grassy groundcover.

Disturbances - This community appears to have been severely underscrubbed in the past and has been impacted with a variety of exotic species.

Classification - This vegetation community has been described by the LHCCREMS as Map Unit 31 – Scribbly Gum Woodland (NPWS 2003) although recent investigations into this map unit would suggest that it has been misinterpreted for the subject site. This vegetation community is commensurate with the EEC – River-flat Eucalypt Forest.

Common Species

Trees: *Eucalyptus tereticornis* (Forest Red Gum), *Casuarina glauca* (Swamp Oak) and *Allocasuarina littoralis* (Black She-oak).

Shrubs: *Breynia oblongifolia*.

Groundcover: *Entolasia stricta* (Wiry Panic), *Hibbertia scandens* (Golden Guinea Flower), *Imperata cylindrica* (Blady Grass), *Lomandra longifolia* (Spiky-headed Mat-rush) and *Microlaena stipoides* (Weeping Grass).

Weeds: *Axonopus affinis* (Narrow-leaf Carpet Grass), *Briza subaristata*, *Centaurium erythraea* (Pink Stars), *Conyza sumatrensis* (Tall Fleabane), *Hypochaeris radicata* (Flatweed), *Plantago lanceolatus* (Ribwort), *Rubus anglocandicans* (Blackberries) and *Verbena rigida* (Veined Verbena).

Vegetation Community 4 – Swamp Mahogany – Smooth-barked Apple – Scribbly Gum Woodland:

Occurrence - This community occurs in a low-lying area towards the centre of the subject site and covers approximately 4% or 1.6ha of the subject site.

Structure - Woodland with a canopy cover of approximately 25% and height of approximately 15-20 metres. The understorey consists of a moderately dense shrub layer and dense groundcover of herbs and grasses, dominated by sedge.

Disturbances - This community appears to be relatively undisturbed other than by a recent bushfire.

Classification - This vegetation community is most similar to Map Unit 42 – Riparian Melaleuca Swamp Woodland as described by the Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) vegetation mapping project (NPWS 2003).

Common Species

Trees: *Eucalyptus robusta* (Swamp Mahogany), *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus resinifera* (Red Mahogany) and *Eucalyptus haemastoma* (Scribbly Gum).

Shrubs: *Allocasuarina littoralis* (Black She-oak), *Dodonaea triquetra* (Hop Bush), *Leptospermum juniperinum, Melaleuca linariifolia* (Snow in summer), *Melaleuca nodosa* and *Melaleuca sieberi.*

Groundcovers: *Baumea teretifolia* (Soft Twig-rush), *Gahnia sieberiana* (Saw Sedge), *Gonocarpus teucrioides, Goodenia heterophylla* and *Adiantum aethiopicum* (Common Maidenhair).

Vegetation Community 5A & 5B – Swamp Mahogany Woodland:

Variation 5A & 5B - This community has been divided into parts A and B. The floristics and species assemblages are similar in both parts however, part A occurs on soils that are lower lying and are periodically waterlogged.

Occurrence - This community occurs in a low-lying area towards the northern central part of the subject site in the vicinity of the poorly defined drainage line and covers approximately 10% or 3.6ha of the subject site.

Structure - Woodland with a canopy cover of less than 30% and height of approximately 15-20 metres. The understorey consists of a moderately dense shrub layer and dense groundcover of herbs and grasses, dominated by sedge.

Disturbances - This community appears to be relatively undisturbed other than by a recent bushfire.

Classification - This vegetation community is most similar to Map Unit 41 – Swamp Oak Sedge Forest as described by the Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) vegetation mapping project (NPWS 2003).

Common Species

Trees: *Eucalyptus robusta* (Swamp Mahogany) and *Angophora costata* (Smooth-barked Apple).

Shrubs: *Allocasuarina littoralis* (Black She-oak), *Dodonaea triquetra* (Hop Bush), *Leptospermum juniperinum, Melaleuca linariifolia* (Snow in summer), *Melaleuca nodosa* and *Melaleuca sieberi.*

Groundcovers: *Baumea teretifolia* (Soft Twig-rush), *Empodisma minus* (Spreading Rope-rush), *Gahnia sieberiana* (Saw Sedge), *Gonocarpus teucrioides, Goodenia heterophylla* and *Adiantum aethiopicum* (Common Maidenhair).

Vegetation Community 6 – Swamp Oak Woodland / Saltmarsh:

Occurrence - This community occurs along the tidal foreshores where elevation is less than 0.5 AHD and covers approximately 6% or 2.2ha of the subject site.

Structure - A mosaic of overlapping Swamp Oak woodland, mangrove, sedgeland and grassland communities.

Disturbances - This community has been impacted by a variety of exotic species.

Classification - This vegetation community is most similar to a combination of Map Unit 41 – Swamp Oak Sedge Forest and Map Unit 47 – Mangrove Estuarine Complex as described by the Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) vegetation mapping project (NPWS 2003).

Common Species

Trees: *Casuarina glauca* (Swamp Oak).

Shrubs: *Acacia longifolia* (Sydney Golden Wattle) and *Avicennia marina* (Grey Mangrove).

Groundcovers: *Apium prostratum* (Sea Celery), *Baumea juncea* (Jointed Twig-rush), *Fimbristylis ferruginea, Goodenia ovata, Hibiscus trionum* (Bladder Ketmia), *Juncus krausii*, *Samolus repens* (Creeping Brookweed), *Sarcocornia quinqueflora* (Samphire), *Schoenus brevifolius* (Heath Bog-rush), *Selliera radicans*, *Sporobolus virginicus* (Salt-water Couch) and *Suadea australis* (Austral Seablite).

Weeds: *Atriplex prostrata, Conyza sumatrensis* (Tall Fleabane), *Hydrocotyle bonariensis* (Pennywort) and *Physalis peruviana* (Cape Gooseberry).

Vegetation Community 7 – Open Forest (Smooth-barked Apple & Forest Red Gum):

Occurrence - This community occurs as an ecotonal area between the River-flat Eucalypt Forest and Vegetation Community 1 and covers approximately 3% or 1.2ha of the subject site.

Structure - Open Forest with a canopy cover of less than 30% and height of approximately 15-20 metres. The understorey consists of a sparse shrub layer and dense groundcover of herbs and grasses.

Disturbances - This community has been impacted by a variety of exotic species.

Classification - This vegetation community has been described by the LHCCREMS as Map Unit 31 – Scribbly Gum Woodland (NPWS 2003) although recent investigations into this map unit would suggest that it has been misinterpreted for the subject site. Scribbly Gums in this community occur in low proportions.

Common Species

Trees: *Angophora costata* (Smooth-barked Apple) and *Eucalyptus tereticornis* (Forest Red Gum).

Shrubs: *Acacia longifolia* (Sydney Golden Wattle), *Allocasuarina littoralis* (Black She-oak), *Breynia oblongifolia* and *Leptospermum trinervium* (Paperbark Tea-tree).

Groundcovers: *Centella asiatica, Dichondra repens* (Kidney Weed), *Entolasia stricta* (Wiry Panic), *Hibbertia scandens* (Golden Guinea Flower), *Imperata cylindrica* (Blady Grass), *Microlaena stipoides* (Weeping Grass), *Polymeria calycina* (Bindweed) and *Pteridium esculentum* (Bracken).

Weeds: *Conyza sumatrensis* (Tall Fleabane), *Lantana camara* (Lantana) and *Rubus anglocandicans* (Blackberry).

4.3 Vegetation connectivity

The subject site is situated at the apex of Wyee Point, a prominent area of land that extends into the southern margin of Lake Macquarie. Extensive areas of bushland are present throughout this peninsula and to the southwest, west and northwest. The subject site is connected to 400ha of native bushland to the south-west. Fragmented bushland and isolated trees characterise the landscape to the south and east, with large sized bushland remnants present to the east of Government Rd. At this stage the subject site provides a substantial vegetation linkage from areas to the west and northwest with areas to the south and east.

Figure 7C below shows the extent of natural bushland within the local area and the likely connectivity routes.

Figure 7C: Likely connectivity paths for local flora and fauna

4.4 Flora species

The plants observed within the vegetation communities of the subject site are listed in Table 3 below.

One threatened species, *Tetratheca juncea* was observed during the survey.

Three (3) endangered ecological communities Swamp Sclerophyll Forest on Coastal Floodplains, Coastal Saltmarsh and River-flat Eucalypt Forest were observed during the survey.

None of the species listed as regionally significant in the *Lake Macquarie City Council* (2001) Flora and Fauna Survey Guidelines - Version 2.0 were observed during the survey.

None of the species listed as of regional significance by the Flora and Fauna Survey Guidelines Lower Hunter Central Coast Region (LHCCREMS 2003) were observed during the survey.

Table 3 – Flora Species List

Scientific Name	Common Name	Community
Trees		
Allocasuarina littoralis	Black She-oak	1 2 3 4 5
Angophora costata	Smooth-barked Apple	1 2 3 4 5 6
Angophora floribunda	Rough-Barked Apple	4
Casuarina glauca	Swamp Oak	3 4 5 6
*Cinnamomum camphora**	Camphora Laurel	3
Corymbia gummifera	Red Bloodwood	1 2 3 4
Eucalyptus haemastoma	Scribbly Gum	1 2 3 4 5
Eucalyptus pilularis	Blackbutt	1
Eucalyptus punctata	Grey Gum	2 4
Eucalyptus racemosa	Narrow-leaved Scribbly Gum	1 2 3 4 5
Eucalyptus resinifera	Red Mahogany	1 2 4 5
Eucalyptus robusta	Swamp Mahogany	2 4 5 6
Eucalyptus tereticornis	Forest Red Gum	2 3 4 5 6
Exocarpos cupressiformis	Native Cherry	1 6
Glochidion ferdinandi	Cheese Tree	2 3 4 5
Livistona australis	Cabbage Tree Palm	4
Melaleuca linariifolia	Snow in Summer	1 2 3 4 5 6
Melaleuca stypheliodes	Prickly-Leaved Paperbark	5
Melia azedarch	White Cedar	3
*Musa acuminata**	Banana	1
Pittosporum undulatum	Sweet Pittosporum	5
-*	Exotic Palm	3
Shrubs		
Acacia brownii	-	1
Acacia falcata	Sickle Wattle	6
Acacia irrorata	-	2
Acacia longifolia	Sydney Golden Wattle	1 2 3 4 5 6
Acacia myrtifolia	Red-stem Wattle	1 2 3
Acacia terminalis	Sunshine Wattle	1
Astrotricha longifolia	-	6
Avicennia marina	Grey Mangrove	6
Banksia oblongifolia	-	2
Banksia spinulosa	Hairpin Banksia	1 2
Bossiaea heterophylla	-	1
Breynia oblongifolia	Breynia	1 2 3 4 5 6
Bursaria spinosa	Blackthorn	1
Callistemon linearis	Narrow-leaved Bottlebrush	1 2

Table 3 – Flora Species List		
Scientific Name	**Common Name**	**Community**
Callistemon salignus	-	2 3 4
*Cestrum parqui**	Green Cestrum	3
*Chrysanthemoides monilifera**	Bitou Bush	3 5
Clerodendrum tomentosum	Hairy Clerodendrum	1
Comesperma ericinum	Matchheads	1 2 4
*Cortaderia selloana**	Pampas Grass	6
*Cortaderia sp.**	Pampas Grass	5
Daviesia ulicifolia	Gorse Bitter-pea	1
Dillwynia retorta	-	1
Dodonaea triquetra	Hop Bush	1 2 3 4 5 6
Duboisia myoporoides	Corkwood	3
Epacris pulchella	-	1
Gompholobium latifolium	Golden Glory Pea	1
Gompholobium pinnatum	-	1
Hakea salicifolia	Willow Hakea	1 3
Hibbertia aspera	-	1 2
*Hylocerus undatus**	Night-blooming Cactus	1
Lambertia formosa	Mountain Devil	1
*Lantana camara**	Lantana	3 5 6
Leptospermum juniperinum	Prickly Tea-tree	2 4 5 6
Leptospermum polygalifolium	Yellow Tea Tree	1 2 4 5
Leptospermum trinervium	Flaky-barked Tea Tree	1 2 4
Leucopogon microphyllus	-	1
Melaleuca ericifolia	-	6
Melaleuca nodosa	-	1 2 4 5
Melaleuca sieberi	-	1 2 4 5 6
Melaleuca thymifolia	Thyme Honey-myrtle	2 4
Mirbelia rubiifolia	-	1
Ozothamnus diosmifolius	Ball Everlasting	1 2
Persoonia levis	Broad-leaved Geebung	1 2
Petrophile pulchella	Conesticks	1
Phyllanthus hirtellus	Thyme Spurge	1
*Physalis peruviana**	Cape Gooseberry	3 6
Pimelea linifolia	Slender Rice Flower	1 2 4 5
Pittosporum revolutum	Rough-fruit Pittosporum	3
*Polygala virgata**	-	1 3
Polyscias sambucifolia	Elderberry Panax	1 3 4 5 6
Pomaderris ferruginea	-	1
Pultenaea daphnoides	Large-leaf Bush-pea	1
Pultenaea elliptica	-	1 2
Pultenaea paleacea	-	1 2
Pultenaea retusa	-	1 2 4 5 6
Pultenaea villosa	-	4 5 6
*Rubus anglocandicans**	Blackberries	1 2 3 5 6
*Senna pendula**	Cassia	1 5
*Solanum mauritianum**	Tobacco Bush	3 6
Viminaria juncea	Golden Spray	3
Vines		
*Asparagus asparagoides**	Bridal Creeper	6

Table 3 – Flora Species List		
Scientific Name	**Common Name**	**Community**
*Asparagus scandens**	Climbing Asparagus Fern	3
Billardiera scandens	Apple Dumplings	1 2 3 4
Cassytha glabella	Devil's Twine	4
Cassytha pubescens	Devil's Twine	3
Cayratia clematidea	Slender Grape	6
Clematis glycinoides	Clematis	6
Desmodium rhytidophyllum	-	1 5
Desmodium varians	-	1 3 4
Eustrephus latifolius	Wombat Berry	1 3
Geitonoplesium cymosum	Scrambling Lily	3
Glycine clandestina	Twining Glycine	1 2 3 4 5 6 7
Glycine microphylla	Twining Glycine	1 3 4 5
Glycine tabacina	Twining Glycine	1 3 5 6
Hardenbergia violacea	False Sarsparilla	1 2
Hibbertia scandens	Golden Guinea Flower	1 2 3 4 5 6
Hibbertia dentata	Climbing Guinea Flower	1
*Ipomoea cairica**	-	1
*Ipomoea indica**	Blue Morning Glory	3
Kennedia rubicunda	Dusky Coral Pea	1 5 6
Parsonsia straminea	Common Silkpod	1 2
*Passiflora edulis**	Passionfruit	1 3
Polymeria calycina	Bindweed	1 2 3 4 5 6
Rhytidosporum procumbens	-	1
Rubus parvifolius	Native Raspberry	3
Herbs and Groundcovers		
-*	Bromeliads	1
*Ageratina adenophora**	Crofton Weed	3
*Aira cupaniana**	Silvery Hairgrass	1 3
*Andropogon virginicus**	Whisky Grass	1 3
Apium prostratum	Sea Celery	6
Aristida vagans	Wire Grass	1
Arthrochilus prolixus	Leafy Elbow Orchid	1
*Asparagus aethiopicus**	Asparagus Fern	3
*Aster subulatus**	Wild Aster	1 2 4 5 6
*Atriplex prostrata**	Orache	6
Austrostipa pubescens	Tall Spear Grass	1
*Axonopus affinis**	Narrowleaf Carpet Grass	1 2 3
Baumea juncea	Jointed Twig-rush	6
Baumea teretifolia	Soft Twig-rush	2 4
*Bidens pilosa**	Cobblers Pegs	1 3
Boronia polygalifolia	Milkwort Boronia	1
Bossiaea heterophylla	-	1 2
*Briza maxima**	Quaking Grass	1
*Briza minor**	Shivery Grass	3
*Briza subaristata**	-	1 3
Brunoniella australis	-	2
Brunoniella pumilio	-	3
Caladenia carnea	Pink Finger Orchid	1
Caladenia catenata	White Finger Orchid	1

Table 3 – Flora Species List		
Scientific Name	**Common Name**	**Community**
Calochilus sp.	Bearded Orchid	3
Carex inversa	Knob Sedge	3 6
*Centaurium erythraea**	Pink Stars	3
Centella asiatica	Swamp Pennywort	1 2 3 4 5 6
Chionochloa pallida	Silvertop Wallaby Grass	1
Chorizandra cymbaria	Bristle-rush	6
*Cirsium vulgare**	Spear Thistle	3
Comesperma sphaerocarpum	-	1
Commelina cyanea	Wandering Jew	1 6
*Conyza bonariensis**	Flaxleaf Fleabane	1 2 3
*Conyza sumatrensis**	Tall Fleabane	1 3 6
*Crassocephalum crepidioides**	Thickhead	3
*Crocosmia X crocosmiflora**	Crocosmia	1
Cryptostylis erecta	-	1
Cryptostylis subulata	-	1 2 4 5
Cyathochaeta diandra	-	1 2
*Cyclospermum leptophyllum**	Slender Celery	3
Cymbidium suave	Native Cymbidium	2
Cymbopogon refractus	Barbwire Grass	1
*Cynodon dactylon**	Common Couch	1 2 3 4 5 6
Cyperus haspan	-	5
Cyperus polystachios	-	6
Dampiera stricta	Blue Dampiera	1
Danthonia caespitosa	Wallaby Grass	1
Dendrobium teretifolium	Bridal Veil Orchid	6
Dianella caerulea	Flax Lily	1 2 3 4 5
Dichantheum sericeum	-	2 6
Dichelachne micrantha	Short-hair Plume Grass	1 3
Dichondra repens	Kidney Weed	1 2 3 4 5 6
*Digitaria sanguinalis**	Summer Grass	1 3
Dipodium punctatum	Hyacinth Orchid	1
Dipodium variegatum	Hyacinth Orchid	1
Drosera spathulata	Sundew	2
Echinopogon caespitosus	Tufted Hedgehog Grass	1 2
Echinopogon ovatus	Forest Hedgehog Grass	1 3 4 5
Empodisma minus	Spreading Rope-rush	2 4 5
Entolasia marginata	Bordered Panic	1 2 3 4 5 6
Entolasia stricta	Wiry Panic	1 2 4 5
Entolasia whiteana	-	1 2
Epilobium billardierianum	Smooth Willow Herb	1
Eragrostis brownii	Brown's Lovegrass	1 2 3 4 5
Eragrostis leptostachya	Paddock Lovegrass	3
*Erigeron karvinskianus**	Seaside Daisy	3
Fimbristylis dichotoma	-	3
Fimbristylis ferruginea	-	3 6
Gahnia clarkei	Saw Sedge	2 4 5
Gahnia sieberiana	Red-fruited Saw-sedge	1 2 3 4 5 6
*Gamochaeta calviceps**	-	3
Genoplesium acuminatum	-	1 3

Table 3 – Flora Species List		
Scientific Name	**Common Name**	**Community**
Geranium homeanum	-	3 5 6
Geranium solanderi	-	3
Glossodia major	Waxlip Orchid	1
Gnaphalium gymnocephalum	Creeping Cudweed	1 2 3 4 5
Gonocarpus micranthus	-	5
Gonocarpus tetragynus	-	1
Gonocarpus teucrioides	-	2 3 4 5 6
Goodenia bellidifolia	-	1 2 3 4 5 6
Goodenia hederacea	-	1 4 5
Goodenia heterophylla	-	1 2 4 5 6
Goodenia ovata	-	1 2 3 4 5 6
Haemodorum corymbosum	Bloodroot	1
*Hedychium gardnerianum**	Ginger Lily	1
Hibiscus trionum	Bladder Ketmia	6
Hybanthus monopetalus	Slipper Violet	1
*Hydrocotyle bonariensis**	Pennywort	6
Hydrocotyle geraniifolia	Forest Pennywort	5 6
Hydrocotyle peduncularis	Pennywort	2 3 4 5 6
*Hypericum gramineum**	Little St Johns Wort	1
*Hypericum japonicum**	-	2 4 5
*Hypochaeris radicata**	Flatweed	1 2 3 4 5 6
Hypoxis hygrometrica	-	2 5
Imperata cylindrica	Blady Grass	1 2 3 4 5 6
*Juncus cognatus**	-	1 3
Juncus continuus	-	2
Juncus krausii	Sea Rush	6
Juncus usitatus	Common Rush	5
Lagenifera stipitata	Common Lagenifera	1 2 4 5 6
Lepidosperma filiforme	-	1
Lepidosperma laterale	Variable Sword-sedge	1 2 3
Leptinella longipes	-	6
Lepyrodia scariosa	-	1 2
*Lilium formosanum**	-	1 3
Lobelia alata	-	4 5 6
Lomandra filiformis	-	3
Lomandra glauca	-	1
Lomandra longifolia	Spiky-headed Mat-rush	1 2 3 4 5
Lomandra multiflora	Many-flowered Mat-rush	1
Lomandra obliqua	Twisted Mat-rush	1
Macrozamia communis	Burrawang	5
Melichrus urceolatus	Urn Heath	1
Microlaena stipoides	Weeping Grass	1 2 3 6
*Nephrolepis cordifolia**	Fish-bone Fern	1
Oplismenus aemulus	-	3 5 6
Oplismenus imdecillis	-	2 3 4
*Osteospermum ecklonis**	-	1 3
*Oxalis corniculata**	-	3
Oxalis perennans	-	1 3 5
Panicum obseptum	-	6

Table 3 – Flora Species List		
Scientific Name	**Common Name**	**Community**
Panicum simile	Two Colour Panic	1 2 3 4
Paspalidium aversum	-	6
*Paspalum dilatatum**	Paspalum	1 2 3
Paspalidium distans	-	3 4
Patersonia sericea	Wild Iris	1
Persicaria lapathifolia	-	3
Philydrum lanuginosum	Woolly Frogmouth	2
*Plantago lanceolata**	Ribwort	3 6
Poa sieberiana	Poa Tussock	1
Polymeria calycina	Bindweed	1 2 3 4 5
Poranthera ericifolia	-	1
Poranthera microphylla	-	3
Pratia purpurascens	Whiteroot	1 2 3 4 5
Pseuderanthemum variabile	Pastel Flower	1 5
Pseudoraphis spinescens	Spiny Mudgrass	6
Pterostylis sp.	Greenhood	4 5
Ptilothrix deusta	-	1
*Richardia brasiliensis**	Mexican Clover	1
Samolus repens	Creeping Brookweed	6
Sarcocornia quinqueflora	Samphire	6
Senecio hispidula	Fireweed	1 3
*Senecio madagascariensis**	Fireweed	3
Scaevola ramosissima	Purple Fan Flower	1
Schoenus brevifolius	Heath Bog-rush	2 6
Schoenus melanostachys	Black Bog-rush	4
Selliera radicans	-	6
Senecio bipinnatisectus	-	5
Senecio hispidula	Hill Fireweed	3 5 6
*Sida rhombifolia**	Paddy's Lucerne	3 6
Sporobolus creber	Slender Rat's Tail Grass	3
Sporobolus virginicus	Salt-water Couch	6
*Stenotaphrum secundatum**	Buffalo Grass	3
Stylidium graminifolium	Trigger Plant	1
Suadea australis	Austral Seablite	6
*Taraxacum officinale**	Dandelion	3
Tetratheca juncea	-	1
Thelymitra ixioides	Spotted Sun Orchid	1
Themeda australis	Kangaroo Grass	1 2 3 4
Thysanotus tuberosus	Fringed Lily	1
Trachymene anisocarpa	-	6
Tricoryne elatior	-	1 2 3
Tricoryne simplex	-	1 3 5
Triglochin striatum	Streaked Arrow Grass	6
Urtica incisa	Stinging Nettle	6
Velleia paradoxa	-	2
*Verbena brasiliensis**	Flaxleaf Fleabane	3
*Verbena litoralis var. bonariensis**	Purple Top	3
*Verbena rigida**	Veined Verbena	1 3 5 6
Veronica plebia	-	1 3

Table 3 – Flora Species List		
Scientific Name	**Common Name**	**Community**
Villarsia exaltata	Yellow Marsh Flower	2 4 5
Viola hederacea	Ivy-leaved Violet	3 6
Wahlenbergia gracilis	Australian Bluebell	1 2 3
Xanthorrhoea latifolia	-	1
Xanthorrhoea resinifera	-	1
Ferns		
Adiantum aethiopicum	Common Maidenhair	2 4 5 6
Cheilanthes sieberi	Mulga Fern	1 3
Lindsaea linearis	Screw Fern	1 2 3 4
Lindsaea microphylla	Screw Fern	3 7
Pteridium esculentum	Bracken Fern	1 2 3 4 5 6
Selaginella uliginosa	-	2 4 5 6
Species name^{TS} = Threatened Species * = Introduced Species		

Methodology utilised throughout the duration of flora surveys is presented in Section 2.1.

4.5 Threatened flora

Fourteen (14) threatened flora species protected by State and National legislation have been identified as occurring within 10km or having the potential to occur within the subject site. These species are identified in the sub-section below and listed in Table 4.

4.5.1 State legislative matters

TSC Act (1995) – A search of the Atlas of NSW Wildlife (DECC 2008) database indicated that thirteen (13) species have been recorded within a 10 km radius of the study area. Table 4 identifies whether the subject site provides potential habitat for these species.

Of those thirteen (13) threatened flora species, all have the potential to occur within the subject site. Those species are *Acacia bynoeana, Angophora inopina, Caladenia tessellata, Callistemon linearifolius, Cryptostylis hunteriana, Diuris praecox, Eucalyptus camfieldii, Genoplesium insignis, Grevillea parviflora* subsp. *parviflora, Melaleuca biconvexa, Rutidosis heterogama, Syzygium paniculatum and Tetratheca juncea.* After extensive survey of the subject site, only one (1) threatened flora species has been recorded, *Tetratheca juncea.* The locality of the sightings is shown on Figure 4A.

Table 4 - Threatened Flora				
Scientific name	**Growth Form and Habitat Requirements**	**Comments**	**TSC Act**	**EPBC Act**
Acacia bynoeana DECC EPBC	Erect or spreading shrub to 0.3 m high growing in heath and dry sclerophyll open forest on sandy soils. Often associated with disturbed areas such as roadsides. Distribution limits N-Newcastle S- Berrima.	Identified 3 km to the NW of the subject site. Marginal habitat present within subject site. Not observed during flora survey.	E1	V
Angophora inopina	Small tree in open sclerophyll forest growing on deep sandy	Identified 1 km to the NW of the subject site.	V	V

Table 4 - Threatened Flora				
Scientific name	**Growth Form and Habitat Requirements**	**Comments**	**TSC Act**	**EPBC Act**
DECC EPBC	soils with associated lateritic outcrops. Distribution limits N- Wyee S- Gorokan.	Marginal habitat present within subject site. Not observed during flora survey.		
Caladenia tessellata DECC EPBC	Terrestrial orchid. Clay-loam or sandy soils. Distribution limits N-Swansea S- south of Eden.	Identified 10km ESE of the subject site. Suitable habitat present within subject site. Not observed during flora survey.	E1	V
Callistemon linearifolius DECC	Shrub to 4 m high. Dry sclerophyll forest on coast and adjacent ranges. Distribution limits N-Nelson Bay S- Georges River.	Identified 10 km to the SE of the subject site. Marginal habitat present within subject site. Not observed during flora survey.	V	-
Cryptostylis hunteriana DECC EPBC	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N- Gibraltar Range S- south of Eden.	Identified 3 km to the WSW of the subject site. Suitable habitat present within subject site. Not observed during flora survey.	V	V
Diuris praecox DECC EPBC	Terrestrial orchid. Grows in sclerophyll forest near the coast. Distribution limits N- Nelson Bay S- Ourimbah.	Identified 8.5 km to the SE of the subject site. Suitable habitat present within subject site. Not observed during flora survey.	V	V
Eucalyptus camfieldii DECC EPBC	Stringybark to 10 m high. Grows on coastal shrub heath and woodlands on sandy soils derived from alluviums and Hawkesbury sandstone. Distribution limits N- Norah Head S- Royal NP.	Identified 9km ESE of the subject site. Within conservation reserves at Brisbane Water NP, Ku-ring-gai Chase NP, Royal NP, Sydney Harbour NP. Marginal habitat present within subject site. Not observed during flora survey.	V	V
Genoplesium insignis DECC	An orchid that is only known from a few sites between Wyong and Chain Valley area. Grows in patches of *Themeda australis* (Kangaroo Grass) amongst shrubs and sedges in heathland and forest and flowers in spring.	Identified approximately 6.5km to the SE. Suitable habitat present within the subject site. Not observed during flora survey.	E	E
Grevillea parviflora subsp	Open to erect shrub to 1 metre. Grows in woodland on light clayey soils Distribution	Not currently known from conservation reserves Suitable habitat present	V	V

Table 4 - Threatened Flora				
Scientific name	**Growth Form and Habitat Requirements**	**Comments**	**TSC Act**	**EPBC Act**
parviflora DECC	limits N– Cessnock S- Appin	within subject site. Not observed during flora survey.		
Melaleuca biconvexa DECC	Tall shrub. Grows in wetlands adjoining perennial streams and on the banks of those streams, generally within the geological series known as the Terrigal Formation. Distribution limits N– Port Macquarie S– Jervis Bay.	Identified approximately 4km to the SW. Suitable habitat present within subject site. Not observed during flora survey.	V	V
Rhizanthella slateri EPBC	An orchid that grows almost entirely underground except for when flowering usually in Oct-Nov. Usually grows in Sclerophyll environments.	No known records in conservation reserves. Suitable habitat present. Not observed during flora survey.	E	V
Rutidosis heterogama DECC	An erect to decumbent herb to 30cm high, which occurs mostly in heath, often along roadsides, chiefly in coastal districts between Maclean and the Hunter Valley.	Identified approximately 6km to the north-west. Suitable habitat present within subject site. Not observed during flora survey.	V	V
Syzygium paniculatum DECC	Small tree. Subtropical and littoral rainforest on sandy soil. Distribution limits N- Forster S- Jervis Bay.	Identified 10 km to the SW of the subject site. Marginal habitat present within subject site. Not observed during flora survey.	V	V
Tetratheca juncea DECC EPBC	Prostrate shrub to 1 m high. Dry sclerophyll forest and heath. Distribution limits N- Bulahdelah S- Port Jackson.	Identified 5 km to the S of the subject site. Suitable habitat present within subject site. Recorded within subject site during target survey.	V	V
DECC - Denotes species listed within 10km of the subject site on the Atlas of NSW Wildlife database EPBC - Denotes species listed within 10km of the subject site in the EPBC Act habitat search				

4.5.2 Endangered flora populations

There is one (1) known endangered population within the Lake Macquarie LGA, *Eucalyptus parramattensis* subsp. *parramattensis*. This species is not represented within the study area.

4.5.3 SEPP No.19 bushland

Bushland within urban areas is a resource of great value to the community, both as part of the natural heritage and from a recreational, psychological, educational and scientific point of view. Bushland areas form a valuable addition to a region's recreational opportunities

including bushwalking, the study of natural history, or simply sitting and picnicking in natural surroundings. Aesthetically they contribute to the landscape quality of an area, and may provide a buffer between residential development and sources of pollution (DUAP 1989).

SEPP No. 19 bushland applies to bushland within the Sydney region and Lake Macquarie area. This policy only applies to bushland that is reserved for open space. Bushland that is not managed under this policy includes areas administered by the National Parks and Wildlife Service and NSW State Forests. Furthermore, lands subject to SEPP No. 14 issues are also not subject to SEPP No. 19 policy (DUAP 1989).

Lands to the east of the subject site are zoned for residential development and as such are not considered to form bushland as defined under SEPP 19. Lands to the north form part of the water body referred to as Lake Macquarie and are not considered to be bushland. Lands to the west and south are under private ownership and are not zoned for open space.

Lands to the north-west of the subject site form part of Wetland 888, a SEPP No.14 wetland and is subject to SEPP No.14 policy only.

However, small portions of land owned by Lake Macquarie City Council are present along the northwestern foreshore of the subject site, lands of which are well covered by natural vegetation and constitute bushland under this policy. For this reason a SEPP No. 19 assessment is appropriate and requires further consideration.

SEPP No.19 policy refers to natural bushland in urban areas. For an area to be classified as urban bushland, the site must satisfy Clause 4 points (i), (ii) and (iii) of Circular No. B13.

The specific aims of SEPP No. 19 are identified in bold print with the responses below each aim:

(a) to protect the remnants of plant communities which were once characteristic of land now within an urban area;

The vegetation present in the area to be affected by the proposed development consists of a number of vegetation communities, including Scribbly Gum Open Forest – Dry Understorey, Scribbly Gum Open Forest – Moist Understorey, Forest Red Gum Woodland, Swamp Mahogany – Smooth-barked Apple – Scribbly Gum Woodland, Swamp Mahogany Woodland, Swamp Oak Woodland / Salt Marsh and Open Forest (Smooth-barked Apple & Forest Red Gum). This vegetation adjoins the foreshore area zoned 6(c) – Open Space (Local Reservation). This foreshore area is to be retained as a Public open space and will not be part of the proposed development.

The definition of “bushland”, as defined in Clause 4 of the policy, means:

> *“land on which there is vegetation which is either a remainder of the natural vegetation of the land or, if altered, is still representative of the structure and floristics of the natural vegetation.”*

No activities associated with the proposed development will occur within SEPP 19 Bushland.

(b) to retain bushland in parcels of a size and configuration which will enable the existing plant and animal communities to survive in the long term;

A number of areas of native vegetation will be retained within the proposed development. These include a wildlife corridor, large allotments, public open space and significant trees within the development areas (where possible). These areas will exhibit a reasonable degree of linkage, generally being separated by only a road (see Development Plan). Road designs will contain street tree planting to allow for fauna movement between the reserves, thus assisting the long-term survival of plant and animal communities within the subject site.

(c) to protect rare and endangered flora and fauna species;

Tetratheca juncea, Squirrel Glider, Glossy Black-Cockatoo, Grey-headed Flying-fox Brown Treecreeper and the Eastern Freetail-bat have been identified within the subject site. It is believed that the Glossy Black-Cockatoo, Eastern Freetail-bat and Grey-headed Flying-fox are using the subject site for foraging purposes only. Identified habitat for both *Tetratheca juncea* and the Squirrel Glider is to be retained within the Foreshore Reserve Area which maintains a vegetated link to the Wildlife corridor. The large lot design and retention of significant trees within the development area (where possible) will assist in maintaining habitat for the Squirrel Glider and foraging habitat for the two bat species. The retention of areas of Allocasuarina within the large allotments will assist in maintaining foraging habitat for the Glossy Black-Cockatoo. The protection of the Swamp Sclerophyll Forest on Coastal Floodplains, River-flat Eucalypt Forest and the Coastal Saltmarsh within the Public open space ensures the conservation and protection of the endangered ecological communities recorded within the subject site.

Based on the proposed retention of habitat within a corridor within the site, adjoining open space land and conserved, similar habitat within the surrounding locality the impact of this activity on threatened species is not considered to be significant.

(d) to protect habitats for native flora and fauna;

The conservation of native vegetation within the Wildlife corridor, Larger Lots, Public open space and significant trees retained within the development area (where possible) it is considered that habitat for threatened species will be retained within the subject site.

(e) to protect wildlife corridors and vegetation links with other nearby bushland;

The preliminary development has been designed to retain connectivity of vegetation within the subject site beyond the boundaries to surrounding vegetation. The retention of native vegetation within the Wildlife corridor, Large allotments , Public open space and retain significant trees within the development area serves to maintain a vegetated link from vegetation beyond the subject site to the foreshores of Lake Macquarie. This retained vegetation will allow for fauna movement throughout the site, with particular focus on the Wildlife corridor as a focal point for fauna activity.

(f) to protect bushland as a natural stabiliser of the soil surface;

The construction phase of the development poses most threat to soil stabilisation within the subject site, however appropriate management techniques will reduce the stability of the soil. Reducing the amount of exposed soil surfaces by reducing vegetation clearing as much as possible and by revegetating exposed areas where possible will reduce the threat of instable soils and maintain the bushland as a natural stabiliser. The use of appropriate sediment fencing and soil erosion measures will reduce the potential of downstream impacts from the proposed development.

(g) to protect bushland for its scenic values, and to retain the unique visual identity of the landscape;

The public open space area is situated upslope of the area of proposed development and forms part of the local ridgelines which will be retained in a vegetated condition thereby ensuring protection of visual amenity. No removal of bushland for the proposed activity will occur and it is considered that the proposal will have a minimal visual impact. The proposed development will not result in the fragmentation of any bushland area therefore protecting the aesthetic quality of that area. The vegetation on the site does not contain any significant scenic value and has no unique visual identity.

(h) to protect significant geological features;

The site does not contain any significant geological features which need to be protected. The geology and soil landscape present are locally common and do not require any specific protection.

(i) to protect existing landforms, such as natural drainage lines, watercourses and foreshores;

A number of small, poorly defined, drainage lines cross the subject site in a generally south east to north west direction. The largest of these runs through the centre of the subject site and is to be protected within the wildlife corridor. The foreshores of the subject site (including those areas of vegetation subject to periodic inundation) are also to be protected within a public open space.

(j) to protect archaeological relics;

An archaeological survey by *Conacher Travers* in consultation with members of the *Koompahtoo Local Aboriginal Lands Council* identified the presence of a previously unrecorded midden site on the foreshores of the subject site. The location of this midden is such that it will be contained within the Public open space, and the *Koompahtoo Local Aboriginal Lands Council* concluded that the protection of this site was adequate and the site would not pose any constraint to the proposed development. There are no known archaeological sites of European origin on the subject site.

(k) to protect the recreational potential of bushland;

Recreational potential of the adjoining bushland is limited to pursuits such as bushwalking and nature study. As the subject site is privately owned, recreational pursuits within this site are limited to public use. The proposed development proposes the Public open space to allow for public recreation within the existing vegetation along the foreshore of the site.

(l) to protect the educational potential of bushland;

The areas of open space have educational potential as areas within a developed residential area to undertake informal nature studies or more formalised tertiary studies on flora and fauna issues. This educational opportunity will prevail due to the retention of the Public open space and implementation of environmental safeguards with any future land development to protect the existing integrity of the open space area.

Within the district, educational opportunities are ample within nearby vegetated areas. The subject site has no potential for use as an educational area as it is privately owned.

(m) to maintain bushland in locations which are readily accessible to the community;

The proposed development is on privately owned land, and is therefore not accessible to the community. The subject site contains bushland designated as 6(c) – Open Space (Local Reservation) with the proposed development causing no change to accessibility to the public.

(n) to promote the management of bushland in a manner which protects and enhances the quality of the bushland and facilitates public enjoyment of the bushland compatible with its conservation.

At this stage of the proposed development, the management obligations for the wildlife corridor and large allotments and public open space has yet to be finalised. However, these areas will be managed by the appropriate group in order to maintain the quality of the bushland and facilitate the conservation and public enjoyment of the areas.

4.5.4 SEPP No. 14 wetlands

State Environmental Planning Policy No. 14 – Coastal Wetlands applies to developments that have the potential to damage or destroy wetlands.

No SEPP No.14 wetlands have been identified within the subject site. An area to the immediate west of the subject site has been mapped as Wetland No. 888 under SEPP No.14 – Coastal Wetlands. Wetland No. 889 is located to the north of this area also.

Due to the close proximity of the proposed development to two SEPP No. 14 Wetlands, the issues addressed in this document have been considered during the planning phase of this development.

No physical works will be carried out on either wetland as a part of the proposed development, thus excluding any direct impacts on the wetlands. However, there is a possibility that the proposed development may cause indirect impacts from effects such as sedimentation and or stormwater runoff and to offset this appropriate assessment and use of WSUD principles should occur to protect the wetlands from the impacts of altered freshwater flows.

4.5.5 National legislative matters

Environment Protection and Biodiversity Conservation Act (1999)

A review of the schedules of the *EPBC Act* (1999) indicated the potential for nine (9) threatened species and no endangered ecological communities to occur within a 10km radius of the site. These include *Acacia bynoeana, Angophora inopina, Caladenia tessellata, Cryptostylis hunteriana, Diuris praecox, Eucalyptus camfieldii, Grevillea parviflora subsp. parviflora, Rhizanthella slateri* and *Tetratheca juncea.*

A review of the schedules of the *EPBC Act* (1999) identified *Tetratheca juncea* which is listed as a vulnerable species. Any proposed activity that is likely to remove *Tetratheca juncea* to the extent that it is a matter of National Environmental Significance (NES) is recommended to be

referred to the Department of the Environment, Water, Heritage & the Arts, as required under the *EPBC Act* (1999).

4.5.5.1 EPBC Assessment for Tetratheca juncea - Vulnerable listed species

Importance of population within the subject site

An *important population* is one that is necessary for a species' long term survival and recovery. This may include populations that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and / or
- Populations that are near the limit of the species range.

The few specimens found on site during surveys (approximately 10 specimens in total) would not constitute an important population as the answer is no to the above three statements.

An action has, will have, or is likely to have a significant impact on an endangered species if it does, will, or is likely to:

- Lead to a long-term decrease in the size of a population;

Comment: A number of specimens of *Tetratheca juncea* were located within the Scribbly Gum Open Forest – Dry Understorey vegetation. It is expected that the recommendations of this report suggesting that the individuals of *Tetratheca juncea* can potentially be retained within larger lots should be adhered to.

- Reduce the area of occupancy of a species;

Comment: A number of specimens of *Tetratheca juncea* were located within the Scribbly Gum Open Forest – Dry Understorey vegetation. There is potential that some lands of this vegetation type could have larger lot sizes whereby some habitat for *Tetratheca juncea* can be retained, in addition to the use of some pockets of open space.

- Fragment an existing population into two or more populations;

Comment: Given the small number of specimens observed, particularly in 2008 (2 specimens in the south-west corner), it is not expected that populations would be fragmented by development.

- Adversely affect habitat critical to the survival of a species;

Comment: The subject site has not been identified as critical habitat for this species. Therefore it is considered that removing *Tetratheca juncea* is not likely to adversely affect critical habitat for the survival of this species.

- Disrupt the breeding cycle of a population;

Comment: The proposed development has potential to disrupt the breeding cycle of this small population within the subject site.

- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline;

Comment: The Scribbly Gum Open Forest – Dry Understorey habitat for this species is likely to be impacted upon by the proposed development. The proposed development is likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that this species is likely to decline. The extent of decline is dependent upon the type of development within the area occupied by the *Tetratheca juncea.* Placement of large lots and/or open space within areas presently occupied by known *Tetratheca juncea* locations will minimise the potential to decline.

- Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat; or

Comment: As a result of the proposal, invasive species would most likely be managed as part of a vegetation management plan or something equivalent.

- Interfere with recovery of the species.

Comment: It is unlikely that removal of any specimens of *Tetratheca juncea* will interfere with the recovery of the species within the local area as the subject site is connected to at least 400ha of bushland of similar type and quality to the west. In May 2003, 178ha of land was dedicated on the Wallarah Peninsula (nearby) to form *Wallarah National Park*. This national park contains a significant number of *Tetratheca juncea* (greater than 1000 clumps) that is to be retained. Given the retention of large numbers within the local area, the potential removal of a few species (up to 10 clumps) will not interfere within the recovery of this species.

4.5.6 Endangered ecological communities

The following endangered ecological communities have been observed within the general locality of the subject site:

- Coastal Saltmarsh
- Freshwater Wetlands on Coastal Floodplains,
- Low Woodland Heath on Indurated Soils
- River-flat Eucalypt Forest on Coastal Floodplains,
- Swamp Oak Floodplain Forest, and
- Swamp Sclerophyll Forest on Coastal Floodplains.
- Sydney Freshwater Wetlands
- Lowland Rainforest.

Vegetation communities 4, 5a and 5b, Swamp Mahogany Woodland, are considered to be representative of *Swamp Sclerophyll Forest on Coastal Floodplains* (SSFCF), which is listed as an Endangered Ecological Community under Part 3, Schedule 1 of the *TSC Act* (1995). The majority of this ecological community will be retained within the proposed foreshore reserve with approximately 0.23ha (4.4%) of this vegetation community proposed to be removed or modified as part of the proposed development.

Vegetation community 6, Swamp Oak Woodland / Saltmarsh, is considered to be representative of *Coastal Saltmarsh*, which is also listed as an Endangered Ecological Community under Part 3, Schedule 1 of the *TSC Act* (1995). This vegetation community will be entirely retained within the foreshore reserve.

Vegetation community 3, Forest Red Gum Woodland, is considered to be representative of *River-flat Eucalypt Forest on Coastal Floodplains,* which is listed as an Endangered Ecological Community under Part 3, Schedule 1 of the *TSC Act* (1995). This community occupies an

area of approximately 2.4ha of which it is expected that 0.43ha (17.9%) will be removed or modified for development.

COASTAL SALTMARSH (CS)

General Description

Coastal Saltmarsh is the name given to the endangered ecological community occurring on intertidal zone on the shores of estuaries and lagoons, including when they are intermittently closed along the NSW coast.

Habitat Requirements

- Geology / Soils: The Coastal saltmarsh is situated upon Wyong soils which are deep with occasional humus podozols.
- Topography: Depressions, flats, drainage lines, lagoons and lakes edges.
- Characteristic Canopy Species: *Baumea juncea, Juncus krausii, Sarcocornia quinqueflora, Sporobolus virginicus, Triglochin striata, Isolepis nodosa, Samolus repens, Selliera radicans, Suaeda australis* and *Zoysia macrantha* (DECC 2008).

Conservation Status and Distribution

Occurs generally at elevations of less than 10 metres AHD in the intertidal zone on shores of estuaries and lagoons. Small areas are conserved in existing conservation reserves, including Ramsar, Towra Point and Kooragang Island Natures Reserves.

Key Threatening Processes

Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; and Anthropogenic climate changes.

Occurrence on site:

Habitat requirements and species that characterise this community were located within Community 6 - Swamp Oak Woodland / Saltmarsh within the subject site. This community is situated in the north-west portion of the site and occupies an area of approximately 2.2ha or 6%.

RIVER-FLAT EUCALYPT FOREST ON COASTAL FLOODPLAINS

General Description

The ecological community associated with silts, clay loams and sandy loams on periodically inundated alluvial flats, drainage lines and river terraces of coastal floodplains.

Habitat Requirements

- Geology / Soils: Alluvial soils of fluvial origin.
- Topography: Flood plains and associated flats and terraces.

- Most dominant canopy species of River-Flat Eucalypt Forest on Coastal Floodplains: *Eucalyptus amplifolia*, *Eucalyptus tereticornis, Angophora floribunda, Angophora subvelutina, Eucalyptus baueriana, Eucalyptus botryoides* and *Eucalyptus elata.*

Conservation Status and Distribution

Small areas of River-Flat Eucalypt Forest on Coastal Floodplains occur in existing conservation reserves, including: Blue Mountains NP, Cattai NP, Dharug NP, Georges River NP, Marramarra NP, Morton NP, Deua NP and Wadbilliga NP.

Key Threatening Processes

Clearing of native vegetation; alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; invasion of native plant communities by exotic perennial grasses; predation, habitat destruction, competition and disease transmission by feral pigs; anthropogenic climate change; high frequency fire and removal of dead wood and dead trees.

Occurrence in Subject Site:

Habitat requirements and species that characterise this community were located on the subject site as the Forest Red Gum Woodland, vegetation Community 3 that occupies an area of 2.4ha or 7%.

SWAMP SCLEROPHYLL FOREST ON COASTAL FLOODPLAINS

General Description

The ecological community associated with humic clay loams and sandy loams on waterlogged or periodically inundated alluvial flats and drainage lines of coastal floodplains.

Habitat Requirements

- Geology / Soils: Waterlogged or periodically inundated humic clay loams and sandy loams.
- Topography: Alluvial flats and drainage lines of coastal floodplains.
- The most widespread canopy species of Swamp Sclerophyll Forest on Coastal Floodplains include: *Eucalyptus robusta, Melaleuca quinquenervia and eucalyptus botryoides.* Other prominent species are: *Callistemon salignus, Casuarina glauca*, *Eucalyptus resinifera subsp. hemilampra, Livistona australis,* and *Lophostemon suaveolens.*

Conservation Status and Distribution

Small areas of Subtropical Swamp Sclerophyll Forest on Coastal Floodplains are contained within existing conservation reserves, including: Bungawalbin NR, Tuckean NR, Moonee Beach NR, Hat Head NP, Crowdy Bay NP, Wallingat NP, Garigal NP and Myall Lakes NP.

Key Threatening Processes

Clearing of native vegetation; alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; invasion of native plant communities by exotic perennial grasses; predation, habitat destruction, competition and disease transmission by feral pigs; anthropogenic climate change; high frequency fire and removal of dead wood and dead trees.

Occurrence in Subject Site:

The specific geomorphologic requirements, habitat requirements and species that characterise this community were located within community 5 (A and B) - Swamp Mahogany Woodland within the subject site. This community is situated in the north-west portion of the site and occupies an area of approximately 3.6ha or 10 %.

The Habitat requirements and species that characterise Community 4 – Swamp Mahogany – Smooth-barked Apple – Scribbly Gum Woodland is also considered to be Swamp Sclerophyll Forest on Coastal Floodplains. Community 4 is associated with waterlogged or periodically inundated alluvial flats. This community is situated in the northern portion of the site and occupies an area of approximately 1.6ha or 4%.

4.6 Regionally significant flora

Eucalyptus tereticornis

Eucalyptus tereticornis (Forest Red Gum Woodland) vegetation community is common around the foreshores of Lake Macquarie and also occurs on foreshores of the Tuggerah Lakes. This species is represented in *Lake Macquarie State Recreation Area*. Except for a few smaller individuals, all were recorded within vegetation community 3, classed as River-flat Eucalypt Forest. This EEC will be mostly protected from development and placed within the Foreshore Reserve.

Eucalyptus robusta

Although Swamp Mahoganies are common and widespread along the NSW coast, north from Moruya, concern has been expressed at the diminishing number of vegetation communities dominated by Swamp Mahogany (*Wyong Shire Council* 1999). This is due to the fact that this vegetation community provides important winter flowering resources for threatened fauna such as Regent Honeyeater, Swift Parrot and Squirrel Gliders. Vegetation community 5 is dominated by the Swamp Mahogany as a canopy cover species and is hence considered to be regionally significant.

Eucalyptus robusta (Swamp Mahogany) was observed within Swamp Mahogany Woodland community 5A & 5B. Vegetation within community 5 was assessed as being representative of the Endangered Ecological Community *Swamp Sclerophyll Forest on Coastal Floodplains* as listed on Schedule 1, Part 3 of the *Threatened Species Conservation Act* (1995). That section of vegetation is within an area proposed to be set aside as Public Reserve and as a result, there will be very little impact on the ecological community by the proposed development which has been designed to minimise losses.

Coastal Saltmarsh

Vegetation Community 6 - Swamp Oak Woodland/Saltmarsh corresponds to the Endangered Ecological Community Coastal Saltmarsh. This section of vegetation is within an area proposed to be set aside as Public Reserve and as a result, there will be no direct impact on the ecological community by the proposed development.

Estuarine shoreline vegetation communities are limited in their distribution and are often excluded from development for conservation / public recreation purposes. Habitats characterised by these environments provide suitable foraging areas for marine and estuarine fauna, including some threatened species and JAMBA / CAMBA avifauna. These habitats are often protected by the SEPP No.14 Coastal Wetlands policy and are considered to be regionally significant.

ROTAP Species

No ROTAP species were observed during the survey. None of the species listed as having particular conservation importance within the Gosford and Lake Macquarie 1:100,000 Map Sheet (DECC 2008) were observed during the survey.

4.7 Fauna species

A detailed fauna assessment was completed by *Woodward-Clyde* (1996) for the subject site. Targeted survey efforts were completed between 13 July and 16 July 1996. Fauna detection methods utilised included owl call playback, terrestrial Elliott trapping, hair tubes, spotlighting and diurnal avifauna / reptile / mammals surveys.

The results of the survey indicate the detection of thirty-four (34) species of avifauna, one (1) amphibian, zero (0) reptiles and ten (10) mammals. A review of this data indicates that one of the species, Grey-headed Flying-fox, detected during this survey is listed as Threatened under the current schedules of the *TSC Act* (1995).

A total of 128 species were observed within the subject site during *Conacher Travers* surveys undertaken in 2000, 2002, 2007, *Travers environmental* surveys undertaken in 2008 and *Woodward & Clyde* in 1996 and 2000. This number comprised 86 bird, 27 mammal, 6 reptile, 8 amphibian and 1 mollusc species. The majority of the species listed in Table 5 are considered to be relatively common in the local area.

Five (5) threatened species were detected within the subject site during surveys. These species were Squirrel Glider (*Petaurus norfolcensis*), Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Brown Treecreeper (*Climacteris picumnus*) and Eastern Freetail-bat (*Mormopterus norfolkensis*. The location of the Grey-headed Flying-fox observations by *Woodward & Clyde* (1996) are unknown.

The results of the fauna surveys indicated that eighty six (86) birds were observed, most of which were considered to be common within the local area. Fifteen (15) threatened bird species are considered to have potential habitat within the subject site. It is considered that the Glossy Black-Cockatoo (*Calyptorhynchus lathami*) is foraging on the site. The Brown Treecreeper was recorded on the site in 2000, however the site appears to provide sub-optimal habitat for this species.

Six (6) common species of reptile were recorded within the subject site. No threatened reptiles have been recorded within a 10 km radius of the site, and as such, none are considered to have potential habitat on the site.

Eight (8) amphibians were recorded on the site or heard calling near the site boundary. One (1) threatened species of amphibian, the Wallum Froglet (*Crinia tinnula*), was considered likely to inhabit the site.

The mammal survey resulted in twenty seven (27) species of mammals being observed. Fourteen (14) threatened mammal species were considered to have potential habitat within the subject site. Of these the Squirrel Glider (*Petaurus norfolcensis*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and Eastern Freetail-bat (*Mormopterus norfolkensis*) were identified on the site.

Table 5 Fauna Observations for the Subject Site

Common name	Scientific name	*Conacher Travers* (2000)	Woodward - Clyde (1996)	*Conacher Travers* (2002)	*Conacher Travers* (2007) *Travers environmental*
Birds					
Australian Magpie	*Gymnorhina tibicen*	O C	O	OC	OC
Australian Magpie-Lark	*Grallina cyanoleuca*	O C	O	OC	
Australian Pelican	*Pelecanus conspicillatus*				O

Table 5 Fauna Observations for the Subject Site					
Common name	**Scientific name**	***Conacher Travers* (2000)**	**Woodward - Clyde (1996)**	***Conacher Travers* (2002)**	***Conacher Travers* (2007) *Travers environmental***
Australian Raven	*Corvus coronoides*	O C	O	OC	OC
Australian White Ibis	*Threskiornis molucca*			OC	
Azure Kingfisher	*Alcedo azurea*	O			
Beautiful Firetail	*Stagnopleura bella*	O			
Bar-shouldered Dove	*Geopelia humeralis*			C	
Barn Owl	*Tyto alba*	O P			
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O C		OC	C
Black Swan	*Cygnus atratus*				
Brown-headed Honeyeater	*Melithreptus brevirostris*				
Brown Gerygone	*Gerygone mouki*				OC
Brown Quail	*Coturnix ypsilophora*	O C		OC	
Brown Thornbill	*Acanthiza pusilla*		O C	OC	OC
Brown Tree-creeper [ts]	*Clemacteris picumnus*	O			
Common Bronzewing	*Phaps chalcoptera*		O		
Common Tern	*Sterna hirundo*			O	
Crested Pigeon	*Ocyphaps lophotes*	O C		OC	OC
Crimson Rosella	*Platycerus elegans*	Sc C			
Dollarbird	*Eurystomus orientalis*	O C			
Eastern Rosella	*Platycercus eximius*	O C	O	OC	OC
Eastern Spinebill	*Acanthorhynchus tenuirostris*	O	C	OC	OC
Eastern Whipbird	*Psophodes olivaceus*	C	O C	OC	C
Eastern Yellow Robin	*Eopsaltria australis*	O C	O	OC	OC
Fan-tailed Cuckoo	*Cacomantris flabelliformis*		C	OC	
Fuscus Honeyeater	*Lichenostomus fuscus*		C		
Galah	*Cacatua roseicapilla*	O C		OC	OC
Glossy Black-Cockatoo[ts]	*Calyptorhynchus lathami*	Sc An			O
Golden Whistler	*Pachycephala pectoralis*	C	O C	OC	O
Great Egret	*Ardea alba*			O	
Grey Butcherbird	*Cracticus torquatus*	C		OC	C
Grey Fantail	*Rhipidura fuliginosa*	O C	O	OC	OC
Grey Shrike-thrush	*Colluricincla harmonica*	O	C	OC	
Horsfield's Bronze-cuckoo	*Chrsococcyx basalis*		C		
Intermediate Egret	*Ardea intermedia*				O
Jacky Winter	*Microeca fascinans*	O			
Laughing Kookaburra	*Dacelo novaeguineae*	O C	O	OC	OC

Table 5 Fauna Observations for the Subject Site					
Common name	**Scientific name**	***Conacher Travers* (2000)**	**Woodward - Clyde (1996)**	***Conacher Travers* (2002)**	***Conacher Travers* (2007) *Travers environmental***
Lewin's Honey-eater	*Meliphaga lewinii*	O C	C	OC	OC
Little Black Cormorant	*Phalacrocorax sulcirostris*	O		O	
Little Lorikeet	*Glossopsitta pusilla*		O C	OC	
Little Pied Cormorant	*Phalacrocorax melanoleucos*				O
Little Wattlebird	*Anthochaera chrysoptera*	O		OC	
Masked Lapwing	*Vanellus miles*		O	OC	OC
New Holland Honeyeater	*Phylidonyris nigra*		O C	OC	
Noisy Miner	*Manorina melanocephala*	O C		OC	OC
Noisy Friarbird	*Philemon corniculatus*	O C	C	OC	OC
Pied Butcherbird	*Cracticus nigrogularis*	O C		OC	C
Pied Currawong	*Strepera graculina*	O C		OC	OC
Pied Cormorant	*Phalacrocorax varius*			O	
Pheasant Coucal	*Centropus phasianinus*	O	O		
Rainbow Bee-eater	*Merops ornatus*	O C			
Rainbow Lorikeet	*Trichoglossus haematodus*	O C	O	OC	OC
Red-browed Finch	*Neochmia temporalis*	O		OC	OC
Rufous Whistler	*Pachycephala rufiventris*		O	OC	
Sacred Kingfisher	*Todiramphus sanctus*				O
Satin Bowerbird	*Ptilonorhynchus violaceus*			OC	
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*				OC
Silver Gull	*Larus novaehollandiae*	O		OC	OC
Silvereye	*Zosterops lateralis*	O C	O C	OC	
Shining Bronze-cuckoo	*Chrysococcyx lucidus*		C		
Spotted Pardalote	*Pardalotus punctatus*	C	C		OC
Spotted Turtle-dove *	*Streptopelia chinensis*	O C		OC	
Striated Heron	*Butorides striatus*			O	
Striated Thornbill	*Acanthiza lineata*	O			
Sulphur Crested Cockatoo	*Cacatua galerita*	O C	O		OC
Superb Fairy-wren	*Malurus cyaneus*	O C		OC	
Southern Boobook	*Ninox novaeseelandiae*			Sp C	C^{08}
Southern Emu-wren	*Stipiturus malachurus*	O		OC	
Swamp Harrier	*Circus approximans*			O	
Tawny Frogmouth	*Podargus strigoides*				O
Variegated Fairy-wren	*Malurus lamberti*	O C	O	OC	OC
Varied Sittella	*Daphoenositta*	O		OC	

Table 5 Fauna Observations for the Subject Site					
Common name	**Scientific name**	***Conacher Travers* (2000)**	**Woodward - Clyde (1996)**	***Conacher Travers* (2002)**	***Conacher Travers* (2007) *Travers environmental***
	chrysoptera				
Whistling Kite	*Haliastur sphenurus*			O	
White Browed Scrubwren	*Sericornis frontalis*	O		OC	OC
White-bellied Sea-eagle	*Haliaeetus leucogaster*	O		OC	
White-cheeked Honeyeater	*Phylidonyris nigra*	O	C		
White-faced Heron	*Egretta novaehollandiae*				O
White-naped Honeyeater	*Melithreptus lunatus*	O	C		
White-throated Gerygone	*Gerygone olivacea*			OC	
White-throated Needletail	*Hirundapus caudacutus*				O
White-throated Treecreeper	*Cormobates leucophaeus*	O	C	OC	C
White-winged Chough	*Corcorax melanorhhamphos*	O			
Willie Wagtail	*Rhipidura leucophrys*	O		OC	
Yellow-faced Honeyeater	*Lichenostomus chrysops*	O C	C	OC	OC
Yellow Thornbill	*Acanthiza nana*	O C			OC
Mammals					
Brown Antechinus	*Antechinus stuartii*	E	E	E	HT
Yellow-footed Antechinus	*Antechinus flavipes*	E			
Bush Rat	*Rattus fuscipes*	E	E	E	HT
Swamp Rat	*Rattus lutreolus*	E		E	
Eastern Grey Kangaroo	*Macropus giganteus*	O Sc	O	O Sp	O
Squirrel Glider [TS]	*Petaurus norfolcensis*	E Sp			
Sugar Glider	*Petaurus breviceps*	Sp C	An		C
Unidentified Glider	*Petaurus sp.*				Sw[08]
Northern Brown Bandicoot	*Isoodon macrourus*			HT	HT
Common Ringtail Possum	*Pseudocheirus peregrinus*	Sp Sc		Sp	Sp
Common Brushtail Possum	*Trichosurus vulpecula*		HT Sc	Sp	HT Sw[08]
Swamp Wallaby	*Wallabia bicolor*	Sc	Sc	O	Sc, HT
Red-necked Wallaby	*Macropus rufogriseus*	Sc		O Sp	
Grey-headed Flying-fox [TS]	*Pteropus poliocephalus*		O		
Gould's Wattled Bat	*Chalinolobus gouldii*	A		A	A
Chocolate Wattled Bat	*Chalinolobus morio*	A		A, HaT	
Eastern Freetail-bat [TS]	*Mormopterus norfolkensis*	A		A	A
Freetail-bat	*Mormopterus sp. 1*	A		A	
Eastern Broad-nosed Bat	*Scotorepens orion*	A			
White striped Freetail Bat	*Nyctinomus australis*			A	C

Table 5 Fauna Observations for the Subject Site					
Common name	**Scientific name**	***Conacher Travers* (2000)**	**Woodward - Clyde (1996)**	***Conacher Travers* (2002)**	***Conacher Travers* (2007) *Travers environmental***
Large Forest Bat	*Vespadelus darlingtoni*				A
Eastern Forest Bat	*Vespadelus pumilus*	A			
Little Forest Bat	*Vespadelus vulturnus*	A			
Southern Forest Bat	*Vespadelus regulus*			A, HaT	
Brown Hare*	*Lepus capensis*				
Rabbit*	*Oryctolagus cuniculus*			Sp O	O
Dog*	*Canis familiaris*			OC	Sc
European Red Fox *	*Vulpes vulpes*	Sc		Sc	Sp
Reptiles					
Delicate Skink	*Lampropholis delicata*	S		O Pf	O
Eastern Brown Snake	*Pseudonaja textilis*	O			
Red-bellied Black Snake	*Pseudechis porphyriacus*		An		
Blue tongued Lizard	*Tiliqua scincoides*			S	
Jacky Lizard	*Amphibolurus muricatus*				O
Lace Monitor	*Varanus varius*		An		Sc
Amphibians					
Common Eastern Froglet	*Crinia signifera*	C	C	C	C
Bleating Tree Frog	*Litoria dentata*	C			C
Broad-palmed Frog	*Litoria latopalmata*				C
Laughing Tree Frog	*Litoria tyleri*				C
Striped Marsh Frog	*Limnodynastes peronii*				C
Spotted Marsh Frog	*Limnodynastes tasmaniensis*				C
Dusky Toadlet	*Uperoleia fusca*				C
Burrowing Toadlet	*Uperoleia laevigata*	C			
Mollusc					
A Land Snail	*Meridolum sp.*	S		S	

Note: * indicates introduced species
^{TS} indicates threatened species
^{08} indicates species recorded during stag-watching surveys undertaken 2008

A	- Anabat II	C	-	Call Identification
O	- Observation	An	-	Anecdotal
E	- Elliott Trap	S	-	Habitat Search
Sp	- Spotlight	Sc	-	Scat, Track or Sign
P	- Call Playback Response	HT	-	Hair Tube
Pf	- Pitfall Trap	Sw	-	Stag-watching
HaT	- Harp Trap			

It is important to note that field survey data collected during the survey period is representative of species occurring within the subject site for that occasion. Due to effects of fire, breeding cycles, migratory patterns, camouflage, weather conditions, time of day, visibility, predatory and / or feeding patterns, increased species frequency or richness may be observed within the subject site outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, has been used to overcome this survey limitation.

4.8 Habitat types

A variety of fauna habitats are present throughout the subject site, providing a range of suitable foraging and breeding environments for avifauna, amphibians, reptiles and mammals. Habitats identified within the subject site include:

- Woodland and Open Forest dominated by the winter flowering Swamp Mahogany;
- Open Forest dominated by the summer flowering Scribbly Gum / Smooth-barked Apple;
- Sparse to dense groundcovers characterised by grasses, herbs and sedges;
- 253 recorded hollow-bearing trees containing approximately 740 hollows of varying size classes and quality for use;
- Locations of densely deposited bark at the base of large Smooth-barked Apple;
- Scattered fallen timber of moderate density (5-10% cover);
- Sparse to moderate density leaf litter;
- Occasional rubbish debris (car wrecks);
- Tree hollows ranging from small (<5cm) to large (30+cm);
- Moist environments characterised by an ephemeral drainage line; and
- Saltwater foreshores containing mangroves and saltmarsh.

4.9 Habitat

Vegetation communities 4 - Swamp Mahogany - Smooth-barked Apple - Scribbly Gum Woodland and 5a & 5b - Swamp Mahogany Woodland, which are dominated by the winter flowering Swamp Mahogany *(Eucalyptus robusta),* provide suitable roosting / nesting habitat for a selected number of bird and mammal species. A moderate amount of fallen timber is present throughout these vegetation communities, a habitat feature providing sub-optimal refuges for several ground-dwelling species of reptile, amphibian, mammal and mollusc.

Hollow bearing or habitat trees were identified throughout these vegetation communities during the survey with no hollows considered suitable for large forest owls (refer to Figure 5 for location). Substantial quantities of nectar will be available throughout the Swamp Mahogany tree canopy during winter, a habitat feature promoting a suitable foraging environment for many species of insectivorous / nectivorous avifauna. Species of particular interest that may frequent these habitats include the Scarlet Honeyeater (*Myzomela sanguinolenta*), Regent Honeyeater (*Xanthomyza phrygia*) and Swift Parrot (*Lathamus discolor*).

Vegetation communities 1 - Scribbly Gum Open Forest-Dry Understorey, 2 - Scribbly Gum Open Forest-Moist Understorey and 3 - Forest Red Gum Woodland are dominated by the spring-summer flowering Smooth-barked Apple and winter-spring flowering Forest Red Gum *(Eucalyptus tereticornis).* These two (2) species provide a large variety of fauna habitat values ranging from tree hollows and subterranean tunnels to various canopy cover stratums. Fallen timber and other imported debris including dumped car bodies provide a number of shelter / refuge sites for reptiles and mammals. Density of hollow-bearing trees is

greatest within these communities ranging in size from <5 cm in diameter to 30+ cm in diameter. These habitat features provide suitable roosting / nesting sites for small to large sized mammals, micro-chiropteran bats and small to large sized avifauna. Hollows suitable for large forest owls are present within these communities.

The shrub understorey of vegetation community's 1-Scribbly Gum Open Forest-Dry Understorey and 2-Scribbly Gum Open Forest-Moist Understorey contain stands of *Allocasuarina littoralis*, which provides suitable foraging habitat for the Glossy Black-Cockatoo.

An ephemeral drainage line passes through the centre of the subject site. This environment provides potential foraging and breeding habitat for a variety of common amphibians and reptiles. The shrubby understorey and tall sedge groundcover also provides a mosaic of habitats for small to medium sized avifauna and mammal species including macropods, rodents and potentially bandicoots.

Exotic species, including introduced grasses, dominate the dense groundcover of the Forest Red Gum Woodland, which provides suitable habitat for birds often frequenting grassland habitats.

The vegetation within the subject site comprises part of a continuous wildlife corridor within the local area. Land-uses to the south and east are characterised by residential / rural environments. To the west and north are large tracts of undisturbed bushland, including a portion of Lake Macquarie SRA.

4.10 Threatened fauna

Five (5) threatened species of fauna were identified within the subject site. These species are Squirrel Glider (Petaurus norfolcensis), Glossy Black-Cockatoo (Calyptorhynchus lathami), Grey-headed Flying-fox (Pteropus poliocephalus), Eastern Freetail-bat (Mormopterus norfolkensis) and Brown Treecreeper (Acanthiza pusilla).

4.10.1 State legislative matters

TSC Act (1995) - A search of the Atlas of NSW Wildlife (DECC 2008) database for threatened species resulted in records of thirty-five (35) threatened species within a 10 km radius of the subject site. Table 6 identifies whether the subject site provides potential habitat for these species.

Pelagic threatened species found within 10 km have not been included. Estuarine shore birds occurring within the 10km range of the subject site have been included as the subject site provides frontage to Lake Macquarie.

Table 6 – Threatened Fauna

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Wallum Froglet *Crinia tinnula*	Found in acidic paperbark swamps and wallum country with dense groundcover. Breeds in temporary and permanent pools and ponds of high acidity. Distribution Limit- N-Tweed Heads S-Kurnell.	Identified 5 km to the E of the subject site. Potential habitat present within subject site.	V	-
Giant Burrowing Frog * *Heleioporus australiacus*	Inhabits open forests and riparian forests along non-perrenial streams, digging burrows into sandy creek banks. Distribution Limit- N-Near Singleton. S-South of Eden	EPBC Act identifies habitat is likely to occur within area. No potential habitat present within subject site.	V	V
Giant Barred Frog *Mixophyes iteratus*	Terrestrial inhabitant of rainforest and open forests. Distribution Limit- N-Border Ranges National Park. S-Narooma.	Identified 10 km to the SW of the subject site. No potential habitat present within subject site.	E	E
Red-crowned Toadlet *Pseudophryne australis*	Prefers sandstone areas, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non-breeding periods. Distribution Limit- N-Pokolbin S-Near Wollongong	Identified 8kms to the NW of the subject site. No potential habitat present within subject site.	V	-
Green and Golden Bell Frog *Litoria aurea*	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. Distribution Limit – N-Byron Bay. S-South of Eden	Identified 10 km to the SW of the subject site. No potential habitat present.	E1	V

Table 6 – Threatened Fauna

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Green Thighed Frog *Litoria brevipalmata*	Found in rainforests and open forests within or at the edge of streams, swamps, lagoons, dams and ponds. Distribution Limit – N-Border Ranges National Park. S-Near Gosford	Identified 8kms to the NW of the subject site. No potential habitat present within subject site.	V	-
Littlejohn's Tree Frog * *Litoria littlejohnii*	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. Distribution Limit – N-Hunter River. S-Eden	EPBC Act identifies habitat is likely to occur within area. No potential habitat present within subject site.	V	V
Broad-headed Snake * *Hoplocephalus bungaroides*	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. Distribution Limit - N-Mudgee Park. S-Nowra	EPBC Act identifies habitat is likely to occur within area. No potential habitat present within subject site.	E	E
Painted Snipe * *Rostratula benghalensis*	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. Distribution Limit- N-Tweed Heads S-South of Eden	EPBC Act identifies habitat is likely to occur within area. No potential habitat present within subject site.	V	-
Black Bittern *Ixobrychus flavicollis*	Freshwater & brackish streams & ponds. Distribution Limit - N-Tweed Heads. S-South of Eden.	Identified within 1 km of the subject site. Potential habitat present within subject site.	V	-
Black-necked Stork *Ephippiorhynchus asiaticus*	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats. Distribution Limit - N-Tweed Heads. S-Nowra.	Identified 4 km to the SW of the subject site. Potential habitat present within subject site.	E	-

Table 6 – Threatened Fauna

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Barking Owl ** *Ninox connivens*	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. Distribution Limits- N-Border Ranges National Park S-Eden	Potential habitat present within subject site.	V	-
Broad-billed Sandpiper Limicola falcinellus	Inhabits tidal mudflats, reefs, saltmarsh, and freshwater wetlands. Distribution Limit N Tweed Heads S -Sydney	Identified 9kms to the SSE of the subject site. Potential habitat present within subject site.	V	
Glossy Black-Cockatoo Calyptorhynchus lathami	Open forests with Allocasuarina species and hollows for nesting. Distribution Limit - N-Tweed Heads. S-South of Eden.	Identified 3 km to the NW of the subject site. Evidence of foraging and known habitat present within subject site.	V	-
Gang-gang Cockatoo ** Callocephalon fimbriatum	Prefers wetter forests and woodlands from sea level to > 2000m on Divide, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. Distribution Limit –mid north coast of NSW to western Victoria	Potential habitat present within subject site.	V	-
Masked Owl Tyto novaehollandiae	Open forest & woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. Distribution Limit - N-Border Ranges National Park. S-Eden	Identified 5 km to the W of the subject site. Potential habitat present within subject site.	V	-

Table 6 – Threatened Fauna

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Osprey Pandion haliaetus	Utilises waterbodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding. Distribution Limit - N-Tweed Heads. S-South of Eden.	Identified 7 km to the SE of the subject site. Potential habitat present within subject site.	V	-
Pied Oystercatcher Haematopus longirostris	Inhabits coastal beaches and estuarine flats. Distribution Limit N-Tweed Heads S-South of Eden.	Identified 10 km to the SE of the subject site. Potential habitat present within subject site.	V	-
Powerful Owl Ninox strenua	Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting. Distribution Limits - N-Border Ranges National Park. S-Eden	Identified 5 km to the W of the subject site. Potential habitat present within subject site.	V	-
Brown Treecreeper Climacteris picumnus victoriae	Occupies Eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. Distribution Limit. (Sub species victoriae) Central NSW west of Great Div. Cumberland Plains, Hunter Valley, Richmond, Clarence and Snowy River Valleys.	Sub-optimal habitat present within the subject site. This species was identified within the subject site.	V	-
Regent Honeyeater Xanthomyza phrygia	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. Distribution Limit - N-Urbanville. S-Eden	Identified within 1km of the subject site. Potential habitat present within subject site.	E	E

Table 6 – Threatened Fauna

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Rose-crowned Fruit-dove Ptilinopus regina	Occurs in dense rainforests with a substantial understorey where it feeds entirely on fruit. Distribution Limit - N-Tweed Heads. S-Wollongong.	Identified 6 km to the E of the subject site. No potential habitat present within subject site.	V	-
Sooty Owl Tyto tenebricosa	Tall, dense, wet forests containing trees with very large hollows. Distribution Limit – N-Border Ranges National Park. S-South of Eden	Identified 9kms to the NW of the subject site. No potential habitat present.	V	-
Sooty Oystercatcher Haematopus fuliginosus	Inhabits coastal beaches and rocky foreshores. Distribution Limit - N-Tweed Heads S-South of Eden.	Identified 10kms to the SE of the subject site. Sub-optimal habitat present within subject site.	V	
Superb Fruit-dove Ptilinopus superbus	Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. Distribution Limit - N-Border Ranges National Park. S-Bateman's Bay.	Identified 6 km to the S of the subject site. No potential habitat present within subject site.	V	-
Swift Parrot Lathamus discolor	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Identified within 1km of the subject site. Potential habitat present within subject site.	E	E
Turquoise Parrot Neophema pulchella	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. Distribution Limit – N-Near Tenterfield. S-South of Eden.	Identified 9kms to the NW of the subject site. Potential foraging habitat present.	V	-

Table 6 – Threatened Fauna

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Common Planigale Planigale maculata	Utilises a range of habitats including rainforest, dry open forest, grasslands and marshland with dense groundcover, a deep litter layer and log debris. Distribution Limit- N-Walgett S-Sydney.	Identified 10 km to the SE of the subject site. Potential habitat present within subject site.	V	-
Koala Phascolarctos cinereus	Inhabits both wet & dry eucalypt forest on high nutrient soils containing preferred feed trees. Distribution Limit - N-Tweed Heads. S-South of Eden	Identified 4 km to the SE of the subject site. Potential habitat present within subject site.	V	-
Spotted-tailed Quoll Dasyurus maculatus	Dry and moist open forests containing rock caves, hollow logs or trees. Distribution Limit- N-Mt Warning National Park S-South of Eden.	Identified 6 km to the E of the subject site. Potential habitat present within subject site.	V	-
Long-nosed Potoroo** Potorous tridactylus	Coastal heath and dry and wet sclerophyll forests with a dense understorey. Distribution Limit - N-Mt Warning National Park. S-South of Eden.	EPBC Act identifies habitat is likely to occur within area. Potential habitat present within subject site.	V	V
Brush-tailed Rock-wallaby Petrogale penicillata	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. Distribution Limit - N-North of Tenterfield. S-Bombala.	EPBC Act identifies habitat is likely to occur within area. No Potential habitat present within subject site.	V	V
Squirrel Glider Petaurus norfolcensis	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. Distribution Limit N- Tweed Heads S-Albury.	This species was captured within the subject site.	V	-

Table 6 – Threatened Fauna

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Yellow-bellied Glider Petaurus australis	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. Distribution Limit- N-Border Ranges National Park. S-South of Eden.	Identified 5 km to the W of the subject site. No potential habitat present within subject site.	V	-
Grey-headed Flying-fox Pteropus poliocephalus	Found in a variety of habitats, including rainforest, mangroves, paperbark swamps, wet & dry sclerophyll forests and cultivated area. Distribution Limit - N- Rockhampton S-Western Victoria.	Identified 3 km to the SE of the subject site. This species was observed foraging within the subject site (Woodward-Clyde, 1996).	V	V
Large-eared Pied Bat * Chalinolobus dwyeri	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. Distribution Limit - N-Border Ranges Nation Park. S-Wollongong.	EPBC Act identifies habitat is likely to occur within area. Potential habitat present within subject site.	V	V
Eastern Bent-wing Bat Miniopterus schreibersii	Prefers areas where there are caves, old mines, old buildings, stormwater drains & well timbered areas. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Identified 4 km to the SW of the subject site. Potential habitat present within subject site.	V	-
Eastern Freetail-bat Mormopterus norfolkensis	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. Distribution Limit - N-Woodenbong. S-Pambula.	Identified 5 km to the W of the subject site. Recorded within subject site.	V	-
Greater Broad-nosed Bat Scoteanax rueppellii	Inhabits areas containing moist river & creek systems especially tree lined creeks. Distribution Limit - N-Border Ranges National Park. S-Pambula.	Identified 5 km to the NW of the subject site. Potential habitat present within subject site.	V	-

Table 6 – Threatened Fauna

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Eastern False Pipistrelle Falsistrellus tasmaniensis	Recorded roosting in caves, old buildings and tree hollows. Distribution Limit- N-Border Ranges National Park S-Pambula.	Identified 5 km to the NE of the subject site. Potential habitat present within subject site.	V	-
Large-footed Myotis Myotis adversus	Rainforests and sclerophyll forests near creeks and lakes over which it feeds. Roosts in tree hollows, caves, mines and tunnels. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Identified 2 km to the NE of the subject site. Potential habitat present within subject site.	V	-
Little Bent-wing Bat Miniopterus australis	Roosts in caves, old buildings and tree hollows in the higher rainfall forests along the south coast of Australia. Distribution Limit - N-Border Ranges National Park. S-Sydney.	Identified 8 km to the E of the subject site. Potential habitat present within subject site.	V	-
Yellow-bellied Sheathtail-bat ** Saccolaimus flaviventris	Rainforests, sclerophyll forests and woodlands. Distribution Limit - N-North of Walgett. S-Sydney.	Identified 12.7 km to the SE of the subject site. Potential habitat present within subject site.	V	-
* - Denotes species listed in EPBC Act search, but not recorded within 10 km of the subject site on the Atlas of NSW Wildlife database				
** - Denotes species not recorded within 10 km of the subject site on the Atlas of NSW Wildlife database but recorded in local area studies or considered to have potential habitat.				

A habitat assessment of the vegetation communities present within the study area, combined with knowledge on the location of local threatened species populations, yielded the identification of potential habitat for a number of threatened species within the subject site. A detailed assessment in accordance with Section 5A of the *EP&A Act* (1979) will be completed for these species in Section 5 of this report.

Fisheries Management Act (1994) – No habitats suitable for marine/aquatic species were observed within the subject site and as such the provisions of this Act do not require any further consideration.

4.10.2 Endangered fauna populations

There are no known endangered fauna populations within the Lake Macquarie LGA.

4.10.3 National legislative matters

EPBC Act (1999) - A review of the schedules of the *EPBC Act* (1999) identified the presence of five (5) additional threatened species to that of the TSC search, with 'likely' habitat within a 10km radius of the subject site. These species have been listed in Table 6 and those with potential to utilise the subject site will be considered in the seven-part test within Section 6. A referral to Department of the Environment, Water, Heritage & the Arts should not be required.

4.10.4 Koala habitat assessment

Three (3) Koala food tree species (*Eucalyptus robusta, Eucalyptus haemastoma and Eucalyptus tereticornis)* listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection, were observed within the subject site. Within the Forest Red Gum Woodland vegetation community Koala food tree *Eucalyptus tereticornis* is present at a density of 65% within the upper strata. Within the Scribbly Gum Woodland vegetation community approximately 50% of the trees were the Koala food species *Eucalyptus haemastoma.* Within the Swamp Mahogany Woodland vegetation community the Koala food tree *Eucalyptus robusta* comprises 90% of the trees. The tree density within the Forest Red Gum Woodland, Open Forest, Scribbly Gum Woodland and Swamp Mahogany Woodland vegetation communities is greater than the 15% indicated by SEPP 44 as a minimum for classification as Potential Koala Habitat. Therefore the site is considered to form Potential Koala Habitat within these communities as defined within SEPP 44.

No Koalas were observed during the various fauna surveys undertaken between 1996 and 2008. A search of the Atlas of NSW Wildlife (DECC 2008) database found seventeen (17) records of Koala habitation within a 10 km radius from the subject site. The closest record was approximately 3.5 km to the south east of the subject site and was recorded in 2006. Due to the lack of evidence of use of the site by the Koala or secondary evidence of use, the site is not considered to form Core Koala Habitat as defined within SEPP 44.

4.10.5 Impacts upon threatened fauna species

Squirrel Glider

Squirrel Gliders inhabit dry sclerophyll forest and woodland in south-eastern Australia away from the denser forests of the coastal ranges. This species usually occurs in areas with high nutrient soils below 600m ASL, where high nectar-producing eucalypts and flowering shrubs are present (SFNSW 1997). Squirrel Gliders feed on nectar, pollen, eucalypt sap, *Acacia* gum, honeydew and arthropods (*Menkhorst & Collier* 1988; *Quin* 1993).

Banksia, Xanthorrhea and *Acacia* species provide important food resources for Squirrel Gliders (SFNSW 1997). These food sources are considered to be more abundant in mature forest because of greater tree canopy size and tree trunk surface area of individual trees. Squirrel Gliders require trees with hollows for nests and den sites. The observations made of this species in eastern NSW have been noted foraging in the canopy at a height of generally 15 to 20 metres on dry upper slopes and ridges.

Both the Squirrel Glider and Sugar Glider were found to be occurring in symbiosis within the subject site. The majority of captures were of the Squirrel Glider, although some Sugar Gliders were captured and the vocalisations of this smaller Petaurus species were heard

clearly on a number of survey nights. In total, three (3) adult individuals and one juvenile Squirrel Glider were captured (with a total of 6 captures). An adult individual was also spotlighted.

Small Petaurus gliders being either Squirrel or Sugar gliders were also recorded in trees HT92 and HT 174 during recent 2008 stag-watching surveys. These two species cannot be accurately identified with a spotlight at the distances observed.

Smith (2002) outlines habitat information required to assist in making any merit based assessment on clearing impacts in relation to the Squirrel Glider population within the Wyong Shire. Based on this document, the following issues are relevant:

- The habitat quality within the Vegetation Communities of the subject site is generally medium to high for Squirrel Gliders, with tree species such as Smooth-barked Apple (Angophora costata), Red Bloodwood (Corymbia gummifera), Scribbly Gum (Eucalyptus haemastoma) and Swamp Mahogany (Eucalyptus robusta) dominating;
- The remnant habitat within the site is over 30 hectares, which is considered the optimum size for the maintenance of population viability;
- Approximately 134 hollow-bearing trees with entrances greater than 10cm considered suitable for Squirrel Gliders were recorded for the subject site. This is a generous estimate given the majority may have a lack of depth or other suitable characteristics. The density of habitat trees from this is estimated at 3.7 per hectare;
- The abundance of food trees is high within the subject site, with the prominence of Melaleuca spp. within the understorey of the lower lying vegetation communities also being of important value;
- The edge to area ratio of the vegetation is very small, which increases the value of the habitat on the site;
- Fire events and historical clearing have impacted upon the subject site, although natural revegetation is occurring. Weed presence is generally low throughout the site, although weeds have impacted upon the Forest Red Gum vegetation community (adjacent to the residential area) and along the foreshore;
- The subject site has residential development located along the eastern boundary, with natural vegetation occurring on the west and southern boundaries. Lake Macquarie Foreshore occurs on the remaining northern boundary.
- It is considered that resident Squirrel Gliders are breeding within (or within close proximity to) the subject site, as three adults and one juvenile have been captured within the subject site during surveys by Conacher Travers in 2000.

The above points indicate that the subject site is generally of high habitat value for the local population of Squirrel Gliders, although the reduced density of observed tree hollows due to previous disturbances reduces the habitat value for nesting.

Glossy Black-Cockatoo

The Glossy Black-Cockatoo utilises a range of forest types including coastal forests, woodlands and timbered watercourses with *Allocasuarina* species in the canopy or understorey. It feeds almost exclusively on the fruit of *Allocasuarina torulosa* (Forest Oak) and *Allocasuarina littoralis* (Black She-oak) in coastal forests, woodlands (Blakers et al. 1984) and timbered watercourses (Pizzey & Knight 1997). It apparently does not feed on *Casuarina glauca* (UBBS 1997).

Observations have shown that this species spends the greater part of the day feeding on *Allocasuarinas* and during that time only frequents areas where *Allocasuarinas* are dominant, and then only on those trees with the greatest density of fruit (*Clout* 1989).

Habitat also consists of Eucalypts, native cypress and Acacia scrub (*Pizzey & Knight* 1997). Characteristic chewed cones beneath trees indicate the presence of this species. Breeding habitat requirements include high large hollows where adults will produce one egg every season on a woodchip based nest floor (*Pizzey* 1997).

The Glossy Black-Cockatoo was not directly observed within the subject site during target surveys in 2000 however characteristic chewed cones underneath *Allocasuarina littoralis* trees were located. The presence of these chewed cones is a known indicator of this species presence. Visual observations were made by *Travers environmental* during recent surveys on 15 October 2008, where three individuals flew into the south eastern corner of the site late in the afternoon at the High Street entry point. These individuals were not observed to forage on-site at this location but later flew off site nearby to forage on street trees (locations shown on Figure 5). This species has been recorded foraging on adjoining peninsulas 3km to the northeast (LMCC 1997; NPWS 2004) and southeast (LMCC 1997). Local bird-watching residents have observed Glossy Black-Cockatoos foraging on *Allocasuarina littoralis* for extended periods within the subject site in 1999 and 2000. The dates recorded for this species foraging in the subject site by the local residents were 8/11/99 – 11/1/99, 21/6/99 - 23/8/99, 26/11/99 – 12/12/99 and 28/12/99 – 24/1/00.

The subject site contains stands of mature Allocasuarina littoralis (Figures 4A) together with approximately twenty (20) suitably sized (large) nesting hollows. These hollows were evident in large specimens of Smooth-barked Apple, Scribbly Gum and stag trees. Hollow bearing trees were targeted during 2000 surveys within the breeding season for this species, with no observations of hollow utilisation recorded. The twenty hollows that are identified as suitable for large forest owls within the subject site, also considered the most suitable for Glossy Black-Cockatoo. These trees were stag-watched during recent 2008 surveys with no utilisation by Glossy Black-Cockatoos recorded.

Figure 4A identifies the distribution of mature Allocasuarina littoralis throughout the site from 2000 surveys. Juvenile A. littoralis were indicated to also occur throughout the majority of the site at this time; these trees are now considered mature and thus feeding resources are more available throughout. Mature stands of Allocasuarina are considered likely to provide important foraging habitat for this species, particularly when considering the recorded use of these trees within the site by local bird enthusiasts (direct bird observations) and during the fauna surveys.

Grey-headed Flying-fox

The Grey-headed Flying-fox is found in a variety of habitats, including rainforest, mangroves, paperbark swamps, wet and dry sclerophyll forests and cultivated area. Its major food source is eucalypt blossom and native fruits from a variety of tree species (Churchill 1998). Churchill (1998) also states that native figs account for a large percentage of the fruit eaten, while they have also been found to chew leaves and appear to eat the salt glands from mangroves. These bats have a nightly feeding range of 20 to 50 km from their camp, which can consist of up to 200 000 individuals.

This species was recorded during the previous survey by Woodward-Clyde (1996). The entirety of the subject site, which is dominated by either Eucalyptus species or mangroves comprises known foraging habitat for this species. There is no suitable roosting habitat for camps of this species within the subject site.

Eastern Freetail-bat

The Eastern Freetail-bat utilises forests and woodlands with grassland interfaces for foraging and tree hollows for roosting / breeding. The subject site contains numerous small hollows

that are suitable for roosting / breeding and vegetation interfaces with open areas that are suitable for foraging. This species was recorded within the subject site foraging within the canopy of the Scribbly Gum Open Forest – Moist Understorey vegetation community and the Forest Red Gum Woodland vegetation community on two consecutive nights in August 2000 and in further surveys carried out on 20 March 2002 foraging in the Forest Red Gum vegetation Community.

Brown Treecreeper

The eastern sub-species of the Brown Treecreeper frequent drier forests and woodlands, and also paddocks and grasslands where there are sufficient logs, stumps and dead trees nearby. The Brown Treecreeper prefers predominantly rough-barked trees such as stringybarks and rough boxes. This species roosts and breeds in tree hollows. The Brown Treecreeper is sedentary and is usually seen in pairs or small family groups (*ACT Government,* 1999). This species was observed during surveys carried out in 2000. No record was made of the exact location of the sighting as the species was not listed as a threatened species at this time. Target surveys in 2002 as well as additional recent surveys in 2007 did not record this species within the subject site. The subject site is considered sub-optimal habitat for the Brown Treecreeper.

Other Threatened Fauna Species Concerns

Grass Owl & Masked Owl

Woodward-Clyde (1996) considered that the subject site provides potential foraging habitat for the Grass Owl and Masked Owl. Inspections by *Conacher Travers* have identified that the site provides potential foraging habitat for the Masked Owl only. The habitat suitability of the site for the Grass Owl is considered to be minimal and this species has not been recorded within 10km of the subject site, therefore this species will not be further considered.

In reference to the site's significance as foraging habitat for the Masked Owl, it is considered that the alternative foraging habitat available throughout the Wyee Point locality is sufficient for the long-term viability of this species within the local area. It is likely that the subject site only comprises part of a wider potential foraging range for this species. This species is known to utilise both undisturbed and disturbed habitats for foraging, which may include residential / rural landscapes with a bushland interface. Breeding habitat is often restricted to undisturbed bushland remnants of substantial size. The presence of *Lake Macquarie SRA* to the north of the subject site, together with substantial tracts of natural bushland to the immediate west indicates that potential foraging and breeding habitat within the local area is well represented and partially conserved within the regional reserve network.

Despite target surveys including call-playback techniques and stag-watching of suitable roosting / breeding trees, no records of this species have been detected within the subject site.

Powerful Owl

The Powerful Owl breeds in open or closed sclerophyll forests and woodlands, including wet sclerophyll forest and dry sclerophyll forest and woodlands. They nest in hollows in large old trees; usually living Eucalyptus, within or below canopy in stumps or broken-off trunks. (Higgins 1999). Powerful Owls are sedentary within home ranges of about 1,000 hectares within open eucalypt, casuarina or *Callitris* pine forest and woodlands, though they often roost in denser vegetation, including rainforest or exotic pine plantations (Garnett & Crowley,

2000). Powerful Owls feed mainly on those medium-sized species of arboreal marsupials that are most readily available at any given locality (*Lavazanian et.al).* (1994).

The subject site contains suitable breeding and roosting habitat for this species. Despite target surveys including call-playback techniques and stag-watching of suitable breeding trees, no records of this species have been detected within the subject site.

Regent Honeyeater and Swift Parrot

Habitat characteristics of the Swamp Mahogany Woodland vegetation community provide potential foraging habitat for the endangered migratory Regent Honeyeater and Swift Parrot. Both of these species often forage for nectar throughout the canopy of Swamp Mahogany forests during the winter months. Specimens of both these species have been previously recorded within the Wyee Point local area, within 1 km of the subject site (DECC 2008). Despite targeted surveys, neither of these species was observed during the surveys carried out on this site by *Woodward-Clyde* (1996), *Conacher Travers* (2000, 2002, 2007) or *Travers environmental* (2008).

4.11 Regional significance

Table 7 lists those fauna species that have been recorded as observed within the subject site during surveys by *Travers environmental, Conacher Travers* and *Woodward-Clyde* as Regionally Significant Species within the *Lake Macquarie City Council Guidelines Version 2* (2001)

Table 7 – Regionally Significant Fauna of the Wyee Point Local Area

Common name	**Scientific name**
BIRDS	
Southern Emu-wren	*Stipiturus malachurus*
Swamp Harrier	*Circus approximans*
Southern Emu Wren	*Stipiturus malachurus*
Swamp Harrier	*Circus approximans*
Barn Owl	*Tyto alba*
Brown Treecreeper	*Acanthiza pusilla*
White-bellied Sea Eagle	*Haliacotus leucogaster*
MAMMALS	
Yellow-footed Antechinus	*Antechinus flavines*
Eastern Grey Kangaroo	*Macropus giganteus*
Red-necked Wallaby	*Wallabia bicolor*
Sugar Glider	*Petaurus breviceps*
Southern Forest Bat	*Vespadelus regulus*
Eastern Forest Bat	*Vespadelus pumilus*
REPTILES	
Eastern Brown Snake	*Pseudonaja textilis*

Southern Emu-wren
The Southern Emu-wren is a species restricted to coastal districts of south-eastern and southwestern Australia. This species has been reported to be locally common, vulnerable or endangered throughout its range primarily due to the fragmentation of these species habitats within its prescribed distribution (*Pizzey* 1997). This species was observed by *Conacher Travers* foraging in the cleared grassy area of the Forest Red Gum Woodland on several occasions in August 2000 and March 2002.

Swamp Harrier
The Swamp Harrier can be found Australia wide where habitat persists. The Swamp harrier prefers swamps and wetlands, tall grasslands, grain-crops, coastal heathland and salt marshes (*Pizzey* 1997). This species was observed by *Conacher Travers* hovering above the edges of the Scribbly Gum Open Forest to the western end of the subject site on 21 March 2002.

Barn Owl
The Barn Owl is widespread across Australia preferring open forests, woodlands, grasslands, farmlands and wherever house mice are abundant (Pizzey 1997). A Barn Owl was observed by *Conacher Travers* on 23 August 2000 during spotlighting roosting at the western end of the Scribbly Gum Open Forest.

Brown Treecreeper
The Brown Treecreeper is considered rare to the area and prefers drier open woodlands with large amounts of fallen timber on which to forage. The Brown Treecreeper was observed by *Conacher Travers* on one occasion on 3 May 2000 foraging on the trunk of a eucalypt tree.

White-bellied Sea Eagle
The White-bellied Sea Eagle is found along coastal Australian shores and along larger rivers, lakes and storages, estuaries and reservoirs. White-bellied Sea Eagles were observed several times by *Conacher Travers* during surveys of March 2002 above the Lake and surrounding area. A juvenile was observed roosting in Swamp Mahogany on the Lake foreshore on the morning of 21 March 2002 and an adult bird was observed above the tree tops and flying above the Lake shore on the evening of 20 March 2002 and again in the morning of 21 March 2002.

Yellow-footed Antechinus
The Yellow-footed Antechinus is the most widespread *Antechinus* occurring from north-eastern Queensland to south-western Western Australia and enjoys a broad spectrum of habitats (*Strahan* 1995). A Yellow-footed Antechinus was trapped by *Conacher Travers* in an arboreal set Elliott Trap on 5 September 2000 positioned the Scribbly Gum Open Forest with dry understorey.

Eastern Grey Kangaroo
Eastern Grey Kangaroos are distributed throughout the eastern states of Australia in habitats ranging from semi-arid mallee to woodland forests (*Strahan* 1995). The Eastern Grey Kangaroo is common on the subject site, it has been observed on most survey dates.

Red-necked Wallaby
The Red-necked Wallaby is found in the forests of southeast Australia in eucalypt forests where there is at least a moderate shrub stratum with open areas nearby. The Red-necked Wallaby was observed by *Conacher Travers* on several occasions in March 2002 feeding in the Scribbly Gum Forest with wet understorey near the power easement on the southern boundary of the subject site.

Sugar Glider
The Sugar Glider is distributed across the north of Australia an along the east coast including Tasmania. This species is hollow dependant, preferring areas where tree hollows are available for shelter and there is abundant food such as gum produced by acacias, nectar, pollen and the sap of certain eucalypts (*Strahan* 1995). *Conacher Travers* recorded Sugar Gliders both visually and by call during surveys conducted in 2000.

Small Petaurus gliders being either Squirrel or Sugar gliders were also recorded in trees HT92 and HT174 during recent 2008 stag-watching surveys. These two species cannot be accurately identified with a spotlight at the distances observed.

Southern Forest Bat
The Southern Forest Bat is distributed from the Queensland NSW border through to Perth WA. It prefers rainforests to wet sclerophyll forest, shrubland and low shrub woodland (Churchill 1998). This species is hollow dependant. The Southern Forest Bat was recorded by *Conacher Travers* via echolocation detection on 20 and 25 March 2002 foraging in both the Forest Red Gum and Scribbly Gum dry understorey Vegetation Communities and was trapped via a Harp Trap set on 26 March 2002 (Harp Trap 8) in the Scribbly Gum dry understorey Vegetation Community.

Eastern Forest Bat
The Eastern Forest Bat has a scattered distribution but is mainly confined to the north and central coastal areas of NSW. It enjoys most forest types from tropical, sub tropical wet and dry sclerophyll forests, and is not known to live in caves so is presumably a forest dweller. (Churchill 1998). *Conacher Travers* recorded this species via echolocation on 22 August 2000 foraging in the Scribbly Gum forest vegetation communities.

Eastern Brown Snake
The Eastern Brown Snake is distributed in the eastern states of Australia, occupying a wide range of habitat from wet and dry sclerophyll forests and heaths of the coasts and ranges (*Cogger* 2000). *Conacher Travers* observed this species during field work in August 2000.

No other species observed within the subject site throughout the duration of the fauna survey are considered to be of regional significance within the Sydney Basin Bioregion.

4.12 Other impacts

The potential ecological impact on this site relates to the impact not only from the construction of the building, but also the long term environmental impacts that can result from any development undertaken within vegetated landscapes. The potential ecological impacts on this site relate to tree removal, interruption to canopy connectivity, functioning of watercourses, construction and implementation of asset protection zones and the potential impacts on the three identified EEC's.

Tree Removal - Tree removal will be restricted to the development portion of the site, and then only if necessary as assessed on a lot by lot basis. All trees will be retained within the foreshore reserve, public open space and wildlife corridor. A habitat tree assessment has been undertaken in order to determine the abundance of hollow bearing trees within this locality.

Interruption to Canopy Connectivity - The subject site is situated at the apex of Wyee Point, a prominent area of land that extends into the southern margin of Lake Macquarie. Extensive areas of bushland are present throughout this peninsula and to the southwest, west and northwest. The subject site is connected to 400ha of native bushland to the south-west. Fragmented bushland and isolated trees characterise the landscape to the south and east, with large sized bushland remnants present to the east of Government Rd. At this stage the subject site provides a substantial vegetation linkage from areas to the west and northwest with areas to the south and east.

An interruption to canopy connectivity on this site has potential to impact upon the Squirrel Glider found on site during survey. As outlined above, it is proposed to retain approximately 4.03ha of connecting vegetation on this site within the Wildlife corridor and 11.50ha within the

foreshore reserve (see Figure 3). This area is to be the subject of a vegetation management plan and will be protected in perpetuity under a Section 88b agreement.

The loss of connectivity within this area is not considered significant when compared to the amount of canopy retention/revegetation proposed for the remainder of the site. The removal of canopy connectivity within the area proposed will not isolate any vegetation with existing connectivity to the south of the subject site.

Functioning of Watercourses - A number of small, poorly defined, drainage lines cross the study area in a generally south east to north-west direction, passing through the centre of the subject site, the west of the subject site and the north east of the subject site. These poorly defined drainage lines (together with overland flow) direct all runoff from the subject site into Lake Macquarie, the edge of which adjoins the northern boundary of the subject site. Approximately 15-20% of this runoff would flow into the unnamed creek that adjoins the north western boundary of the subject site and flows into Lake Macquarie.

4.13 Potential for better environmental outcomes

The subject site is currently an unmanaged landscape. Upon implementation of the recommendations from each of the reports prepared for this proposal, there is potential on this site to achieve a better environmental outcome than the current situation. Building envelopes, asset protection zones and retained vegetation areas have been designed for the proposal to ensure that the bulk of the development has been contained within the already cleared portions of the site.

The major drainage line is to be protected within the wildlife corridor. This corridor will provide a buffer to the development which is designed to protect the watercourse from overland flow and edge effects from the development.

An assessment of the bushfire protection requirements needed for the development to guard against the potential impact of bushfires has been prepared (*Travers environmental, 2008*). This assessment provides recommendations in respect of fuel management, construction standards / building protection, access, bushfire education and land ownership responsibility.

In order to maintain canopy connectivity across the site no tree clearing is to be undertaken retained vegetation portions of the site (foreshore reserve and wildlife corridor) as depicted on Figure 3. This will ensure that fauna movement is not impeded.

The three EEC's, Swamp Sclerophyll Forest on Coastal Floodplains, River-flat Eucalypt Forest on Coastal Floodplains and Coastal Saltmarsh, are to be predominantly retained and protected under the Section 88B agreement. The retention and protection of these EEC's will require the implementation of a vegetation management plan which will ensure the long term protection of the EEC's and other retained vegetation within the subject site.

A vegetation management plan is to be prepared for the threatened species. The plan will identify the area proposed for conservation and outline the management objectives for each species.

SECTION 5 – PEER REVIEW

5.1 Peer review

In June of 2008, *Forest Fauna Surveys* and *Eastcoast Flora Survey* performed a peer review of the draft *Travers environmental* Flora and Fauna assessment for Ramsgate Estate DP1596, Wyee Point (January, 2008). A response to the peer review (Appendix 1) was prepared for discussion with *Lake Macquarie City Council* in July 2008 where it was agreed that additional targeted survey was required to clarify the issues raised within the peer review. This related specifically to the presence or not of threatened orchid species, an additional EEC and potential habitat for the Powerful Owl and Masked Owl. A detailed and comprehensive habitat tree survey was also undertaken in association to this work. Additional flora surveys were undertaken during the peak flowering periods.

LHCCREMS vegetation mapping for the subject site suggests an area in the north-eastern portion is Map Unit 31 but is more consistent with Map Unit 38 (*Conacher Travers* previous Flora and Fauna Assessments) which is equivalent to the endangered ecological community River-flat Eucalypt Forest. This was not identified in previous reports and due to the low number of prominent mid-storey and upper stratum indicator species for River-flat Eucalypt Forest, it was originally ruled out. *Travers environmental* has now undertaken further extensive survey in the vicinity of the area referred to by *Conacher Travers* as Map Unit 38 to identify any portion that could be River-flat Eucalypt Forest. This grid based survey incorporated sampling of 51 quadrats within and adjacent to the questionable area and resulted in the vegetation community previously mapped as Forest Red Gum Woodland being divided into two (2) separate communities, with the one closest to Lake Macquarie been given EEC status.

The additional targeted survey has been incorporated into this report with the main findings being that;

- No threatened orchid species were recorded within the subject site during the additional survey period of August to September.
- No observations, calls, call-response or indicative signs (such as whitewash below potential breeding trees) were recorded for the threatened large forest owls (specifically Powerful Owl and Masked Owl) following the breeding period.
- 253 hollow-bearing trees were identified across the subject site. These contained a total of 740 hollows. These were broken down as 208 at <5cm, 220 hollows at 5-10cm, 141 hollows at 10-15cm, 83 hollows at 15-20cm, 37 hollows at 20-25cm, 15 hollows at 25-30cm, and 36 hollows at >30cm. All hollow tree data is provided in Appendix 2, where hollow sizes greater than 30cm are indicated.
- Vegetation communities within the north-eastern portion of the site have been re-defined. This area had been originally mapped as Forest Red Gum Woodland (*Conacher Travers*) and referred to as Map 38 under LHCCREMS that would be

classed as the endangered ecological community (EEC) River-flat Eucalypt Forest on Coastal Floodplains. A grid based system was applied (the methodology of which is explained in section 2) with the results suggesting that only a portion of the original vegetation community – Forest Red Gum Woodland is in fact commensurate with the EEC River-flat Eucalypt Forest on Coastal Floodplains.

- Two additional specimens of *Tetratheca juncea* were found near the southern boundary in the south-western corner of the subject site.

- No *Cryptostylis hunteriana* were observed in target surveys during January 2009.

5.2 Response to the review of ecological issues by *Forest Fauna Surveys* and *Eastcoast Flora Survey*.

This site has undergone extensive survey and assessment for a number of years and *Travers environmental* has been involved with this project since 1996, in which time we have prepared a number or reports. Some of these reports have never been submitted to Council for various reasons, such as changes in development design and changes in Council requirements and planning requirements.

In June of 2008, *Forest Fauna Surveys* and *Eastcoast Flora Survey* performed a peer review of our Ecological Assessment for Ramsgate Estate DP1596, Wyee Point (January, 2008) and we would like to take this opportunity to respond to a number of issues raised within this report. Each of the identified issues has been individually addressed below.

It should be noted that, to our knowledge, the draft Species Impact Statement (*Conacher Travers*, 2005) which has previously been provided to council was also referred to *Eastcoast Flora Survey* for review. This document provides comprehensive assessment and further detail on threatened species identified within the site.

1. ***The current location and size of the threatened Tetratheca juncea population on the site.***

The abundance of *Tetratheca juncea* has been surveyed by this firm on numerous occasions since 2000. An intensive targeted survey of two hours duration by two teams of two botanists / ecologists was completed on 11 February 2000 (a total of eight person hours) to search for *Tetratheca juncea* throughout the Scribbly Gum Open Forest – Dry Understorey and parts of the Scribbly Gum Open Forest – Moist Understorey.

Due to the presence of potential habitat, and the lack of flowering expected during the original survey period (being outside of the ideal flowering time), additional targeted surveys were undertaken on 28 August, 14 September and 9 October 2000 and on 2, 3, 4 and 24 January 2002.

These surveys resulted in the recording of only one small population of *Tetratheca juncea* within the Vegetation Community 1 – Scribbly Gum Open Forest – Dry Understorey. The actual location of the population is adjacent the southern boundary of the site in an area of approximately $15m^2$ consisting of less than 10 clumps. Although the number of clumps was not provided in the Ecological Assessment (*Travers environmental*, 2008), this information has been provided to council in the Species Impact Statement (*Conacher Travers*, 2005).

The location depicted on Figure 4 of the Ecological Assessment (Jan 2008) is incorrect and has been adjusted on the current Figure 4a.

Additional survey was undertaken on 14, 22 & 28 August, 5 September and 8 & 9 October 2008. This resulted in an additional 2 specimens being observed less that 1m apart. These are located in the south-western corner of the subject site and are depicted in Figure 4A.
The *Murray and Bell* (2008) report to council questioned the survey method undertaken when targeting this species and if it was undertaken in accordance with *Payne et. al* (2002). Flora survey was undertaken using a systematic stratified sampling regime within each of the identified vegetation communities. This comprised the placement of nineteen (19) 20x20 metre quadrats, twenty-one (21) walking transects and observations of 100 metre transects.

It is considered that appropriate survey methodology has been undertaken in addition to adequate survey times and repetition.

2. ***Additional surveys for the threatened orchid Cryptostylis hunteriana***

A search of the NSW Atlas Database (DECC 2008) shows records of 2 specimens within a 10km radius of the site, with the closest record for this species being approximately 3km to the west-south-west in 2000. Targeted survey was undertaken for this species in January 2002.

The flowering times provided by DECC (2005) are November to February whilst the *Lake Macquarie Survey Guidelines* state December to February. Targeted survey for this species was therefore undertaken within the recognised flowering times of this species and in accordance with the requirements of *Lake Macquarie City Council's Survey Guidelines* (2001).

Whilst the findings of Bell (2001) state the flowering times as November to December, NSW Atlas database (2008) records report that this species has been recorded during the months of September, November and January (DECC 2008).

In light of this, an additional targeted survey has been undertaken within the appropriate flowering time of this species during January 2009. No specimens were found.

3. ***Surveys for the threatened orchid Diuris praecox need to be conducted during the period July to August***

A search of the NSW Atlas Database (DECC 2008) shows records of 12 species within a 10km radius of the site, with the closest record for this species being 8.5km to the south-east in 2000. Targeted survey for this species was originally undertaken on 28 August 2000 and 2, 3, 4 and 24 January 2002.

Given that this species is most likely to flower during the period July to August, with some records of it flowering in September and October (DECC Wildlife Atlas database, 2008), it is considered that targeted survey in August 2000 was undertaken in accordance with the flowering time of this species.

Further targeted survey for this species was undertaken on the 14, 22 & 28 August and 5 September 2008. No specimens of *Diuris praecox* were observed.

4. ***Accurate identification and mapping of endangered ecological communities on the site an impact assessment based on s5A of the Environmental Planning and Assessment Act 1979 is required.***

Eastcoast Flora Survey advised that an additional Endangered Ecological Community (EEC) being present on site – River-flat Eucalypt Forest (RFEF) is also onsite.

The area in question has been mapped as MU31 – Coastal Plains Scribbly Gum Woodland although previous surveys by this firm suggested that this area is more consistent with MU38 – Red Gum Rough-barked Apple (although lacking in Rough-barked Apple). It appears that again there are discrepancies in the LHCCREMS mapping. There are few Scribbly Gums in this portion of land which is dominated by *Eucalyptus tereticornis* with occasional *Angophora costata.* In addition, no Rough-barked Apple trees (*Angophora floribunda*) were observed.

The NSW Scientific Committee characterised the RFEF vegetation community with an assemblage of eighty eight (88) native species. Of these twenty (20) were observed in the three (3) flora quadrats (0.04ha each) in July 2008. Individually, the percentage of RFEF indicator species in each quadrat was 52%, 61% and 57% respectively which is typically border-line on numbers alone.

Point 4 of the Scientific Committee's determination says "A layer of small trees may be present, including *Melaleuca decora, M. styphelioides, Backhousia myrtifolia, Melia azedarch, Casuarina cunninghamiana* subsp. *cunninghamiana* and *C. glauca*". None of these species were observed within the three (3) July 2008 quadrats.

Point 6 of the Scientific Committee's determination says there is a relatively low abundance or sub-dominance of Casuarina and Melaleuca species. A random meander did not locate any Casuarina or Melaleuca species unless within close proximity to the shoreline which has been mapped as "Swamp Oak Woodland" by us or until the central portion of the subject site which again has been mapped as alternative vegetation units consistent with the Swamp Sclerophyll Forest on Coastal Floodplains EEC. During surveys in late 2008, the survey intensity level was increased significantly and this located more individual Casuarina specimens that added to the validity of the RFEF.

Please find supporting information regarding LHCCREMS vegetation mapping attached as Attachment 1.

Additional assessment was undertaken on 8, 9 & 13 October 2008 incorporating 51 quadrats of 10x10m within the north-eastern corner. The data was assessed with percentages of indicative RFEF species higher when closer to the lake side. This was then followed by a re-mapping exercise that lead to a vegetation boundary change that split the Forest Red Gum Woodland community into two (2) – Forest Red Gum Woodland (EEC - RFEF) and Open Forest (*Angophora costata & Eucalyptus tereticornis*). This new community formed 7 in total for the subject site. The end analysis now shows that *Travers environmental* had previously overlooked this vegetation community which has now been marked on new site figures in the Ecological Assessment.

Mr Bell was provided with the quadrat data which he later analysed running various statistical programs. Those results differed slightly to the vegetation communities shown in the December 2008 report. Vegetation communities within the north-eastern portion of the site were re-visited with the boundaries amended slightly to conform with Mr Bells advice of using the *Eucalyptus tereticornis* as the boundary for RFEF vegetation. The vegetation boundaries were redrawn and the ecotonal community - Open Forest (*Angophora costata & Eucalyptus tereticornis*) was removed.

In regards to other EEC's present on site, we can advise that those present include;

- *Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions*
- *Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*

The habitat requirements and a small number of characteristic species of *Swamp Oak Floodplain Forest* were observed within community 6 – Swamp Oak Woodland / Saltmarsh. Several *Casuarina glauca* and other characteristic species were scattered throughout, however it is considered that Community 6 is more likely to be commensurate with the Endangered Ecological Community *Coastal Saltmarsh* rather than *Swamp Oak Floodplain Forest*.

It is believed that a narrow band of land beyond that which is periodically inundated to be an ecotone between the two abovementioned communities, however the species make up is more typical of the *Coastal Saltmarsh* EEC as opposed to a *Swamp Oak Floodplain Forest* EEC. As such, Swamp Oak Floodplain Forest is not considered to occur within the subject site.

The assessment of the identified EEC's is provided within Section 6 of the Ecological Assessment.

5. Anabat survey for Microchiropteran bats

Anabat survey has been undertaken for a total of 23.75hrs on the subject site over multiple surveys between 2000 and 2007. This survey has been undertaken in accordance with the *Lake Macquarie Survey Guidelines*. There are no requirements within this document stating that the devices have to be left overnight. The survey has been undertaken from dusk in all vegetation communities which would record the greatest majority of foraging microbat species utilising the site.

In addition, harp trapping has been undertaken on numerous occasions. Harp traps were left overnight from 6:30pm – 6:30am over 9 trap nights.

Due to the retention of foraging habitat for this species within the foreshore reserve and riparian corridor, further microbat survey is not considered necessary.

6. Targeted monthly surveys for nationally endangered Swift Parrot and Regent Honeyeater

Although these species were not recorded during survey, it is recognised that suitable habitat for both of these species exists on the site. This was addressed in detail in the Species Impact Statement (*Conacher Travers* 2005) which has previously been provided. Habitat characteristics of the Swamp Mahogany Woodland vegetation community provide potential foraging habitat for the endangered migratory Regent Honeyeater and Swift Parrot. Both of these species often forage for nectar throughout the canopy of Swamp Mahogany forests during the winter months. Specimens of both these species have been previously recorded within the Wyee Point local area, within 1 km of the subject site (DECC 2008). Despite targeted surveys, neither of these species was observed during the surveys carried out on this site by *Woodward-Clyde* (1996) or *Conacher Travers* (2000, 2002, 2007 & 2008).

Additional survey for both of these species is not considered necessary due to the retention of the majority of high quality habitat for both of these migratory species within the Foreshore Reserve and Habitat Corridor. Further detail is provided in point 7 below.

7. A revised impact assessment of the proposed rezoning on the Swift Parrot and Regent Honeyeater

Both of these species utilise Swamp Mahogany vegetation as a primary winter flowering food resource which provide the best quality foraging resource for the species in this area and will be conserved within the Foreshore Reserve and Habitat Corridor.

The impact upon these species has been addressed in depth in previous assessments, including the Ecological Assessment (*Travers environmental*, 2008/2009) and the Species Impact Statement (*Conacher Travers*, 2005). Both of these reports conclude that there will be no significant impact upon either of these species as a result of the proposed development.

Both of these species have been recorded in retained habitat in close proximity to residential development. One particular location where these species are known to occur reliably during the survey season is found at Suttons Reserve, Bateau Bay. This reserve is surrounded by urban residential development with no evidence of impact upon the use of this site annually by the Swift Parrot and occasionally by the Regent Honeyeater.

According to the DECC (2005), favoured feed trees of the Swift parrot include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*) and White Box (*E. albens*). Whilst Regent Honeyeaters are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the Central Coast.

Although potential winter flowering resources consisting of *Eucalyptus haemastoma*, *Corymbia gummifera* and *Eucalyptus resinifera* will be partially removed within the development area, significant trees are proposed to be retained where possible.

Due to the conservation of the majority of the best quality habitat for both of these species and the subsequent lack of significant impact, a revised impact assessment is not required for these species.

8. ***It is considered a referral to the Dept. Environment, Heritage, Water and the Arts would be required for the current proposal in light of the significance of habitat on site for nationally endangered species.***

Multiple assessments undertaken on this site have concluded that a referral is not required due to the lack of significant impact upon federally listed threatened species and/or communities.

Based on current updated assessment (and lack of threatened species recorded on site), a referral to the *Dept. Environment Heritage, Water & the Arts* is not required.

9. ***Details of the habitat tree survey need to be produced for analysis, particularly suitability for threatened large forest owls as roost and or nest sites, the squirrel glider and Microchiropteran bats.***

The *Murray and Bell* report states that “the report failed to present a detailed analysis of data on habitat trees on the subject site” and “the assessments of significance of the proposed rezoning on threatened species such as the Swift Parrot, Regent Honeyeater, Powerful Owl, and Masked Owl fail to recognise significant habitat attributes of the subject site”.

An updated survey of habitat trees throughout the subject site was undertaken from 14 to the 17 October 2008, as part of recent surveys. An uploaded image of the subject site as a background and an overlay grid system was prepared onto a handheld *Trimble Geo XT* unit. All meanders within grids were recorded to ensure a comprehensive coverage of the site. All trees with likely hollows were observed with binoculars from a minimum of two alternate angles. Data on hollows including the numbers within each size class (using 5cm increments) and types of hollows (eg trunk, branch, broken trunk, etc) were collected using a

pre-formulated custom dictionary within the handheld *Trimble* unit. Hollow-bearing trees were tagged with an updated number.

253 hollow-bearing trees were identified across the subject site – see Figure 1. These contained a total of 740 hollows. These were broken down as 208 at <5cm, 220 hollows at 5-10cm, 141 hollows at 10-15cm, 83 hollows at 15-20cm, 37 hollows at 20-25cm, 15 hollows at 25-30cm, and 36 hollows at >30cm. All hollow tree data is provided in Appendix 2.

All hollows with entry sizes greater than 40cm and other suitable characteristics suitable for the Masked Owl (*Tyto novaehollandiae*) and Powerful Owl (*Ninox strenua*) according to the habitat descriptions in the *Recovery Plan for the Large Forest Owls* (2006). These were stagwatched during recent surveys. Other hollows smaller than 40cm were also stag-watched if they displayed any evidence of potential owl activity or were indicated as potential by *Michael Murray* (2008). No large forest Owls were recorded as part of these target surveys. Stag-watching details and results are provided below in Attachment 4.

The proposed development has been designed to take into consideration the habitat for threatened species on this site. This design process has resulted in the reduction in developable area. Most significantly, it has resulted in the conservation of the foreshore reserve and habitat corridor.

A detailed analysis of habitat for each of the identified threatened species has been provided within Section 4.10.5 - Impacts upon Threatened Fauna Species.

Conclusion

Identified habitat for the Squirrel Glider is to be retained within the foreshore reserve area which maintains a vegetated link to the wildlife corridor. The large lot design and retention of significant trees within the development area (where possible) will assist in maintaining habitat for the Squirrel Glider as well as the two recorded bat species.

In addition, the retention of areas of Allocasuarina within the large allotments will assist in maintaining foraging habitat for the Glossy Black-cockatoo.

The Masked Owl and Powerful Owl have not been recorded on the site by any of the previous surveys undertaken or during recent stag-watching efforts targeting suitable breeding trees.

10. Stag watch surveys of potential nest sites for the Powerful Owl during the breeding period June to August.

In regard to the Powerful Owl, the 'significant habitat attributes' referred to by Murray and Bell are represented by the assertion that the hollow bearing trees provide significant habitat for these species. It is agreed that this would normally be the case. However, the survey results by both *Travers environmental* (2008/2009) and *Murray and Bell* (2008) do not support this assertion. These two large forest owls have not been recorded utilising hollows on this site by either of these studies.

Nocturnal bird survey has been undertaken in accordance with the requirements of the *Lake Macquarie Flora and Fauna Survey Guidelines* (2001) which do not list stag-watching as a target survey technique for these (or any) species. Summer and winter is indicated as the survey period for nocturnal birds. Additionally, the DECC's *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (working draft) (DECC 2004) state that the survey period for every method of nocturnal bird survey is all year. Owl call playback has been undertaken within and outside of the breeding seasons for both of these

species on several occasions between 2000 and 2007, with no individuals of either species being recorded.

Based on *Travers environmental* experience, the playback technique used is effective outside of the breeding season for the species targeted. According to *Pizzey and Knight* (1997), the breeding seasons of the majority of *Tyto* owl species including Masked Owl (*Tyto novaehollandiae*), Sooty Owl (*Tyto tenebricosa*) and Grass Owl (*Tyto capensis*) are considered to be in any month when foraging resources are available.

Travers environmental had undertaken a total of 21.67 hours of nocturnal bird survey. This survey (which has been deemed adequate by *Murray and Bell*, 2008) did not record the presence of the Powerful Owl or Masked Owl. Despite targeted survey, there was no indication that either of these species has utilised the site in the past.

Recent 2008 surveys have comprehensively assessed hollow-bearing trees within the subject site. All hollows greater than 40cm entrances and other characteristics deemed suitable for Masked Owl and Powerful Owl were recorded. This data is provided in Appendix 2 of the updated Ecological Assessment Report (2008). These trees, along with other trees with smaller hollow entrances (greater than 30cm) totalling twenty (20) trees, were targeted for large forest owl activity using stag-watching techniques. Recent stag-watching surveys have provided an additional 25 hours and 15 minutes of targeted survey time. Searches for whitewash and pellets below these hollows were also conducted following the recent breeding season.

11. Undertake stag watch surveys of potential roost and or nest sites for the masked Owl concurrently with the Powerful Owl survey. Also note incidental observations such as Squirrel Glider and or microbat den trees.

Please see above.

Other Matters

There have been inconsistencies in the reports on the species identification for the Scribbly Gum. It has been referred to in previous *Conacher Travers* reports as *Eucalyptus signata* and in the Peer Review as *Eucalyptus racemosa.* A specimen was sent to the Royal Botanical Gardens for a positive identification which came back as *Eucalyptus haemastoma* (samples were taken near the southern boundary). We believe that it is possible that there is a mix of Scribbly Gums on the subject site but the sample sent for identification was *Eucalyptus haemastoma.* Considering that the southern extent of *Eucalyptus signata* occurs in the Morisset area approximately 3-4km to the north-west, it may be more likely that the *Eucalyptus racemosa* occurs co-dominantly with the *Eucalyptus haemastoma.* It was evident at a recent site inspection in January 2009 that the eucalypt (scribbly) that was dominant within the central to northern portion of the site was *Eucalyptus racemosa* because the fruits were available at that time. The more upright nature of most of the scribbly gums suggests that most would be *E. racemosa.* Both scribbly gum species have been included within the species list (Table 3).

Conclusion

- The peer review by *Murray and Bell* suggesting that RFEF occurs within the subject site is correct, although the extent of which has now been determined statistically, is not as far reached as their work suggests. There is a lack of shrub and tree species consistent with a typical RFEF community in particular absent Casuarina and Melaleuca species.

- Regardless of mapping inconsistencies, it is believed that the *Travers environmental* vegetation community 3 – Forest Red Gum Woodland does conform to the EEC RFEF. The previously mapped vegetation community 3 was been split into two communities to ensure that there is sufficient differentiation between EEC and non EEC vegetation communities (December 2008). After statistical analysis of the quadrat data was obtained from *Bell,* the EEC was re-defined to ensure that most of the *Eucalyptus tereticornis* specimens were included within the EEC. This meant the loss of vegetation community 7 (an ecotonal community) and a line was drawn between vegetation communities 1 and 7. In addition, the Swamp Sclerophyll Forest communities were adjusted slightly to ensure better preservation of borderline adjacent vegetation within former vegetation community 2 (Scribbly Gum Open Forest with moist understorey).

- The protection of this endangered ecological community within the public open space and exclusion of development activities from this area is considered to be an adequate amelioration measure to ensure that the presence of this vegetation community does not form a constraint to the proposed development of the subject site.

- Addition survey for *Diuris praecox* has been recently undertaken during the known flowering period (Aug-early Sep 2008), with no specimens being recorded. Additional survey for *Cryptostylis hunteriana* was also undertaken during the known flowering period (Jan 2009), with no specimens being recorded.

- Additional microchiropteran bat survey is considered unnecessary as previous survey has been undertaken in accordance with survey requirements and foraging habitat for these species is being conserved within the foreshore reserve and riparian corridor.

- A significant impact upon the Swift Parrot and Regent Honeyeater is not expected due to the conservation of high quality foraging habitat within the Foreshore Reserve and Habitat Corridor. In addition, *Travers environmental* experience with both of these species shows that the presence of residential development does not perturb this species from taking advantage of available foraging resources should they be flowering during their annual migration.

- The previous survey techniques utilised for targeting the Powerful Owl and Masked Owl are considered adequate. Further target survey incorporating stag-watching techniques and indicative signs of use of all potential roosting and breeding hollows has now been undertaken.

SECTION 6 – DRAFT 7 PART TEST OF SIGNIFICANCE (SECTION 5A EPA ACT 1979)

Council as the determining authority is required to consider the impact upon threatened species, populations and or endangered ecological communities from any development or activity via the process of a 7 part test of significance. The significance of the assessment is then used to determine the need for a more detailed Species Impact Statement (SIS).

The following 7 part test of significance relies on the ecological assessment provided in Sections 3 & 4 of this report and should be read as such.

The '7 part test of significance' is as follows.

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

Detailed flora and fauna investigations of the subject site, together with habitat assessments, have resulted in the identification of potential habitat for a variety of threatened species. An assessment of these species is as follows:

Threatened Flora

- *Acacia bynoeana*
- *Caladenia tessellata*
- *Cryptostylis hunteriana*
- *Eucalyptus camfieldii*
- *Grevillea parviflora* subsp. *parviflora*
- *Rhizanthella slateri*
- *Syzygium paniculatum*
- *Angophora inopina*
- *Callistemon linearifolius*
- *Diuris praecox*
- *Genoplesium insignis*
- *Melaleuca biconvexa*
- *Rutidosis heterogama*
- *Tetratheca juncea**

Endangered Ecological Communities

- *Swamp Sclerophyll Forest on Coastal Floodplains**
- *Coastal Saltmarsh**
- *River-flat Eucalypt Forest on Coastal Floodplains**

Threatened Fauna

- Wallum Froglet
- Black Bittern
- Broad-billed Sandpiper
- Glossy Black-Cockatoo*
- Barking Owl
- Black-necked Stork
- Gang-gang Cockatoo
- Masked Owl

Threatened Fauna

- Osprey
- Powerful Owl
- Sooty Oystercatcher
- Turquoise Parrot
- Long-nosed Potoroo
- Spotted-tailed Quoll
- Grey-headed Flying-fox*
- Greater Broad-nosed Bat
- Eastern Freetail-bat*
- Large-footed Myotis
- Yellow-bellied Sheathtail-bat
- Pied Oystercatcher
- Brown Treecreeper*
- Regent Honeyeater
- Swift Parrot
- Common Planigale
- Koala
- Squirrel Glider*
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Large-eared Pied Bat
- Little Bentwing-bat

Species indicated with a (*) were recorded within the subject site during surveys. Despite the presence of potential habitat, the remaining listed species were not recorded during the flora and fauna survey. It is considered that the proposal is unlikely to disrupt the life cycle for any of these listed species such that a viable local population would be placed at risk of extinction.

Summary of Threatened Species Recorded

FLORA

Tetratheca juncea
Tetratheca juncea is a prostrate shrub to 1 m high that grows in dry sclerophyll forest and heath from Bulahdelah to Port Jackson. Throughout the duration of the flora survey of the subject site it was identified that the subject site provides potential habitat for this species. During the survey of the subject site, specimens of *Tetratheca juncea* were observed. Due to the presence of large areas of similar or better quality habitat and the presence of other populations of this species in the local area and the small number of observed plants, it is considered that the future development of the site is not likely to disrupt the habitat of a local viable population of this species such that it is likely to be placed at risk of extinction.

FAUNA

Glossy Black-Cockatoo
The Glossy Black-Cockatoo inhabits Allocasuarina forest and woodland where it feeds almost exclusively on the fruit of *Allocasuarina* spp. (*Lindsey* 1992). It is considered that the subject site provides potential foraging, roosting and nesting habitat for this species within the Allocasuarina stands and large hollows across the subject site. Observations were made of three individuals within the south-eastern corner of the subject site during recent 2008 surveys. Characteristic chewed cones indicating presence were located within *Allocasuarina* stands on the subject site during 2000 surveys.

There are areas of similar quality foraging habitat within the adjacent area including *Koompahtoo Aboriginal Reserve, Lake Macquarie State Recreation Area* and *Wyee Point Reserve.* Retention or replacement of *Allocasuarina littoralis* and hollow bearing trees for the Glossy Black-Cockatoo as part of the site landscaping plan is recommended. It is considered that the proposal is not likely to disrupt the life cycle of this species such that a viable local population of the Glossy Black-Cockatoo is likely to be placed at risk of extinction.

Brown Treecreeper
The eastern sub-species of the Brown Treecreeper frequents drier forests and woodlands, and also paddocks and grasslands where there are sufficient logs, stumps and dead trees nearby. The Brown Treecreeper prefers predominantly rough-barked trees such as stringybarks and rough boxes. This species roosts and breeds in tree hollows. The Brown Treecreeper is sedentary and is usually seen in pairs or small family groups (*ACT Government* 1999).

This species was recorded during a previous survey by *Conacher Travers* (2000). It is considered that the subject site provides sub-optimal foraging habitat for this species. More suitable habitat for the Brown Treecreeper occurs to the far west, away from coastal areas. One other record of a Brown Treecreeper within a 10km search of the subject site was located 4km to the north-east in 1996. Local records of this species are considered to be vagrants. It is considered that the proposal is not likely to disrupt a viable local population of the Brown Treecreeper such that it is likely to be placed at risk of extinction.

Squirrel Glider
The Squirrel Glider inhabits mixed aged stands of eucalypt forest & woodlands including gum barked and high nectar producing species with hollow bearing trees. According to *Quin* (1995) the home-ranges of Squirrel Gliders have been estimated at between 0.65 and 8.55 ha, the movement of males being greater than that of females (*NPWS* 1995). Nightly movements are estimated at between 300 and 500 m (*NPWS* 1995). It is considered that the subject site provides high habitat value for this species. A number of specimens of this species were observed and captured during fauna surveys by *Conacher Travers* in 2000. Due to the habitat value and presence of this species observed with young, retention or replacement of hollow bearing trees for the Squirrel Glider as part of the site landscaping plan is recommended. Adequate representations of each eucalypt species currently occupying the site and supplying foraging resources in varying seasons would need to be sustained within retained areas. Given these, it is considered that the proposal would not likely to disrupt a viable local population of the Squirrel Glider such that it is likely to be placed at risk of extinction.

Grey-headed Flying-fox
The Grey-headed Flying-fox are canopy feeding frugivore and nectarivore species inhabiting rainforests, open forests, woodlands, Melaleuca swamps and Banksia woodlands. This species provides a means of seed dispersal and pollination for many native plants. Grey-headed Flying-foxes congregate in large numbers at roosting sites (camps) that may be found in rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas (NPWS 2000).

It is considered that the subject site provides potential foraging habitat for this species. This species was recorded during the previous survey by Woodward-Clyde (1996). This species was recorded within adjacent vegetation to the south of the site during recent fauna surveys. Extensive similar quality foraging habitat for Grey-headed Flying-foxes exists within the adjacent area including *Koompahtoo Aboriginal Reserve, Lake Macquarie State Recreation Area* and *Wyee Point Reserve* as well as additional suitable foraging habitat locally in *Munmorah State Conservation Area*, Council Nature Reserves and the remaining sections of *Lake Macquarie State Recreation Area*. Retention or replacement of the various flowering native trees used as a foraging resource by the Grey-headed Flying-fox is recommended as part of the site landscaping plan. It is considered that the proposal is not likely to disrupt a viable local population of the Grey-headed Flying-fox such that it is likely to be placed at risk of extinction.

Eastern Freetail-bat
The Eastern Freetail-bat inhabits open forests and woodlands foraging above the canopy and along the edge of forests. This species is known to roost in tree hollows, under bark and buildings. The subject site contains numerous small hollows that are suitable for roosting / breeding and vegetation interfaces with open areas that are suitable for foraging. This species was recorded within the subject site foraging within the canopy of the Scribbly Gum Open Forest – Moist Understorey vegetation community and the Forest Red Gum Woodland vegetation community on two consecutive nights. Retention or replacement of potential roosting hollows for the Eastern Freetail-bat as part of the site landscaping plan is recommended. It is considered that the proposal is not likely to disrupt the life cycle of this species such that a viable local population of the Eastern Freetail-bat is likely to be placed at risk of extinction.

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

No endangered populations listed under the *TSC Act* (1995) have been identified within the subject site. This matter does not require any further consideration.

c) In the case of a critically endangered or endangered ecological community, whether the action proposed:

i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Three (3) Endangered Ecological Communities, Swamp Sclerophyll Forest on Coastal Floodplains, River-flat Eucalypt Forest on Coastal Floodplains and Coastal Saltmarsh were observed within the subject site.

The EEC Coastal Saltmarsh, represented within the subject site by Vegetation Community 6, will be retained wholly within the subject site.

Swamp Sclerophyll Forest on Coastal Floodplains occupies vegetation communities 4, 5a and 5b, which make up an area of approximately 5.2ha or 14.4% of the subject site. The proposed development will impact upon 0.23ha or 4.4% of the endangered ecological community SSFCF whilst 4.97ha or 95.6% of SSFCF will be retained within the subject site and protected under a Section 88B agreement. *Swamp Sclerophyll Forest on Coastal Floodplains* is most similar to (LHCCREMS 2003) map units 37 - Swamp Mahogany – Paperbark Swamp Forest, 40 - Swamp Oak – Rushland Forest, 41- Swamp Oak Sedge Forest and 43- Wyong Paperbark Swamp Forest these map units occupy approximately 9,726ha within the LHCCREMS region. Therefore the proposed development will remove or modify approximately 0.23ha or 0.002% of *Swamp Sclerophyll Forest on Coastal Floodplains* within the LHCCREMS region.

It is therefore considered that the proposed development is likely to have a moderately adverse effect on the insitu extent of this community. Asset protection zones for the road will increase the impact.

River-flat Eucalypt Forest on Coastal Floodplains occurs as vegetation community 3. This occupies approximately 2.4ha of vegetation within the subject site. The development boundary has potential to remove or modify approximately 0.43ha (17.9%) of the vegetation within this community. *Conacher Travers* initially identified this area to be representative of Map Unit 38 of the LHCCREMS vegetation mapping (despite LHCCREMS referring to it as

otherwise). *Travers environmental's* refined vegetation mapping (2008) confirmed that River-flat Eucalypt Forest on Coastal Floodplains occurs on site. Within the LHCCREMS area, approximately 366ha occurs predominately on the foreshores of Lake Macquarie and subsequent lake systems to the south. The loss or modification of 0.43ha of vegetation represents 0.12% cumulative loss of this vegetation community within the LHCCREMS region. The impact will be along the southern margin of this community where the groundcover vegetation is already heavily modified due to past disturbances and where the canopy cover is sparse from past clearance.

It is therefore considered that the proposed development is likely to have a minor adverse effect on the insitu extent of this community. Asset protection zones for the development precinct near Short Street will be the main cause of vegetation loss at the edge of this community.

ii. Is likely to substantially and adversely modify the composition such that its local occurrence is likely to be placed at risk of extinction,

The proposed development will retain the Coastal Saltmarsh, represented by Vegetation Community 6 wholly within the subject site.

The proposed development will remove a very small amount of EEC vegetation within the subject site, but the retention of 93% of EEC vegetation (loss of 0.66ha of 9.8ha within the site) within the Foreshore Reserves, public open space and wildlife corridor will ensure that any vegetation modification will not adversely modify the composition such that its local occurrence is likely to be placed at risk of extinction.

d) In relation to the habitat of threatened species, populations or ecological community:

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

It is considered that the habitat attributes of the subject site provide known or potential habitat for *Acacia bynoeana, Angophora inopina, Caladenia tessellata, Callistemon linearifolius, Cryptostylis hunteriana, Diuris praecox, Eucalyptus camfieldii, Grevillea parviflora* subsp. *parviflora, Melaleuca biconvexa, Rutidosis heterogama, Syzygium paniculatum, Tetratheca juncea,* Swamp Sclerophyll Forest on Coastal Floodplains, Coastal Saltmarsh, Wallum Froglet, Barking Owl, Black Bittern, Black-necked Stork, Broad-billed Sandpiper, Gang-gang Cockatoo, Masked Owl, Osprey, Pied Oystercatcher, Powerful Owl, Brown Treecreeper, Regent Honeyeater, Sooty Oystercatcher, Swift Parrot, Turquoise Parrot, Common Planigale, Long-nosed Potoroo, Koala, Spotted-tailed Quoll, Eastern Bentwing-bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Large-eared Pied Bat, Large-footed Myotis, Little Bentwing-bat, Glossy Black-Cockatoo, Squirrel Glider, Grey-headed Flying-fox, Yellow-bellied Sheath-tailed Bat and Eastern Freetail-bat within the local area or region.

The subject site has an area of 36ha, and is connected to a large patch of native vegetation greater than 300ha. The proposed development is likely to remove or modify approximately 20ha or 55-60% of potential habitat for the aforementioned species. A large portion of vegetation will be retained within the Foreshore Reserves, public open space and wildlife corridor.

ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The subject site is covered by disturbed natural bushland and is at the northern most tip of a remnant patch of approximately 300ha. The site is bound to the south and south-west by native vegetation and by rural residential properties to the east, and to the north by Lake Macquarie. It is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become isolated or fragmented as a result of the proposal.

iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The proposed development is likely to impact approximately 20ha or 55-60% of habitat within the subject site. Given the occurrence of at least 300ha of similar vegetation adjoining the subject site and the retention of 95.6% of *Swamp Sclerophyll Forest on Coastal Floodplains* and 82.1% of *River-flat Eucalypt Forest on Coastal Floodplains* the importance of the proposals impact on the long-term survival of this ecological community in the locality is not considered to be significant.

The subject site is situated near the Morisset peninsula, a prominent area of land that extends into Lake Macquarie. Extensive areas of bushland are present throughout this area amidst fragmented residential landscape. In consideration of the extent of bushland connectivity within the local area and the scope of the proposed development, it is considered that the current level of wildlife corridor connectivity in the local area for threatened species will not be significantly altered by the proposed development. The retention of native vegetation within the wildlife corridor, foreshore reserve and significant trees within the development areas (where possible) will maintain access throughout and beyond the site for threatened species, populations and ecological communities within the area.

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

The site has not been identified as critical habitat within the provisions of the *TSC Act* (1995). Therefore this matter does not require any further consideration.

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

Draft recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Barking Owl (*Ninox connivens)* (DECC 2003)

Approved recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Large Forest Owls (Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*) (DECC 2006)
- Southern Brown Bandicoot (*Isoodon obesulus*) (DECC 2006)

It is considered that the proposed development is generally consistent with the objectives or actions of the above mentioned draft and approved recovery plans.

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

The current list of key threatening processes under TSC Act, and whether the proposed activity is recognised as a threatening process is shown below.

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	**Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?**		
	Likely	**Possible**	**Unlikely**
Alteration of habitat following subsidence due to long wall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Bushrock removal		✓	
Clearing of native vegetation	✓		
Competition and habitat degradation by feral goats			✓
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)		✓	
Competition from feral honeybees			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Ecological consequences of high frequency fires			✓
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments			✓
Herbivory and environmental degradation caused by feral deer			✓
Human-caused Climate Change			✓
Importation of red imported fire ants into NSW			✓
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered psittacine species and populations			✓
Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis			✓
Infection of native plants by *Phytophthora cinnamomi*			✓
Introduction of the large earth bumblebee (*Bombus terrestris*)			✓
Invasion of the Yellow Crazy Ant (*Anoplolepis gracilipes*)			✓
Invasion and establishment of the Cane Toad (*Bufo marinus*)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion of native plant communities by bitou bush & boneseed *Chrysanthemoides monilifera*		✓	
Invasion of native plant communities by exotic perennial grasses		✓	
Invasion, establishment and spread of *Lantana camara*		✓	
Loss and/or degradation of sites used for hill-topping by butterflies			✓
Loss of Hollow-bearing Trees	✓		
Predation by the Feral Cat (*Felis catus*)	✓		
Predation by the European Red Fox (*Vulpes vulpes*)			✓

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Predation by Plague Minnow or Mosquito Fish (*Gambusia holbrooki)*			✓
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island			✓
Predation, habitat degradation, competition & disease from Feral pigs (*Sus scofa*)			✓
Removal of dead wood and dead trees		✓	

"Bushrock removal" is listed as Key Threatening Processes under the *TSC Act* (1995). Whilst it is thought that the proposed development will not form part of this key threatening process, there is a small potential as there is bushrock within the vicinity of the site.

"Clearing of native vegetation" is a Key Threatening Process and as such the proposal is of a class of development recognised as a threatening process. The removal of native vegetation on the subject site is not likely to significantly affect the biodiversity of the local area due to the extent of conserved natural vegetation within the local area and within the subject site.

"Invasion of native plant communities by Lantana" is a Key Threatening Process. The proposal is of a class of development recognised as a threatening process due to possible spread of Lantana from within the degraded areas of the site to adjacent bushland. It is expected that the proposed development will provide an opportunity to remove, control and manage this species throughout the whole of the site by the application of a Bushland Management Plan.

"Loss of Hollow Bearing Trees" is a Key Threatening Process. A complete assessment of the location and number of hollows within trees throughout the subject site has been undertaken as part of field surveys. Small, medium and large sized hollows were noted to be present during site visits. Threatened species with suitable habitat within the subject site that rely on these hollow size classes include Squirrel Glider, Powerful Owl, Masked Owl, Greater Broad-nosed Bat, Eastern Freetail-bat, and Large-eared Pied Bat.

Common fauna species recorded present within the subject site with dependence on these hollow size classes include Species identified as being impacted upon by this process include Glossy Black-Cockatoo Gang-gang Cockatoo, Swift Parrot, Turquoise Parrot, Brown Treecreeper, Barking Owl, Powerful Owl, Masked Owl, Sooty Owl, Spotted-tailed Quoll, Eastern False Pipistrelle, Eastern Freetail-Bat, Large-footed Myotis, Squirrel Glider, Yellow-bellied Sheathtail-Bat and Greater Broad-nosed Bat. Retention of good quality hollows and those within canopy connective corridors is recommended.

"Removal of Dead Wood and Dead Trees" is a Key Threatening Process. Standing dead trees need to be included in future tree survey plans so that an indication of the level of removal can be properly evaluated. Any removal of these trees as part of the plans will include the proposal as of a class of development recognised as a threatening process in this regard.

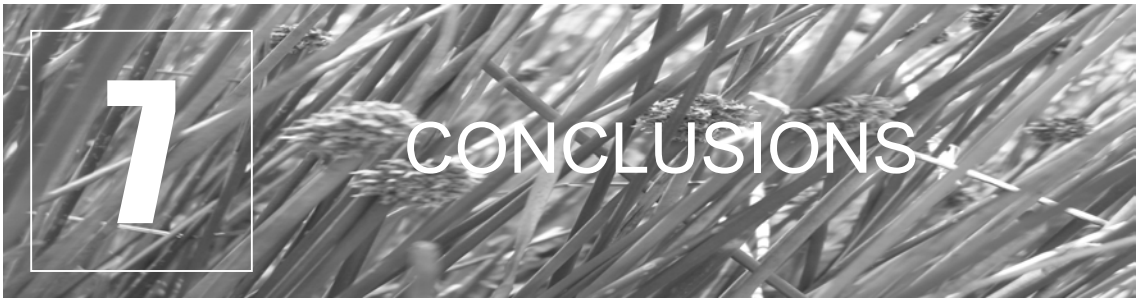
The proposed development may alter impacts on adjoining or nearby natural lands by increasing the numbers of domestic Cat ownership. 'Predation by Feral Cat (*Felis catus*)' is listed as Key Threatening Processes under the *TSC Act* (1995) and as such the action proposed may increase the impact of this threatening process.

A final determination exists within the *Threatened Species Conservation Act* (1995) for 'Competition and grazing by the Feral European Rabbit' as a Key Threatening Process. It is expected that the proposed development will provide an opportunity to manage the area with regard to Feral European Rabbit invasion.

A final determination exists within the *Threatened Species Conservation Act* (1995) for "Invasion of native plant communities by *Chrysanthemoides monilifera*" as a Key Threatening Process. This species is present on the subject site. The proposed development may provide an opportunity to ameliorate the effect of this Key Threatening Process by the application of suitable weed control measures.

A final determination exists within the *Threatened Species Conservation Act* (1995) for "Invasion of native plant communities by exotic perennial grasses" as a Key Threatening Process. It is expected that the proposed development will increase the number of exotic grass species and will provide an opportunity to manage the area with regard to weed invasion.

Other key threatening processes which may be impacting on threatened species in the local area include 'Predation by the European Red Fox (*Vulpes vulpes*)' and 'Predation by the Feral Cat (*Felis catus*)'.



SECTION 7 – CONCLUSIONS

7.1 Conclusions

This Flora and Fauna Assessment Report has been prepared by *Travers environmental* to identify the flora and fauna characteristics at Ramsgate Estate DP 1596, Wyee Point. This survey was undertaken having regard to previous Flora and Fauna Assessments carried out on the site by *Travers environmental* (formerly *Conacher Travers*) between 2000 and 2009.

The current development concept plan contains development precincts and possible road layouts. Figure 8 displays the conceptual development proposal within the precinct plan inclusive of proposed bushfire asset protection zones including a widened road alignment adjacent to the corridor to allow an APZ to occur without impacting a proposed conservation zoning. This development area extends marginally into areas of EEC due to the low condition of this area of EEC and it possible use as a bushfire asset protection zone. A wildlife corridor of approximately 50m in width and 380m in length runs through the centre of the site to link hinterland vegetation with the foreshores of Lake Macquarie.

Targeted survey has been incorporated into this report with the main findings being that;

- No threatened orchid species were recorded within the subject site during the additional survey period of August to September for *Diuris praecox* and in January for *Cryptostylis hunteriana.*

- No observations, calls, call-response or indicative signs (such as whitewash below potential breeding trees) were recorded for the threatened large forest owls (specifically Powerful Owl and Masked Owl) following the breeding period.

- 253 hollow-bearing trees were identified across the subject site. These contained a total of 740 hollows. These were broken down as 208 at <5cm, 220 hollows at 5-10cm, 141 hollows at 10-15cm, 83 hollows at 15-20cm, 37 hollows at 20-25cm, 15 hollows at 25-30cm, and 36 hollows at >30cm. All hollow tree data is provided in Appendix 2, where hollow sizes greater than 30cm are indicated.

- Vegetation communities within the north-eastern portion of the site have been re-defined. This area had been originally mapped as Forest Red Gum Woodland which under LHCCREMS (as map unit 38) would be classed as the endangered ecological community (EEC) River-flat Eucalypt Forest on Coastal Floodplains. A grid based system was applied (the methodology of which is explained in section 2) with the results suggesting that a portion of the original vegetation community – Forest Red Gum Woodland is in fact commensurate with the EEC River-flat Eucalypt Forest on Coastal Floodplains.

- Two additional specimens of *Tetratheca juncea* were found near the southern boundary in the south-western corner of the subject site.

Environmental Planning & Assessment Act 1979 & Threatened Species Conservation Act 1995

In respect of matters required to be considered in the *Environmental Planning & Assessment Act* (1979) and relating to the species / provisions of the *Threatened Species Conservation Act* (1995),

- Five (5) threatened fauna species Squirrel Glider (*Petaurus norfolcensis*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Brown Treecreeper (*Acanthiza pusilla)* and the Glossy Black-Cockatoo (*Calyptorhynchus* lathami);

- One (1) threatened flora species *Tetratheca juncea;* and

- Three (3) endangered ecological communities, Swamp Sclerophyll Forest on Coastal Floodplains, River-flat Eucalypt Forest on Coastal Floodplains and Coastal Saltmarsh, were recorded within or in close proximity to the subject site.

The draft 7 part test of significance (Section 5 of this report) has identified two EEC's as being affected by incremental loss of habitat. No final opinion on the level of significance has been proffered at this point in time given the rezoning process and no actual development plan available to comment upon.

Environment Protection and Biodiversity Conservation Act 1999

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act* (1999);

- One (1) threatened fauna species, Grey-headed Flying Fox;

- One (1) threatened flora species, *Tetratheca juncea;* and

- Two (2) endangered ecological communities Swamp Sclerophyll Forest on Coastal Floodplains, River-flat Eucalypt Forest on Coastal Floodplains and Coastal Saltmarsh were recorded within or in close proximity to the subject site.

Fisheries Management Act 1994

In respect of matters relative to the *Fisheries Management Act 1994*, no suitable habitat for marine/aquatic species was observed within the subject site and as there are no matters requiring further consideration under this Act.

Local Conservation Initiatives

In respect of matters relative to local conservation initiatives the proposal retains most of the Swamp Mahogany's within the open space drainage reserve apart from those required to be removed road bridge.

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APPENDIX 1

PEER REVIEW & OTHER SUPPORTING DATA

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ATTACHMENT 1

LHCCREMS 2003 VEGETATION MAPPING

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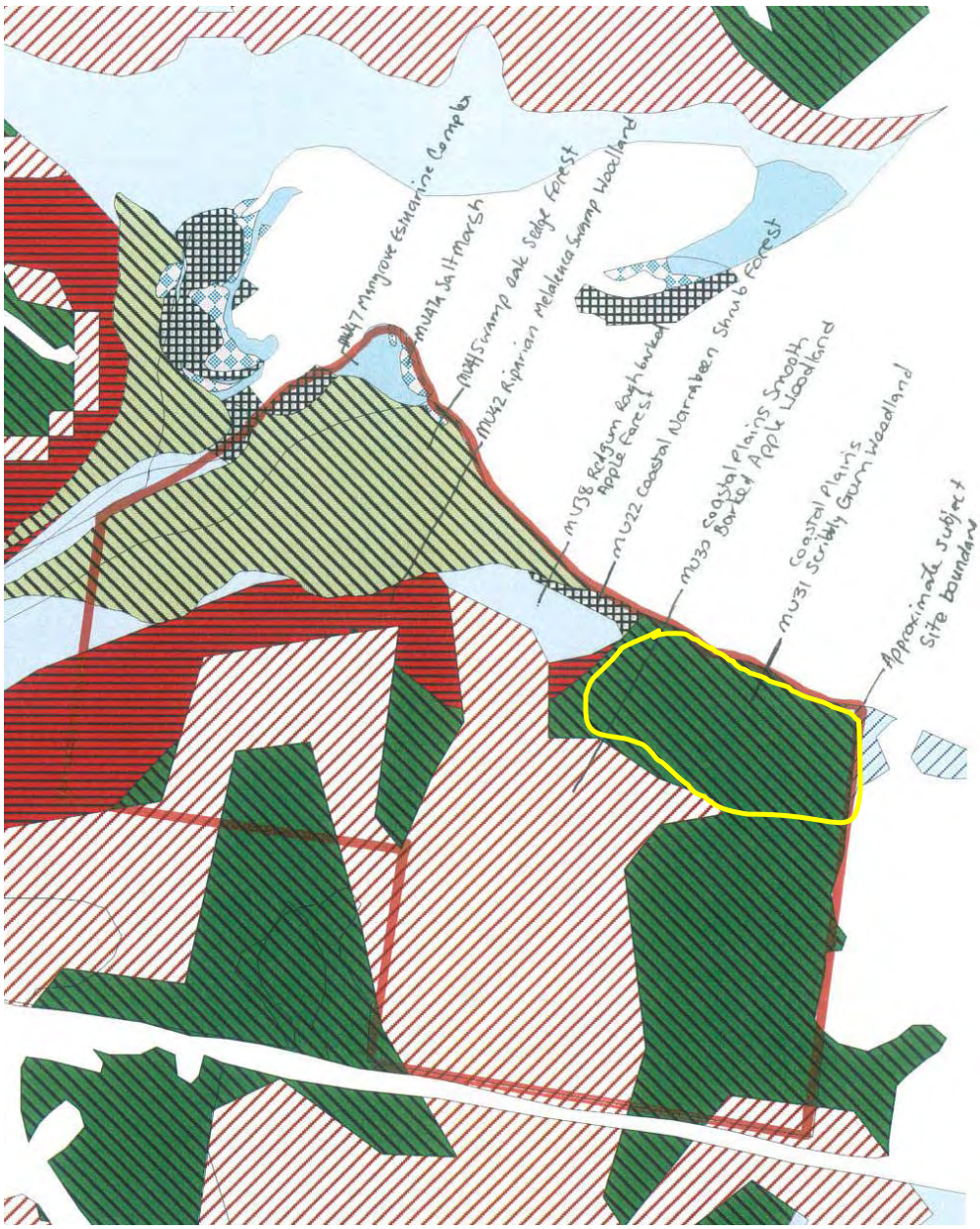

The yellow outline refers to the area referred to by *Eastcoast Flora Survey* as RFEF.

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ATTACHMENT 2

STAG-WATCHING SURVEY EFFORT (2008)

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Date	Time	Tree No.	Species	DBH (cm)	Spread (m)	Height (m)	Health (%)	Large Forest Owl Hollows	Stag-watching Results
02/10/08	1800-1915	92	Stag	100	6	19	0	Broken Trunk	Unidentified Glider
	1800-1915	43 (MM002)	*Angophora costata*	130	8	19	20	Broken Trunk	Common Brushtail Possum
	1800-1915	46	*Eucalyptus haemastoma*	140	10	18	20	Broken Trunk	No records
	1805-1915	121 (MM003)	*Eucalyptus haemastoma*	140 / 45	26	21	50	Trunk	Common Brushtail Possum
	1800-1915	130 (MM004)	*Angophora costata*	140	14	22	55	Branch (only 25-30cm)	No records
08/10/08	1915-2025*	33	Stag	80	1	13	0	Broken Trunk	No records
	1915-2025*	31	Stag	90	2	20	0	Broken Trunk	No records
	1915-2025*	51	Stag	115	6	14	0	Broken Trunk	No records
	1905-2015*	165	Stag	60	5	22	0	Trunk (only 25-30cm)	No records
	1900-2015*	170	Stag	110	4	19	0	Branch	No records
	1935-2020*	121 (MM003)	As above						No records
15/10/08	1920-2020*	110	*Angophora costata*	100	9	18	55	Branch	Common Brushtail Possum
	1920-2020*	109	*Eucalyptus haemastoma*	130	13	25	60	Trunk	Common Ringtail Possum
	1850-2050*	132	*Eucalyptus haemastoma*	105	9	18	45	Broken Trunk	Bird close, to redo
16/10/08	1920-2020*	174	Stag	85	5	13	0	Broken Trunk	x3 Unidentified Gliders
	1920-	170	Stag	110	2	14	0	Broken Trunk	No records

Date	Time	Tree No.	Species	DBH (cm)	Spread (m)	Height (m)	Health (%)	Large Forest Owl Hollows	Stag-watching Results
	2020*								
	1920-2020*	205	*Eucalyptus resinifera*	120	12	19	45	Branch	Bird close, to redo
	1920-2020*	206	Stag	65	8	16	0	Branch	No records
	1900-2040*	101	*Eucalyptus haemastoma*	90	9	17	15	Broken Trunk	No records
04/11/08	1945-2035*	132	*Eucalyptus haemastoma*	105	9	18	45	Broken Trunk	Bird close, to redo
	1940-2040*	164	Stag	70	2	15	0	Broken Trunk	No records
	1945-2035*	205	*Eucalyptus resinifera*	120	12	19	45	Branch	No records
	1945-2035*	206	Stag	65	8	16	0	Branch	No records
	1950-2030*	203	*Eucalyptus haemastoma*	125	19	29	75	Branch (only 25-30cm)	No records
	1950-2035*	223	*Eucalyptus resinifera*	80	5	18	25	Broken Trunk	No records
05/11/08	1945-2035*	132	*Eucalyptus haemastoma*	105	9	18	45	Broken Trunk	No records

Weather conditions:
02/10/08 - 0/8 cloud, no wind, no rain, 1/4 moon, temp 26-24.5^0 C
08/10/08 - 1/8 cloud, no wind, no rain, 2/4 moon, temp 14^0 C
15/10/08 - 7/8 cloud, no wind, no rain, late 4/4 moon, 16.5^0 C
16/10/08 - 0/8 cloud, no wind, no rain, late 4/4 moon, 16^0 C
04/11/08 - 8/8 cloud, light SE wind, no rain, 25% moon, 17^0 C
05/11/08 - 0/8 cloud, no wind, no rain, 50%moon, 19^0 C

Note: * indicates time difference according to daylight savings

APPENDIX 2

HOLLOW-BEARING TREE DATA

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Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT1	*Eucalyptus tereticornis*	Forest Red Gum	70	10	27	65	scratches		1	0	0	0	0	0	0
HT2	*Eucalyptus tereticornis*	Forest Red Gum	60	11	25	75	scratches		0	1	0	0	0	0	0
HT3	*stag*	stag	90	9	22	0			1	1	1	0	0	0	0
HT4	*stag*	stag	100	9	25	0			1	1	1	0	0	0	0
HT5	*Eucalyptus tereticornis*	Forest Red Gum	85	12	27	70			0	1	1	0	0	0	0
HT6	*Eucalyptus tereticornis*	Forest Red Gum	75	10	27	70			0	0	1	0	0	0	0
HT7	*Eucalyptus tereticornis*	Forest Red Gum	90	9	23	65			0	1	1	0	0	0	0
HT8	*Eucalyptus tereticornis*	Forest Red Gum	65	11	28	70			2	0	1	0	0	0	0
HT9	*Eucalyptus tereticornis*	Forest Red Gum	70	10	21	75			2	0	0	0	0	0	0
HT10	*Eucalyptus tereticornis*	Forest Red Gum	75	9	26	60			0	1	0	0	0	0	0
HT11	*Eucalyptus tereticornis*	Forest Red Gum	60	9	24	70			0	1	0	0	0	0	0
HT12	*stag*	stag	65	3	12	0			2	1	1	0	0	0	0
HT13	*Eucalyptus tereticornis*	Forest Red Gum	70	14	27	70			0	1	1	1	0	0	0
HT14	*Eucalyptus haemastoma*	Scribbly Gum	35	8	19	70			0	1	0	0	0	0	0
HT15	*Angophora costata*	Smooth-barked Apple	90	12	25	75			1	1	0	0	0	0	0
HT16	*Eucalyptus tereticornis*	Forest Red Gum	65	11	24	75			1	1	0	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT17	*Eucalyptus haemastoma*	Scribbly Gum	60/45	12	11	65			0	2	0	0	0	0	0
HT18	*Eucalyptus tereticornis*	Forest Red Gum	70/70	14	22	60			0	0	3	1	0	0	0
HT19	*Eucalyptus haemastoma*	Scribbly Gum	60	11	27	85		Trunk base	0	2	0	0	0	0	0
HT20	*Eucalyptus tereticornis*	Forest Red Gum	15	2	5	5			1	0	0	0	0	0	0
HT21	*Eucalyptus haemastoma*	Scribbly Gum	70	10	22	65	scratches		5	0	0	0	0	0	0
HT22	*Eucalyptus haemastoma*	Scribbly Gum	45/45	12	18	85			1	0	0	0	0	0	0
HT23	*stag*	stag	35	4	8	0			3	1	1	0	0	0	0
HT24	*Eucalyptus haemastoma*	Scribbly Gum	35/60	13	19	75		Trunk base	1	2	0	0	0	0	0
HT25	*Eucalyptus haemastoma*	Scribbly Gum	75	11	20	70			2	0	0	0	0	0	0
HT26	*Eucalyptus haemastoma*	Scribbly Gum	130	13	19	65			7	2	2	1	0	0	0
HT27	*Eucalyptus haemastoma*	Scribbly Gum	100	13	26	75		Trunk base (40cm)	0	0	0	1	0	0	1
HT28	*Eucalyptus haemastoma*	Scribbly Gum	115	12	19	65			2	0	0	0	0	0	0
HT29	*Eucalyptus haemastoma*	Scribbly Gum	45	9	19	75			2	0	0	0	0	0	0
HT30	*Eucalyptus haemastoma*	Scribbly Gum	70	10	20	60			1	1	1	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT31	*stag*	stag	100	2	18	0	Stag-watched - no records	Hollow from base to top? Base (30cm), Broken Trunk (35cm)	0	0	0	0	0	0	2
HT32	*Angophora costata*	Smooth-barked Apple	85	13	21	65			1	0	0	1	0	0	0
HT33	*stag*	stag	80	2	10	0	Stag-watched – no records	Broken Trunk (30cm & 40cm), all hollows may be connected	0	0	1	1	1	0	2
HT34	*Eucalyptus haemastoma*	Scribbly Gum	60	9	18	75			2	0	0	0	0	0	0
HT35	*Eucalyptus haemastoma*	Scribbly Gum	70	11	22	60			0	0	1	0	0	0	0
HT36	*Angophora costata*	Smooth-barked Apple	100	16	23	85	scratches		1	1	0	0	0	0	0
HT37	*Eucalyptus piperita*	Sydney Peppermint	90	12	21	70			0	0	1	0	0	0	0
HT38	*Corymbia gummifera*	Red Bloodwood	100	11	20	60			5	0	0	0	0	0	0
HT39	*stag*	stag	110	5	9	0			0	1	0	0	2	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT40	*Eucalyptus haemastoma*	Scribbly Gum	90	11	23	50		Trunk base deep	3	1	1	0	0	0	0
HT41	*Eucalyptus haemastoma*	Scribbly Gum	70	11	20	75			0	3	0	0	0	0	0
HT42	*Angophora costata*	Smooth-barked Apple	70	13	21	80	scratches		2	0	0	0	0	0	0
HT43	*Angophora costata*	Smooth-barked Apple	130	9	18	15	Stag-watched – Common Brushtail Possum	Branch (40cm), Broken Trunk (30cm)	0	1	1	3	2	0	2
HT44	*Eucalyptus haemastoma*	Scribbly Gum	45/60	10	14	70			1	1	0	0	0	0	0
HT45	*Eucalyptus haemastoma*	Scribbly Gum	30/15/45	11	18	80			1	1	0	0	0	0	0
HT46	*Eucalyptus haemastoma*	Scribbly Gum	150	7	17	40	Stag-watched – No records	Broken Trunk (30cm & 60cm)	1	0	4	3	0	0	2
HT47	*Eucalyptus haemastoma*	Scribbly Gum	120	14	26	50			0	2	1	2	0	0	0
HT48	*Angophora costata*	Smooth-barked Apple	130	17	25	65	scratches		2	3	1	1	1	0	0
HT49	*Eucalyptus haemastoma*	Scribbly Gum	100	10	19	60			0	1	0	0	0	0	0
HT50	*Angophora costata*	Smooth-barked Apple	85/35	11	22	75			1	0	0	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT51	*stag*	stag	150	4	13	0	Stag-watched - no records	Broken Trunk (40cm & 30cm)	1	1	2	3	1	0	2
HT52	*Eucalyptus haemastoma*	Scribbly Gum	150	13	25	75			1	0	1	0	0	0	0
HT53	*Eucalyptus haemastoma*	Scribbly Gum	40	9	16	70			0	1	0	0	0	0	0
HT54	*Angophora costata*	Smooth-barked Apple	130	22	28	65	boobook recorded		3	2	3	3	3	0	0
HT55	*Eucalyptus haemastoma*	Scribbly Gum	70	8	17	60		Trunk base (40cm)	0	0	0	0	0	0	1
HT56	*Eucalyptus haemastoma*	Scribbly Gum	85	12	18	60		Trunk base	4	1	0	1	0	1	0
HT57	*Eucalyptus resinifera*	Red Mahogany	100	16	26	60			1	0	0	0	0	0	0
HT58	*stag*	stag	95	9	26	0			2	1	0	0	0	0	0
HT59	*Eucalyptus haemastoma*	Scribbly Gum	115	13	23	70			0	2	2	0	0	0	0
HT60	*Eucalyptus haemastoma*	Scribbly Gum	100	15	19	55			0	1	1	0	1	0	0
HT61	*Eucalyptus tereticornis*	Forest Red Gum	55	11	26	45			0	1	0	0	0	0	0
HT62	*Eucalyptus tereticornis*	Forest Red Gum	65	15	24	75			0	2	0	0	0	0	0
HT63	*Eucalyptus tereticornis*	Forest Red Gum	60	5	19	15			2	1	0	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT64	*Eucalyptus tereticornis*	Forest Red Gum	70	6	21	10			0	1	0	0	0	0	0
HT65	*Eucalyptus tereticornis*	Forest Red Gum	95	13	22	70			2	0	0	0	0	0	0
HT66	*Eucalyptus tereticornis*	Forest Red Gum	80	10	19	75			1	1	1	0	0	0	0
HT67	*stag*	stag	55	3	16	0			2	0	0	0	0	0	0
HT68	*stag*	stag	95	10	24	0			0	2	0	0	0	0	0
HT69	*Eucalyptus tereticornis*	Forest Red Gum	100	20	27	65			1	2	1	0	0	0	0
HT70	*Eucalyptus tereticornis*	Forest Red Gum	60	4	20	30			1	1	0	0	0	0	0
HT71	*Eucalyptus tereticornis*	Forest Red Gum	95	18	25	65			1	1	0	0	0	0	0
HT72	*Eucalyptus tereticornis*	Forest Red Gum	85	16	25	75			2	1	1	0	0	0	0
HT73	*Eucalyptus tereticornis*	Forest Red Gum	90	16	27	70			2	1	0	0	0	0	0
HT74	*Eucalyptus tereticornis*	Forest Red Gum	55	11	23	60			0	2	0	0	0	0	0
HT75	*Eucalyptus tereticornis*	Forest Red Gum	80	18	24	68			1	0	1	0	0	0	0
HT76	*Eucalyptus tereticornis*	Forest Red Gum	75	12	23	60			2	2	0	0	0	0	0
HT77	*Eucalyptus tereticornis*	Forest Red Gum	60	10	24	60			0	1	0	0	0	0	0
HT78	*Eucalyptus tereticornis*	Forest Red Gum	85	13	24	60			2	1	0	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT79	*Eucalyptus tereticornis*	Forest Red Gum	90	15	25	55			2	0	0	0	0	0	0
HT80	*Eucalyptus tereticornis*	Forest Red Gum	60	8	19	55			1	1	0	0	0	0	0
HT81	*Eucalyptus tereticornis*	Forest Red Gum	90	13	25	55			2	3	2	0	0	0	0
HT82	*Eucalyptus tereticornis*	Forest Red Gum	50	4	28	10			2	0	0	0	0	0	0
HT83	*Eucalyptus tereticornis*	Forest Red Gum	85	12	22	65			2	3	4	0	0	0	0
HT84	*Eucalyptus tereticornis*	Forest Red Gum	80	11	26	65			1	1	0	0	0	0	0
HT85	*Eucalyptus tereticornis*	Forest Red Gum	95	11	23	65			1	1	0	0	0	0	0
HT86	*Eucalyptus tereticornis*	Forest Red Gum	25/60	10	21	40	leaf nest near base in base hollow		0	0	0	0	1	0	0
HT87	*Angophora costata*	Smooth-barked Apple	110	17	23	70		Trunk base (50cm)	4	1	1	0	2	0	1
HT88	*Eucalyptus tereticornis*	Forest Red Gum	65	9	22	40			1	1	0	0	0	0	0
HT89	*stag*	stag	60	4	22	0			2	1	1	0	0	0	0
HT90	*stag*	stag	55	3	22	0			0	2	0	0	0	0	0
HT91	*Angophora costata*	Smooth-barked Apple	110	14	23	70			1	1	4	1	1	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT92	*stag*	stag	115	6	20	0	Stag-watched – unidentified small glider observed	Broken Trunk (40cm)	0	1	4	2	0	0	1
HT93	*Eucalyptus haemastoma*	Scribbly Gum	65	10	23	90		Trunk base	0	0	0	0	1	0	0
HT94	*Angophora costata*	Smooth-barked Apple	85	12	21	85			1	0	0	0	0	0	0
HT95	*Eucalyptus haemastoma*	Scribbly Gum	120	6	19	40	scratches		0	0	2	1	2	1	0
HT96	*Angophora costata*	Smooth-barked Apple	120	17	21	70	wasps nest		1	1	1	0	0	0	0
HT97	*stag*	stag	55	2	15	0		Broken Trunk (30cm)	0	0	1	0	0	0	1
HT98	*Eucalyptus haemastoma*	Scribbly Gum	65	10	21	65			1	0	0	0	0	0	0
HT99	*Angophora costata*	Smooth-barked Apple	75	12	22	80			0	1	0	0	0	0	0
HT100	*Angophora costata*	Smooth-barked Apple	85	13	18	85			0	1	1	0	0	0	0
HT101	*Eucalyptus haemastoma*	Scribbly Gum	90	9	17	15	Stag-watched – no records	Broken Trunk (50cm)	0	0	0	0	0	0	1
HT102	*stag*	stag	65	5	14	0			0	1	2	1	0	0	0
HT103	*stag*	stag	90	3	18	0			0	1	0	3	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT104	*stag*	stag	70	1	7	0			0	0	0	0	1	0	0
HT105	*stag*	stag	120	9	18	0			2	4	3	2	0	0	0
HT106	*stag*	stag	160	2	9	0		Broken Trunk (70cm & down to ground level), no owl activity within	0	0	0	0	0	0	1
HT107	*Eucalyptus resinifera*	Red Mahogany	115	19	20	50			0	3	2	1	0	0	0
HT108	*stag*	stag	45	1	6	0			0	1	0	0	0	0	0
HT109	*Eucalyptus haemastoma*	Scribbly Gum	130	13	25	60	Stag-watched – Common Ringtail Possum	Trunk base (110cm), Branch (30cm), Trunk (35cm)	0	0	1	3	0	1	3
HT110	*Angophora costata*	Smooth-barked Apple	100	9	18	55	Stag-watched – Common Brushtail Possum	Branch (35cm)	0	1	0	0	0	1	1

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT111	*Angophora costata*	Smooth-barked Apple	95	14	22	60	small whitewash		1	1	3	1	0	0	0
HT112	*Angophora costata*	Smooth-barked Apple	90	17	23	80			1	0	0	0	0	0	0
HT113	*Eucalyptus resinifera*	Red mahogany	65	12	19	70			1	0	0	0	0	0	0
HT114	*Eucalyptus resinifera*	Red mahogany	65/50	12	19	75			1	0	0	0	0	0	0
HT115	*Angophora costata*	Smooth-barked Apple	115	22	23	75			0	1	0	0	0	0	0
HT116	*Eucalyptus resinifera*	Red mahogany	90	12	18	40			0	2	1	1	0	0	0
HT117	*Eucalyptus resinifera*	Red mahogany	80	5	24	5			2	0	1	0	0	0	0
HT118	*Eucalyptus resinifera*	Red mahogany		70	19	55			0	1	0	0	0	0	0
HT119	*Melaleuca linariifolia*	Snow In Summer	70	4	8	25			0	1	0	1	0	0	0
HT120	*stag*	stag	100	2	18	0		Broken Trunk (30cm x2)	0	1	0	0	0	0	2
HT121	*Eucalyptus haemastoma*	Scribbly Gum	160	17	24	65	Stag-watched – Common Brushtail Possum	Broken Trunk (40cm), Trunk (40cm)	1	1	2	0	1	0	2
HT122	*Eucalyptus haemastoma*	Scribbly Gum	100	15	22	50		Trunk base (100cm)	1	3	4	2	0	0	1

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT123	*stag*	stag	60	3	14	0			0	1	0	0	0	0	0
HT124	*Angophora costata*	Smooth-barked Apple	180	22	23	75			0	1	0	0	0	0	0
HT125	*stag*	stag	65	5	11	0			2	0	0	0	0	0	0
HT126	*Eucalyptus haemastoma*	Scribbly Gum	80	12	16	60			0	1	0	0	0	0	0
HT127	*Eucalyptus haemastoma*	Scribbly Gum	120	17	22	75			0	1	0	0	0	0	0
HT128	*Angophora costata*	Smooth-barked Apple	100	15	22	75			5	6	3	0	0	0	0
HT129	*Eucalyptus haemastoma*	Scribbly Gum	105	17	24	70			0	0	2	1	1	0	0
HT130	*Angophora costata*	Smooth-barked Apple	130	16	24	65	Stag-watched – no records	Branch (30cm)	1	4	1	0	1	0	1
HT131	*Eucalyptus haemastoma*	Scribbly Gum	110	18	24	80			0	1	1	0	0	0	0
HT132	*Eucalyptus haemastoma*	Scribbly Gum	105	9	18	45	Stag-watched – no records	Broken Trunk (40cm) & filled with Casuarina leaves, Branch (30cm)	0	0	0	1	0	0	1
HT133	*Eucalyptus haemastoma*	Scribbly Gum	60/70	13	22	75			0	1	0	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT134	*Eucalyptus haemastoma*	Scribbly Gum	160	16	24	55			3	0	3	2	2	0	0
HT135	*Angophora costata*	Smooth-barked Apple		100	24	80			3	1	0	0	0	0	0
HT136	*Angophora costata*	Smooth-barked Apple	90	14	25	85			0	1	0	0	0	0	0
HT137	*stag*	stag	55	3	15	0			0	1	1	0	0	0	0
HT138	*Eucalyptus haemastoma*	Scribbly Gum	85	15	19	55		Trunk base (100cm)	1	4	1	0	0	0	1
HT139	*Eucalyptus haemastoma*	Scribbly Gum	85	12	18	75			1	1	1	0	0	0	0
HT140	*Corymbia gummifera*	Red Bloodwood	80	12	17	70			0	2	0	0	0	0	0
HT141	*Angophora costata*	Smooth-barked Apple	85	12	24	70			3	2	1	0	0	0	0
HT142	*Corymbia gummifera*	Red Bloodwood	80	10	19	65			1	1	0	1	0	0	0
HT143	*Eucalyptus haemastoma*	Scribbly Gum	90	13	19	60			0	0	1	1	0	0	0
HT144	*Angophora costata*	Smooth-barked Apple	110	9	20	10			2	3	1	0	0	0	0
HT145	*Eucalyptus haemastoma*	Scribbly Gum	90	9	20	55			0	1	3	1	0	0	0
HT146	*Eucalyptus resinifera*	Red Mahogany	80	8	24	35			0	3	0	0	0	0	0
HT147	*Eucalyptus haemastoma*	Scribbly Gum	100	12	22	75			1	1	0	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT148	*Eucalyptus haemastoma*	Scribbly Gum	100	13	23	70			1	3	0	0	0	0	0
HT149	*stag*	stag	25	1	9	0			1	1	0	0	0	0	0
HT150	*Eucalyptus haemastoma*	Scribbly Gum	95	15	24	75			3	1	0	0	0	0	0
HT151	*Eucalyptus haemastoma*	Scribbly Gum	90	14	21	75			0	2	1	0	0	0	0
HT152	*Eucalyptus haemastoma*	Scribbly Gum	45	9	17	60			0	1	0	0	0	0	0
HT153	*Angophora costata*	Smooth-barked Apple	40	6	12	55			0	0	0	0	0	0	0
HT154	*Eucalyptus haemastoma*	Scribbly Gum	60	10	14	70			1	1	0	0	0	0	0
HT155	*Angophora costata*	Smooth-barked Apple	45/30	6	18	40			4	0	0	0	0	0	0
HT156	*Eucalyptus haemastoma*	Scribbly Gum	55	8	17	70			0	1	1	0	0	0	0
HT157	*Angophora costata*	Smooth-barked Apple	55	5	20	65			1	1	0	0	0	0	0
HT158	*Eucalyptus haemastoma*	Scribbly Gum	85	11	20	75			0	0	1	0	0	0	0
HT159	*Eucalyptus haemastoma*	Scribbly Gum	70/25	11	19	80			1	0	0	0	0	0	0
HT160	*Eucalyptus haemastoma*	Scribbly Gum	25	6	12	70			0	0	1	0	0	0	0
HT161	*Corymbia gummifera*	Red Bloodwood	100	10	19	45			1	0	1	0	1	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT162	*stag*	stag	50	2	8	0			0	2	1	0	0	0	0
HT163	*Eucalyptus haemastoma*	Scribbly Gum	50	7	13	55			0	2	0	0	0	0	0
HT164	*stag*	stag	70	2	15	0		Broken Trunk (40cm) goes down to a Trunk hollow (20cm) at base	1	0	1	1	1	0	1
HT165	*stag*	stag	80	4	20	0	Stag-watched – no records	Branch (40cm)	1	0	0	1	1	0	1
HT166	*Eucalyptus haemastoma*	Scribbly Gum	25	3	9	40			0	1	0	0	0	0	0
HT167	*Angophora costata*	Smooth-barked Apple	25/25	4	15	45			0	0	0	1	0	0	0
HT168	*Eucalyptus haemastoma*	Scribbly Gum	85	13	20	70			1	2	0	0	0	0	0
HT169	*Eucalyptus resinifera*	Red Mahogany	85	11	17	20			0	1	0	0	0	1	0
HT170	*stag*	stag	110	2	14	0	Stag-watched – no records	Broken Trunk (50cm)	0	0	0	0	0	0	1
HT171	*Melaleuca linariifolia*	Snow In Summer	105	7	11	40			1	1	0	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT172	*Angophora costata*	Smooth-barked Apple	90	3	15	10	numerous scratches		0	2	1	0	0	2	0
HT173	*Angophora costata*	Smooth-barked Apple	70	5	16	15	scratches		0	0	1	1	0	0	0
HT174	*stag*	stag	85	5	13	0	Stag-watched – Unidentified Petaurus gliders	Broken Trunk (40cm)	0	1	0	2	1	1	1
HT175	*Eucalyptus haemastoma*	Scribbly Gum	70	9	13	65			0	1	2	0	0	0	0
HT176	*Eucalyptus haemastoma*	Scribbly Gum	100	13	20	70			1	2	0	0	0	0	0
HT177	*Eucalyptus haemastoma*	Scribbly Gum	100	12	22	75			0	1	1	0	0	0	0
HT178	*Eucalyptus haemastoma*	Scribbly Gum	90	10	18	70			3	0	0	0	0	0	0
HT179	*Eucalyptus robusta*	Swamp Mahogany	60	5	15	20			2	1	0	0	0	0	0
HT180	*stag*	stag	45	1	9	0			0	0	1	0	0	0	0
HT181	*Eucalyptus haemastoma*	Scribbly Gum	80	12	25	65			0	1	0	0	0	0	0
HT182	*Eucalyptus robusta*	Swamp Mahogany	85	7	13	65			0	0	0	1	0	0	0
HT183	*Angophora costata*	Smooth-barked Apple	90	13	22	80			3	0	0	0	0	0	0
HT184	*Angophora costata*	Smooth-barked Apple	60	8	24	65			2	0	0	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT185	*stag*	stag	35	1	9	0			0	0	0	1	0	0	0
HT186	*Eucalyptus robusta*	Swamp Mahogany	50	6	13	80			0	1	0	0	0	0	0
HT187	*Eucalyptus robusta*	Swamp Mahogany	60	5	14	65			1	0	0	0	0	0	0
HT188	*Eucalyptus robusta*	Swamp Mahogany	90	12	19	60			1	1	0	0	0	0	0
HT189	*Eucalyptus robusta*	Swamp Mahogany	70	9	19	65			1	1	0	0	0	0	0
HT190	*Eucalyptus robusta*	Swamp Mahogany	40	2	14	10			0	0	0	0	1	0	0
HT191	*Eucalyptus robusta*	Swamp Mahogany	100	12	20	65			0	1	2	1	0	0	0
HT192	*Angophora costata*	Smooth-barked Apple	85	10	21	70			0	1	0	0	0	0	0
HT193	*stag*	stag	45	1	20	0			0	0	1	0	0	0	0
HT194	*stag*	stag	90	8	18	0			1	2	3	2	1	0	0
HT195	*Eucalyptus resinifera*	Red Mahogany	110	14	20	40			0	1	2	1	1	0	0
HT196	*Eucalyptus tereticornis*	Forest Red Gum	100	4	14	10			0	0	0	1	0	0	0
HT197	*Eucalyptus haemastoma*	Scribbly Gum	120	11	21	60		Broken trunk open to weather	0	0	0	0	0	1	0
HT198	*Eucalyptus haemastoma*	Scribbly Gum	150	16	25	60			1	3	4	3	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT199	*Eucalyptus haemastoma*	Scribbly Gum	120	16	25	65			0	1	2	1	0	1	0
HT200	*Eucalyptus resinifera*	Red Mahogany	90	8	20	35			1	1	2	2	0	0	0
HT201	*Angophora costata*	Smooth-barked Apple	110	11	25	65			1	3	1	1	1	0	0
HT202	*Angophora costata*	Smooth-barked Apple	130	20	30	75			1	3	1	0	1	0	0
HT203	*Eucalyptus haemastoma*	Scribbly Gum	125	19	29	75	whitewash below large branch hollow		0	1	2	0	0	1	0
HT204	*Angophora costata*	Smooth-barked Apple	90/30	14	22	55			0	1	0	0	0	0	0
HT205	*Eucalyptus resinifera*	Red Mahogany	120	12	19	45	Stag-watched – no records	Branch (40cm)	1	1	0	1	0	0	1
HT206	*stag*	stag	65	8	16	0	Stag-watched – no records		0	0	1	0	0	0	0
HT207	*Casuarina glauca*	Swamp Oak	60	8	21	70		Trunk base	1	0	0	1	0	0	0
HT208	*Eucalyptus tereticornis*	Forest Red Gum	55	6	19	45			1	0	0	0	0	0	0
HT209	*Eucalyptus tereticornis*	Forest Red Gum	65	10	18	60		Trunk base	1	0	0	0	0	0	0
HT210	*Eucalyptus robusta*	Swamp Mahogany	80	12	18	80			1	0	0	0	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT211	*stag*	stag	40	2	8	0			0	0	0	1	0	0	0
HT212	*Eucalyptus robusta*	Swamp Mahogany	60	8	17	45			2	0	0	0	0	0	0
HT213	*Angophora floribunda*	Rough-barked Apple	60	7	16	65			1	0	0	0	0	0	0
HT214	*Eucalyptus robusta*	Swamp Mahogany	60	7	16	45			1	1	0	0	0	0	0
HT215	*Eucalyptus robusta*	Swamp Mahogany	60	7	17	50			1	0	0	0	0	0	0
HT216	*Eucalyptus resinifera*	Red Mahogany	80	11	21	55			1	0	0	0	0	0	0
HT217	*stag*	stag	45	1	6	0			1	0	0	0	1	0	0
HT218	*Eucalyptus robusta*	Swamp Mahogany	110	14	22	60			0	3	1	0	0	0	0
HT219	*Eucalyptus robusta*	Swamp Mahogany	95	7	22	50			0	2	0	0	0	0	0
HT220	*Eucalyptus robusta*	Swamp Mahogany	70	6	17	60			0	0	1	0	0	0	0
HT221	*Eucalyptus robusta*	Swamp Mahogany	90	8	19	65			0	0	0	1	0	0	0
HT222	*Angophora costata*	Smooth-barked Apple	75	11	20	75			0	1	1	0	0	0	0
HT223	*Eucalyptus resinifera*	Red Mahogany	80	5	18	25		Broken Trunk (40cm)	0	0	0	0	0	0	1
HT224	*stag*	stag	85	3	15	0			0	1	1	3	0	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT225	*Eucalyptus robusta*	Swamp Mahogany	110	7	18	60			1	0	1	0	0	0	0
HT226	*stag*	stag	120	1	5	0		Broken Trunk (80cm), ferns growing within, too low for owl	0	0	0	0	0	0	1
HT227	*Eucalyptus robusta*	Swamp Mahogany	85	8	19	65			1	1	0	0	0	0	0
HT228	*Eucalyptus tereticornis*	Forest Red Gum	80	11	21	65			0	1	0	0	0	0	0
HT229	*Eucalyptus robusta*	Swamp Mahogany	90	8	19	65		Trunk base	2	0	0	0	0	1	0
HT230	*Eucalyptus robusta*	Swamp Mahogany	100	6	12	45		Broken Trunk (45cm), too low for large forest owls	0	0	0	0	0	0	1
HT231	*Eucalyptus tereticornis*	Forest Red Gum	90	11	22	70			2	2	0	0	0	0	0
HT232	*Eucalyptus tereticornis*	Forest Red Gum	75	8	27	60			1	2	0	0	0	0	0
HT233	*Eucalyptus tereticornis*	Forest Red Gum	120	12	28	65			1	0	0	2	0	1	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT234	*Eucalyptus tereticornis*	Forest Red Gum	60	3	16	10			0	0	0	0	0	1	0
HT235	*Eucalyptus tereticornis*	Forest Red Gum	110	18	28	65		Trunk base	2	2	0	1	0	0	0
HT236	*Eucalyptus tereticornis*	Forest Red Gum	100	16	28	65			0	0	1	0	0	0	0
HT237	*Eucalyptus tereticornis*	Forest Red Gum	85	15	27	65			0	1	0	0	0	0	0
HT238	*Eucalyptus robusta*	Swamp Mahogany	100	9	20	75			0	1	0	0	0	0	0
HT239	*stag*	stag	40	4	15	0			1	0	0	0	0	0	0
HT240	*stag*	stag	40	1	5	0			0	1	0	0	0	0	0
HT241	*Eucalyptus robusta*	Swamp Mahogany	90	8	17	75		Trunk base	1	0	0	0	1	0	0
HT242	*stag*	stag	55	4	21	0			1	1	0	0	0	0	0
HT243	*stag*	stag	70	4	20	0			1	0	1	0	0	0	0
HT244	*Angophora costata*	Smooth-barked Apple	80	13	22	85			0	1	0	0	0	0	0
HT245	*Angophora costata*	Smooth-barked Apple	30	7	22	90			1	0	0	0	0	0	0
HT246	*Angophora costata*	Smooth-barked Apple	85	9	21	75			0	1	1	0	0	0	0
HT247	*Eucalyptus resinifera*	Red Mahogany	105	9	21	45			1	0	0	2	1	0	0

Tree No.	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	% Health	Fauna Use	Hollows Comment	0 to 5cm	5-10cm	10 to 15	15 to 20	20 to 25	25 to 30	30+
HT248	*stag*	stag	115	6	24	0			0	0	0	2	0	0	0
HT249	*Eucalyptus haemastoma*	Scribbly Gum	45	3	20	80		Trunk base	0	0	0	0	1	0	0
HT250	*Eucalyptus tereticornis*	Forest Red Gum	35	3	16	30			1	1	0	0	0	0	0
HT251	*stag*	stag	40/45	3	10	0			0	0	1	1	0	0	0
HT252	*Eucalyptus haemastoma*	Scribbly Gum	100	14	23	80			1	2	0	0	0	0	0
HT253	*Eucalyptus haemastoma*	Scribbly Gum	55	11	22	75		Trunk base	0	0	0	0	0	1	0
								TOTALS	**208**	**220**	**141**	**83**	**37**	**15**	**36**

APPENDIX 3

EEC BOUNDARY REVIEW BY EAST COAST FLORA SURVEYS

Review of EEC boundary definition in "*Ecological Assessment – Ramsgate Estate DP1596, Wyee Point*" (Travers Environmental, December 2008)

Stephen Bell

18 December 2008

Background:

Following a full flora and fauna review (Murray & Bell 2008) of previously documented ecology information on the proposed Ramsgate Estate development at Wyee Point (Travers Environmental 2008a), I have been asked to review and sign-off on the latest revision of ecological studies completed by Travers Environmental (2008b). The main issue of contention concerns the presence of the River-Flat Eucalypt Forest on Coastal Floodplains EEC, and the boundary of this community with surrounding vegetation. Following a site inspection and meeting with representatives from Travers Environmental, their client, and Lake Macquarie City Council, it was agreed that I would analyse vegetation survey data to assist in resolving this issue.

Detailed vegetation quadrat data collected from the contentious area by Travers Environmental was supplied and analysed by me, then compared with the latest results and mapping contained in the Travers Environmental (2008b) report. The current brief report outlines the results of this analysis. Time has not allowed me to read the entire report, and I have not considered any fauna issues previously raised.

Data Analysis:

The supplied data was re-formated and cleaned (duplicate taxa merged, etc). It was noted that all data consisted of effectively presence-absence qualifiers only, and that sample quadrats 1 to 19 were 20 x 20m in size, while the more recent quadrats 20 to 52 were only 10 x 10m. This presents obvious problems in data analysis (expected greater species diversity in larger plots), but analysis was continued. Weed species were retained in the dataset. All quadrats were allocated to one of the seven vegetation communities as defined in the Travers Environmental (2008b) report, through a simple comparison of their positioning on Figure 4a.

Two statistical analysis methods were used to explore the data:

1. Multivariate analysis – this was performed on the data using Primer v6 (Clarke & Gorley 2006). Bray-Curtis similarity coefficients were computed and a cluster diagram produced, showing the relationship between all sample plots. This was done initially on the entire dataset (both $10m^2$ and $20m^2$ quadrats) and also with only the $10m^2$ dataset. Neither dataset produced completely logical results, although the $10m^2$ data allowed more identifiable variations to be determined (Figure 1). Despite this, quadrats comprising Units 1, 2, 3 and 7 mostly grouped within the one large clade.

Non-metric multidimensional scaling (nMDS) was also performed on the data with Primer. As with the cluster diagram, clear results were not attainable, and the high stress level (0.21) showed the difficulty in arranging the quadrats into 2-dimensional space (Figure 2). Distinct groups of sample quadrats are expected in a well defined classification.

Evidently, neither the cluster analysis nor the nMDS analysis could satisfactorily define the variation in vegetation present in the area. There are many factors that may contribute to this,

including different sample plot sizes, past history of the site, close proximity of sample plots, fire history, weed invasion etc.

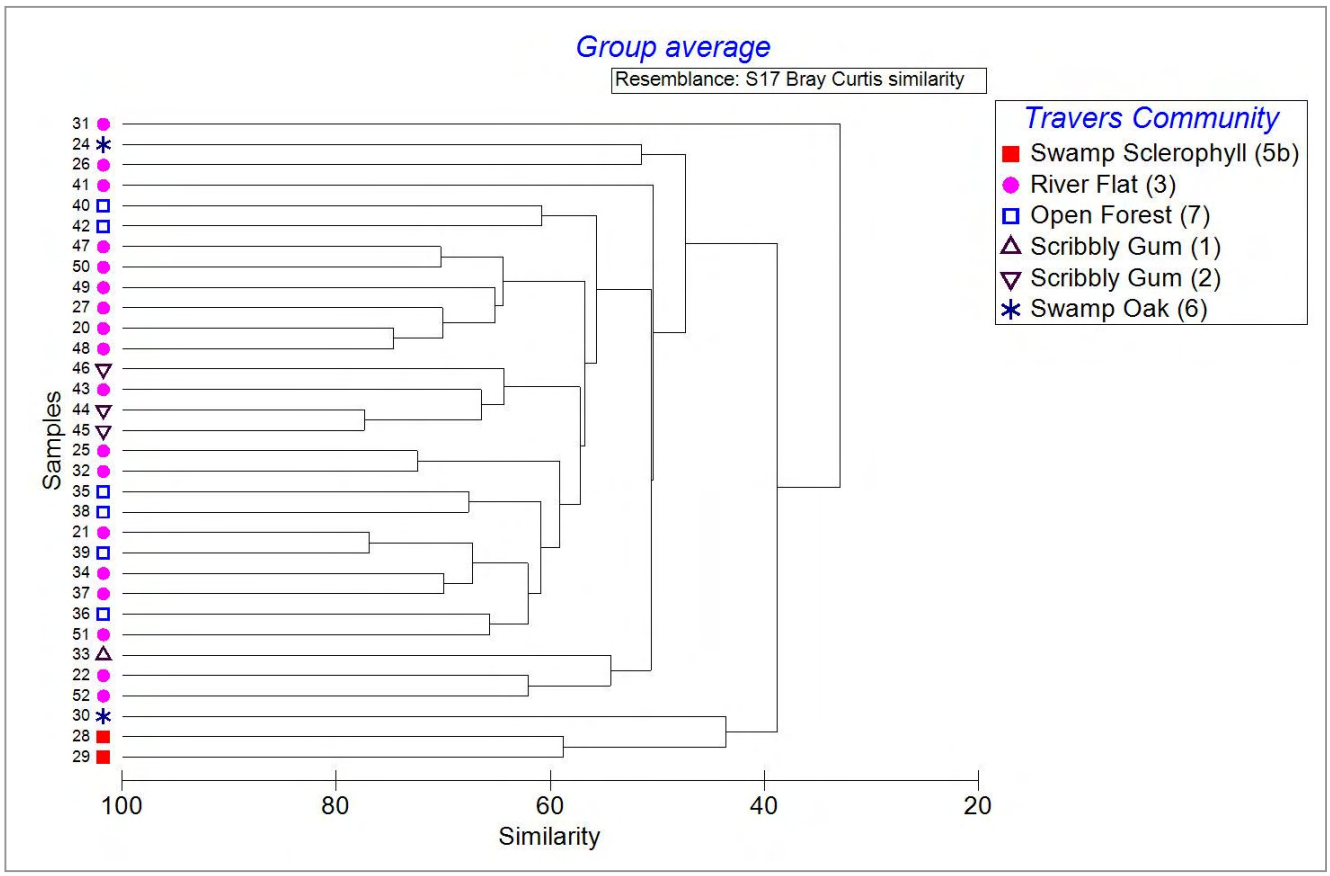


Figure 1 **Site dendrogram from the cluster analysis, with each plot code allocated to the appropriate community based on Figure 4a in Travers Environmental (2008b).**

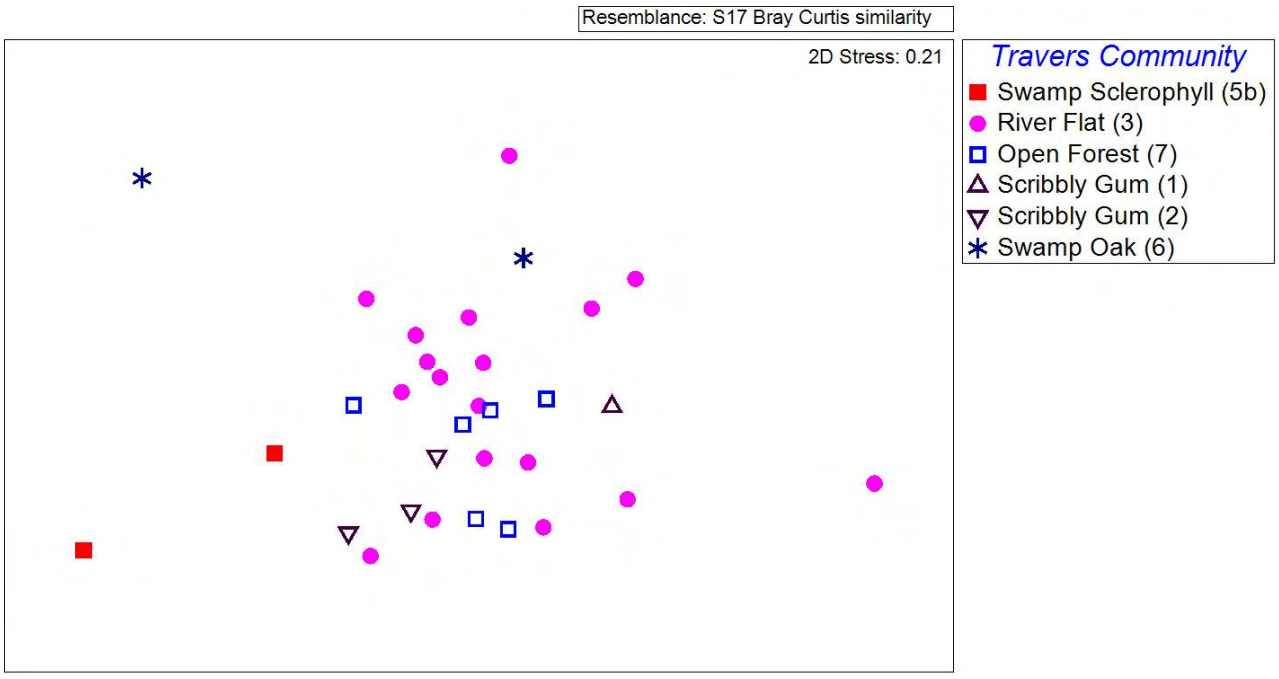


Figure 2 **nMDS scatter plot, with each plot code allocated to the appropriate community based on Figure 4a in Travers Environmental (2008b).**

2. Moving Split-Window analysis – this technique involves the progressive comparison of adjacent sample quadrats ('plot-pairs') to identify locations of maximum dissimilarity. Examples of its use include Fortin et. al. 2000, Choesin and Boerner 2002, and Hennenberg et. al. 2005. Ideally, transects or strings of quadrats are sampled across potential community boundaries, and the floristic composition of each subsequent pair of quadrats is compared. Dissimilarity is calculated using the Squared Euclidean Distance (SED), with rates of change in species composition plotted on a graph. SED values were calculated using Primer, and values graphed in Excel. Twelve strings of quadrats were analysed in this way from the supplied dataset: 5 orientated in an east-west direction, and 7 in a north-south direction. Some strings comprised less than 4 adjacent quadrats and could not be analysed.

Appendix 1 shows the SED graphs for each string of quadrats. Obvious peaks in the graphs represent potential boundary changes from one community to another, and these were compared with the position of plot-pairs in relation to the mapped community boundaries in the Travers Environmental (2008b) report. More gentle changes in the graphs typically represent gradual ecotonal shifts, which may also be associated with the past clearing of much of the site. Table 1 summarises these comparisons, arranged along currently mapped community boundaries.

From Table 1, pairs of plots spanning the transition from:

- Scribbly Gum (Unit 1) to Open Forest (Unit 7) – were generally not supported by MSWA. This may reflect past disturbances to the site or the general similarity of the two communities, which is in itself interesting as one is dominated by Forest Red Gum and the other by Scribbly Gum.

- Scribbly Gum (Unit 1) to Scribbly Gum (Unit 2) – insufficient data.

- Scribbly Gum (Unit 2) to Open Forest (Unit 7) – MSWA supported two of the three plot-pairs.

- Scribbly Gum (Unit 2) to Swamp Mahogany (Unit 4) - neither of the two plot-pairs were supported in the MSWA.

- Scribbly Gum (Unit 2) to Swamp Mahogany (Unit 5b) – the single plot-pair was not supported.

- Scribbly Gum (Unit 2) to Forest Red Gum (Unit 3) – two of the 4 plot-pairs were supported by MSWA.

- Forest Red Gum (Unit 3) to Swamp Oak (Unit 6) – one of the 2 plot-pairs were supported by MSWA.

- Forest Red Gum (Unit 3) to Swamp Mahogany (Unit 5b) – the single plot-pair was not supported by MSWA.

- Forest Red Gum (Unit 3) to Open Forest (Unit 7) – six of the 12 plot-pairs were supported by MSWA.

- Swamp Mahogany (Unit 4) to Swamp Mahogany (Unit 5b) – insufficient data.

- Swamp Mahogany (Unit 5b) to Swamp Oak (Unit 6) – the single plot-pair was supported by MSWA.

Table 1 Comparison of Travers Mapping vs Moving Split-Window Analysis (MSWA). Shading represents congruence between the Split-Window analysis and the current mapping.
? = some uncertainty in interpretation; * = insufficient data to test.

Community Change from ...	Plot pairs	Shown in Travers Mapping	Supported by MSWA
Scribbly Gum (1) to Open Forest (7)	1 / 13	yes	*
	2 / 14	yes	no
	3 / 4	yes	no
	3 / 15	yes	yes (?)
	3 / 35	no	yes (?)
	4 / 5	yes	no
	6 / 8	yes	no
Scribbly Gum (1) to Scribbly Gum (2)	6 / 7	yes	*
Scribbly Gum (2) to Open Forest (7)	8 / 9	yes	no
	8 / 17	yes	yes
	17 / 42	yes	yes
Scribbly Gum (2) to Swamp Mahogany (4)	10 / 11	yes	no
	12 / 18	yes	no
Scribbly Gum (2) to Swamp Mahogany (5b)	18 / 28	yes	no
Scribbly Gum (2) to Forest Red Gum (3)	17 / 43	yes	no
	19 / 47	yes	yes
	19 / 49	yes	yes
	43 / 44	yes	no
Forest Red Gum (3) to Swamp Oak (6)	22 / 24	yes	yes (?)
	24 / 25	yes	no
Forest Red Gum (3) to Swamp Mahogany (5b)	27 /28	yes	no
Forest Red Gum (3) to Open Forest (7)	13 / 31	yes	*
	14 / 34	yes	yes
	15 / 37	yes	no
	20 / 40	yes	no
	32 / 33	yes	yes (?)
	34 / 36	yes	no
	36 / 37	yes	no
	36 / 51	yes	no
	37 / 39	yes	yes (?)
	39 / 50	yes	yes (?)
	40 / 41	yes	yes
	41 / 42	yes	yes
Swamp Mahogany (4) to Swamp Mahogany (5b)	12 / 29	yes	*
Swamp Mahogany (5b) to Swamp Oak (6)	28 / 30	yes	yes (?)

Potential changes detected but currently not mapped			
Scribbly Gum (1)	1 / 2	no	yes (?)
Scribbly Gum (2)	9 / 10	no	yes (?)
	18 / 45	no	yes
Forest Red Gum (3)	20 / 26	no	yes (?)
	20 / 50	no	yes

	21 / 25	no	yes (?)
	22 / 51	no	yes
	25 / 26	no	yes
	31 / 32	no	yes
Open Forest (7)	4 / 8	no	yes
	4 / 16	no	yes
	14 / 35	no	yes

New Mapping:

The revised mapping (Travers Environmental 2008b) has resulted in a splitting of the former Forest Red Gum Woodland into two units (see Figures 3 & 4 below). The new vegetation unit Open Forest (Unit 7) is described in the text (p 29) as an ecotonal area between Units 3 and 1. I think this community should be mapped and described as such (eg: Ecotonal Units 1/3), rather than creating a new name and Unit number (giving the impression of an entirely new community). There are other unmapped ecotonal areas in the study area, but these are not singled out.

A few questions can be raised in relation to the status of Unit 7. Where would this community fit within the regional classification ? Should it still be considered part of REMS Unit 38 (and hence the EEC) ? The Split-Window analysis appears to support a change in community for part of the mapped area, but this is inconsistent and may be a result of past clearing activities. I think there needs to be a little more justification for this split, and reasoning as to why it does not form part of the EEC. As I understand it, any vegetation within the Lake Macquarie area which supports *Eucalyptus tereticornis* in the canopy, can only fall into REMS Unit 38.

I would not agree that Unit 2 extends to the north as a small tongue between Units 3 and 5 (see Figure 4 below). There are no Scribbly Gums in the area between Units 3 and 5. Quadrats 18, 19, 44, 45 and 46 within this tongue support *Eucalyptus tereticornis* and *Angophora costata* or *Eucalyptus robusta*, more typical of Unit 3, 4 or 5. This area should probably be re-mapped to Unit 3, 4 or 5, or even Unit 7, or a combination of these units.

Scribbly Gum Identity:

I would disagree with the RBG about the Scribbly Gum identification – it is clearly not *E. haemastoma* but (probably) *E. racemosa* or *E. signata*. Intergrades between these species are known from the southern Lake Macquarie area, however, so perhaps the specimen lodged was such an intergrade. Forests dominated by *E. racemosa* have been mapped for the southern Lake Macquarie area, and the current study area is no exception. These forests are regionally significant as they are not represented elsewhere in the lower Hunter or Central Coast. In the southern Lake Macquarie region, woodlands and forests dominated by *Eucalyptus haemastoma* occur upslope of those dominated by *E. racemosa/ signata*, and support an understorey of heathy shrubs.

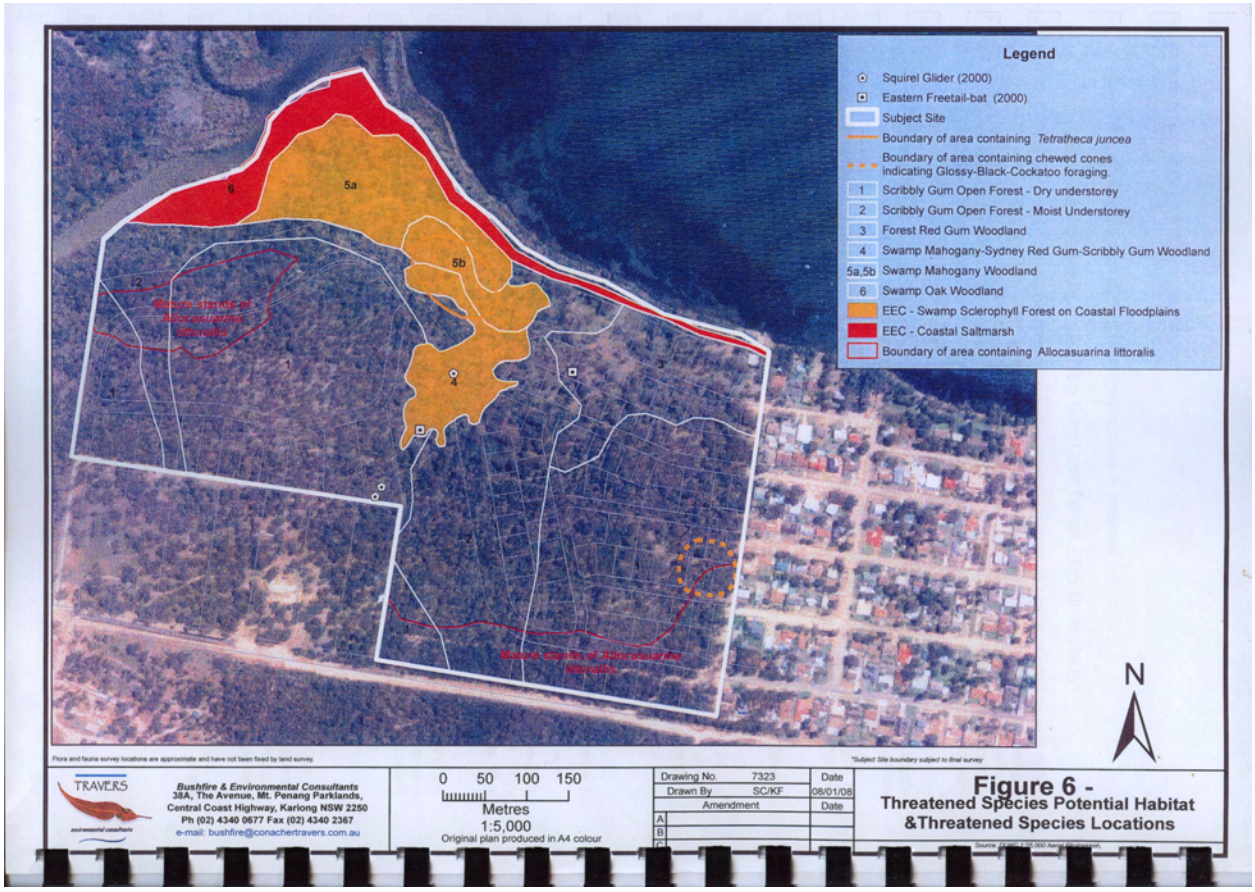


Figure 3 Vegetation map from Travers Environmental January 2008a.

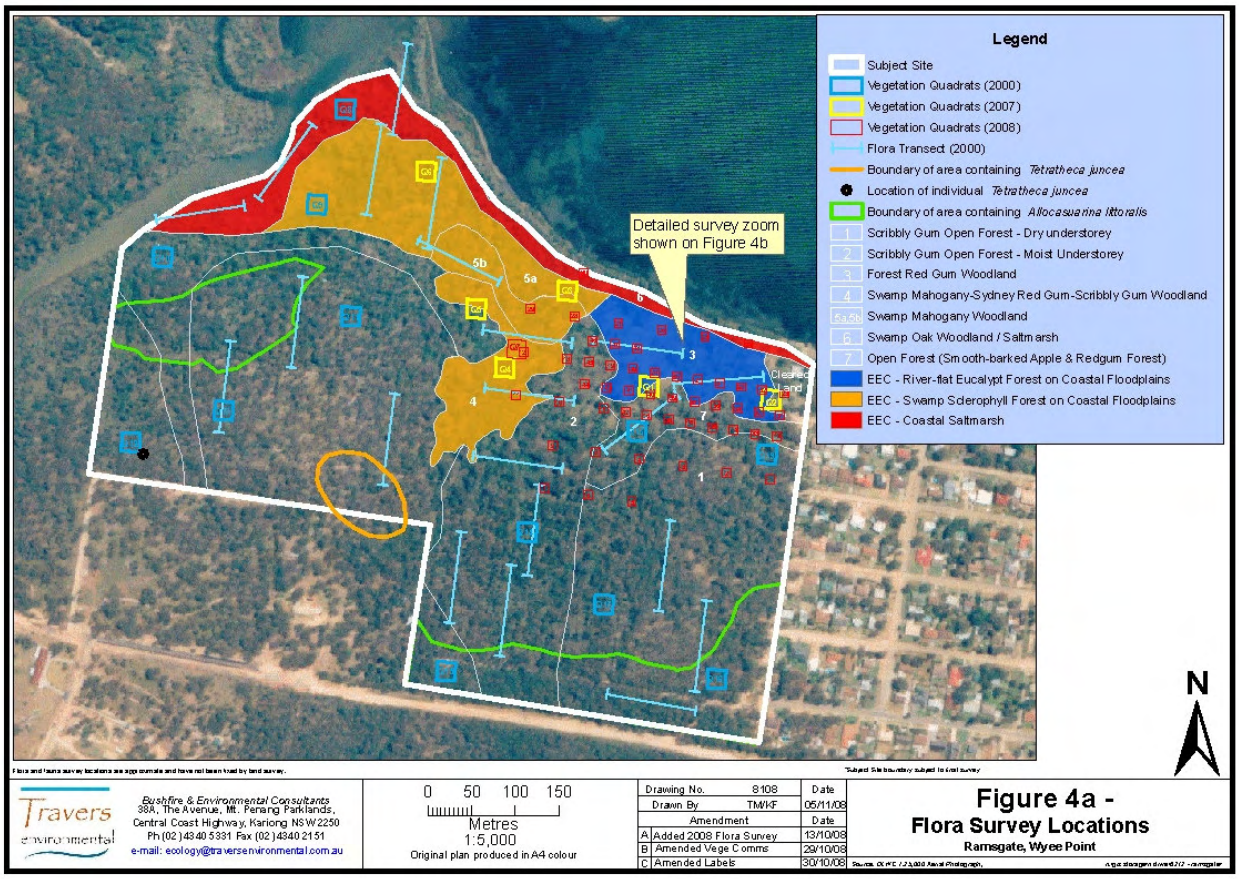


Figure 4 Vegetation map from Travers Environmental December 2008b.

Conclusions:

So where does this leave the issue of the EEC boundary ? Unfortunately, analysis of plot data could not consistently support the revised boundary of the EEC, as contained in the Travers Environmental (2008b) report. Multivariate analysis using clustering and ordination techniques on 52 sample plots could not definitively support the described communities when correlated to the mapping. Moving Split Window Analysis, comparing the floristic diversity of adjacent pairs of sample plots, suggested that the current EEC boundary still requires some adjustment. The issue of whether or not the new (ecotonal) Unit 7 forms part of the River-Flat EEC is still to be resolved, although I believe that at least part of it may.

Figure 5 provides an indication of where the EEC and other community boundaries may lie, based on the Moving Split Window Analysis and ground control data (as presented in Murray & Bell 2008). It is difficult to determine a precise boundary given the disturbance history of the site, which understandably has contributed to the differing interpretations.

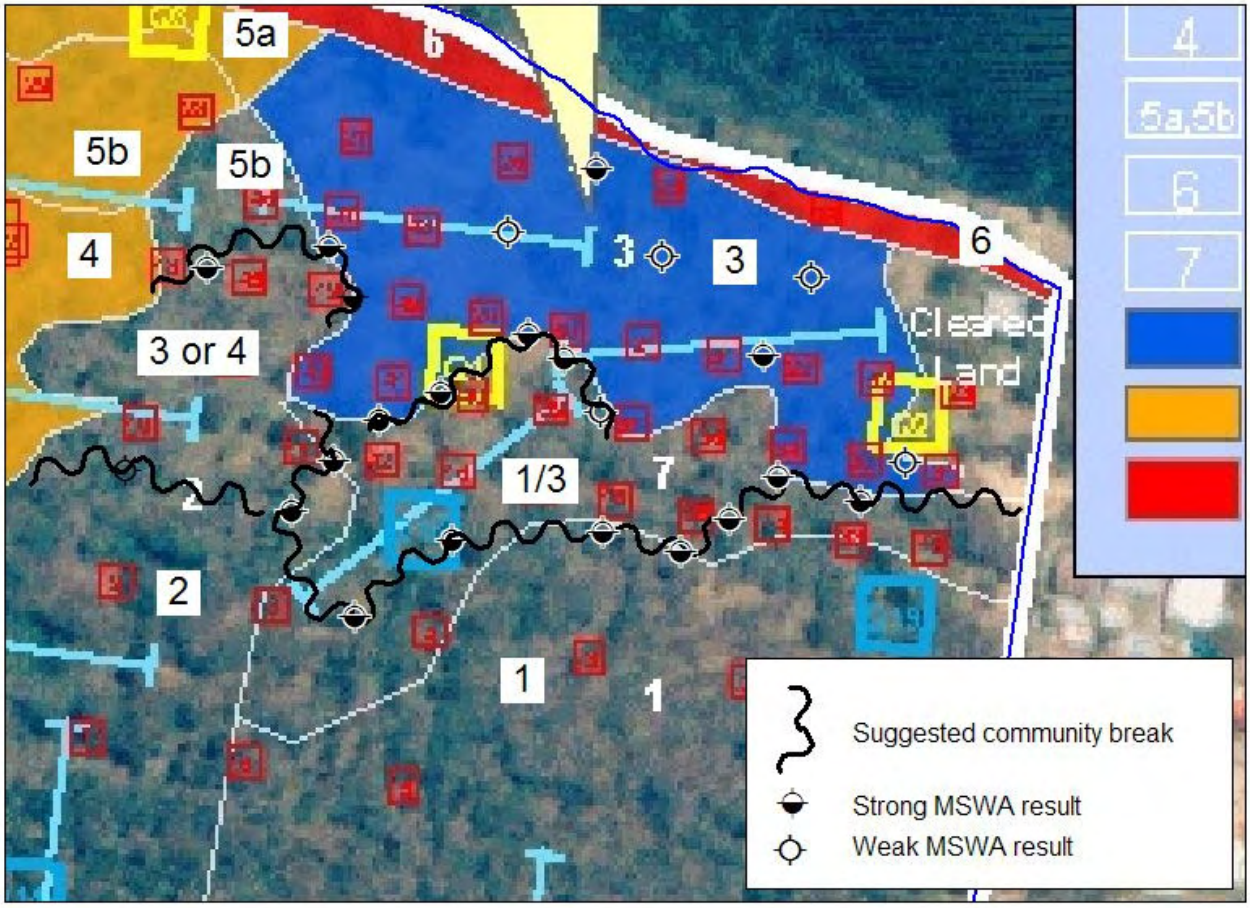


Figure 5 **Suggested community boundary changes and associated Unit numbers, based on MSWA and ground data, overlain on Figure 4a of Travers Environmental (2008b).**

References:

Choesin, D. & Boerner, R.E.J. (2002) Vegetation boundary detection: A comparison of two approaches applied to field data. *Plant Ecology* 158: 85-96.

Clarke, K.R. & Gorley, R.N. (2006) *PRIMER v6: User Manual/ Tutorial*. PRIMER-E: Plymouth.

Fortin, M-J., Olson, R.J., Ferson, S., Iverson, L., Hunsaker, C., Edwards, G., Levine, D., Butera, K., & Klemas, V. (2000) Issues related to the detection of boundaries. *Landscape Ecology* 15: 453-466.

Hennenberg, K.J., Goetze, D., Kouame, L., Orthmann, B., & Porembski, S. (2005) Border and ecotone detection by vegetation composition along forest-savanna transects in Ivory Coast. *Journal of Vegetation Science* 16: 301-310.

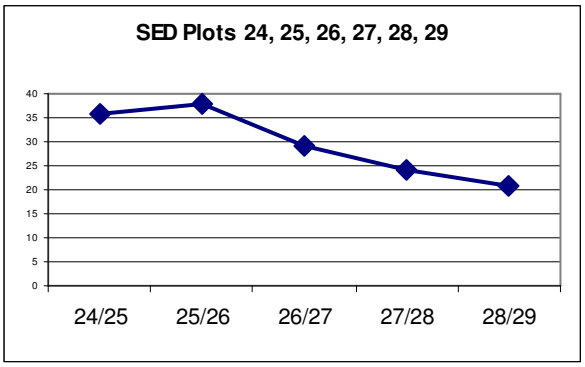
Murray, M. & Bell, S. (2008) *Review of Ecological Issues Proposed Rezoning DP1596 Wyee Point City of Lake Macquarie*. Unpublished Report to Lake Macquarie City Council. Forest Fauna Surveys Pty Ltd & Eastcoast Flora Survey, June 2008.

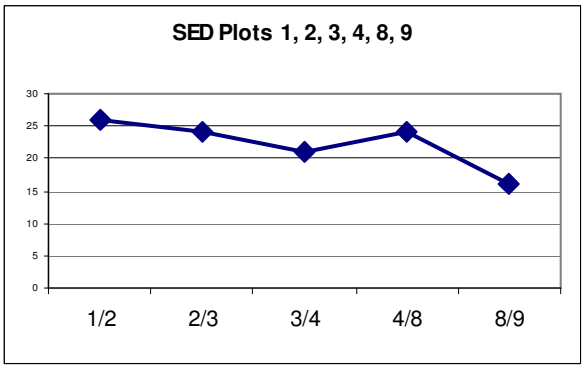
Travers Environmental (2008a) *Ecological Assessment, Ramsgate Estate DP1596 Wyee Point*. Unpublished Report. Travers Environmental Consultants, January 2008.

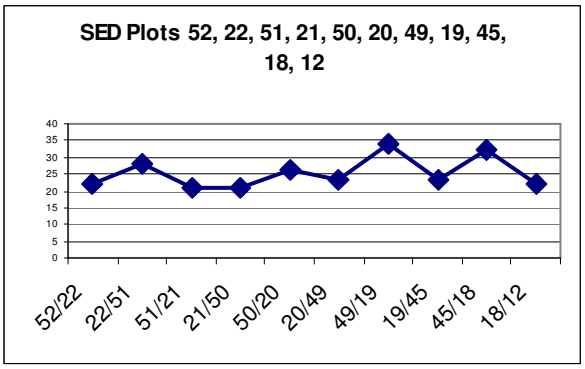
Travers Environmental (2008b) *Ecological Assessment – Ramsgate Estate DP1596, Wyee Point*. Unpublished Report. Travers Environmental Consultants, December 2008.

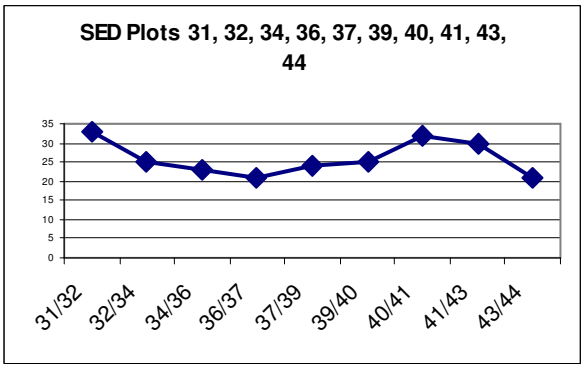
Appendix 1 Moving Split Window Analysis Results

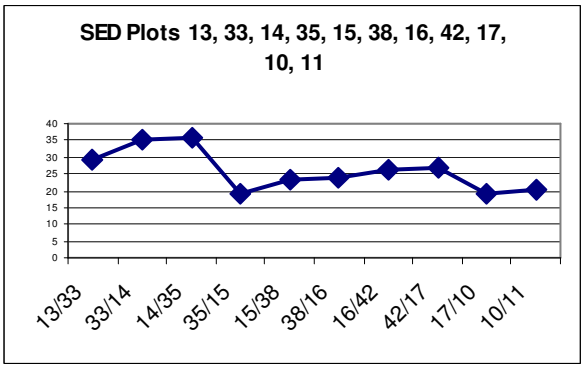
Squared Euclidean Distance (SED) –
East-West Plot Strings:



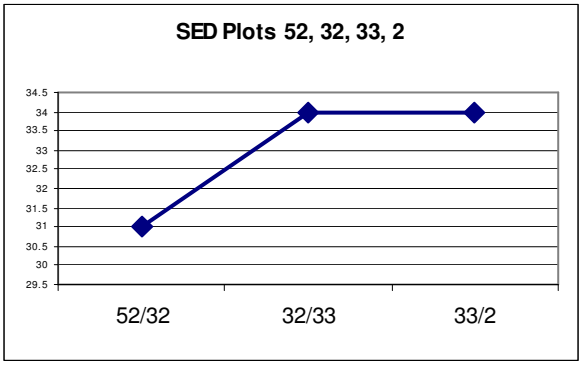


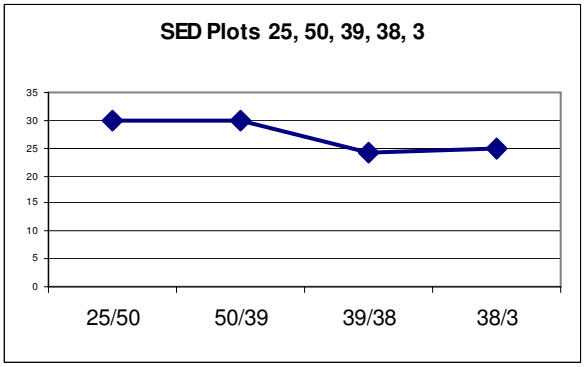


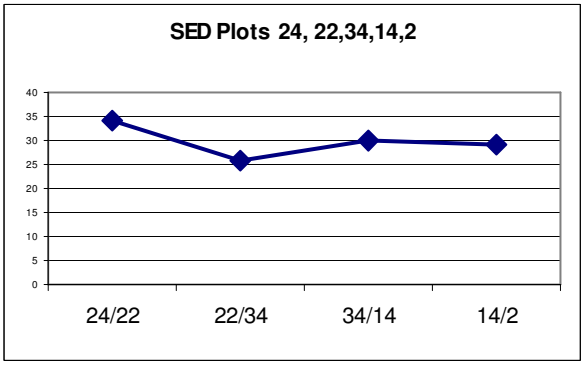


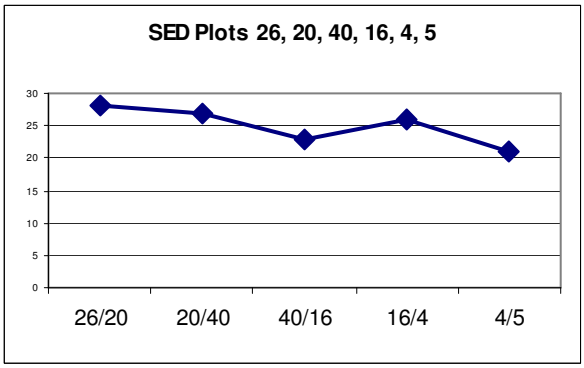


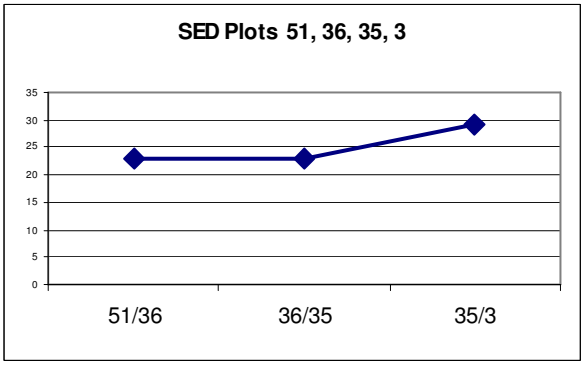
Squared Euclidean Distance (SED) –
North-South Plot Strings:

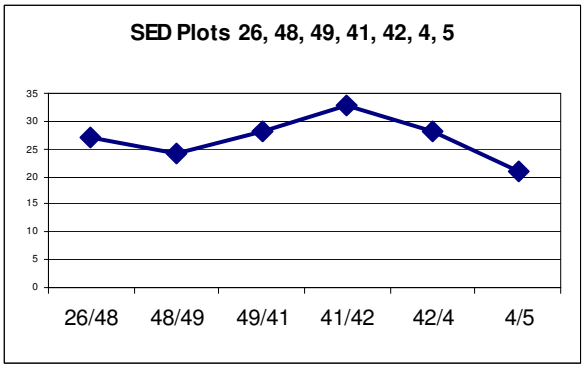


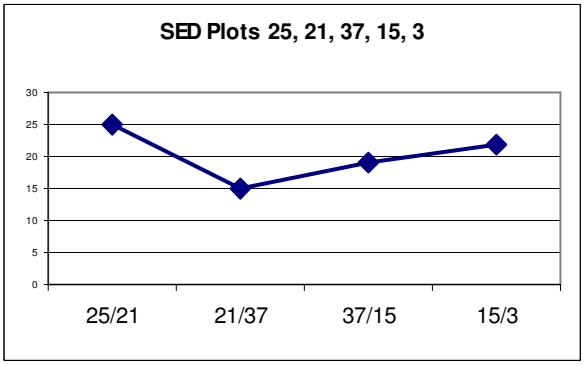


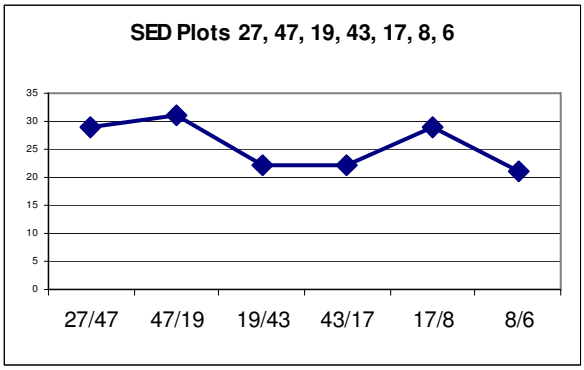


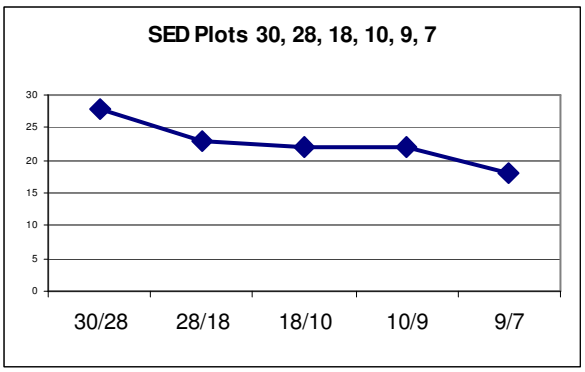











SED Plots 30, 28, 18, 10, 9, 7
30
25
20
15
10
5
0
30/28
28/18
18/10
10/9
9/7

FIGURES

*Subject Site boundary subject to final survey

0 1.5 3 4.5 7.5 Kilometres

N

Scale 1:150 000

Travers environmental

Bushfire & Environmental Consultants

38A, The Avenue, Mt. Penang Gardens,
Pacific Highway, Kariong NSW 2250
Ph (02) 4340 0677 Fax (02) 4340 2367

e-mail: ecology@conachertravers.com.au

FIGURE 1 - LOCALITY MAP

Fig1: A4P
05/11/08
Ref. 7323

Source: State Forests, 1999

Flora and fauna survey locations are approximate and have not been fixed by land survey.

*Study Area boundary subject to final survey

0 100 200 300 m

1:6,000

Original plan produced in A4 colour

N

Legend

Subject Site

SEPP14 Wetland Number 888

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Ph (02) 4340 5331 Fax (02) 4340 2151
e-mail: ecology@traversenvironmental.com.au

Figure 2 -

Aerial Appraisal and SEPP19 Wetlands

Ramsgate, Wyee Point

Ver.F2 By. KF/TM
02/12/08
Ref.No.8108

Source: DLWC 1:25,000 Aerial Photograph,

*Subject Site boundary subject to final survey

Travers environmental

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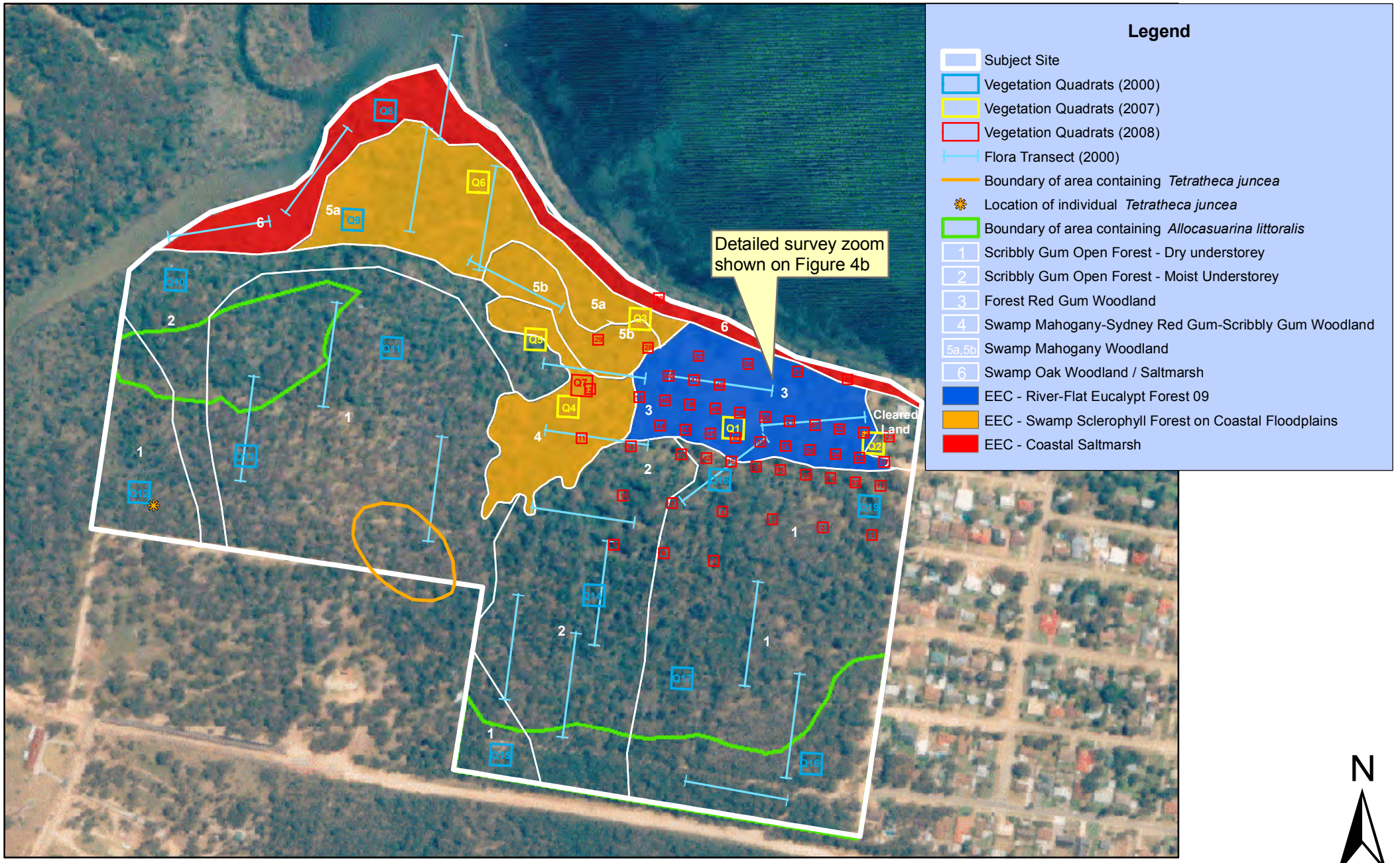
e-mail: ecology@traversenvironmental.com.au

0 50 100 150
Metres
1:5,000
Original plan produced in A4 colour

Drawing No.	8108		Date
Drawn By	KF/TM		05/11/08
Amendment			Date
B	Label Amendments	TM	05/11/08
C	Figure Updates	TM	12/12/08
D	Figure Updates	KF	29/01/09

Figure 3-
Development Concept Plan
Ramsgate, Wyee Point

Source: DLWC 1:25,000 Aerial Photograph, *n:/gis storage/n drive/6272 - ramsgate/*



Flora and fauna survey locations are approximate and have not been fixed by land survey.

*Subject Site boundary subject to final survey

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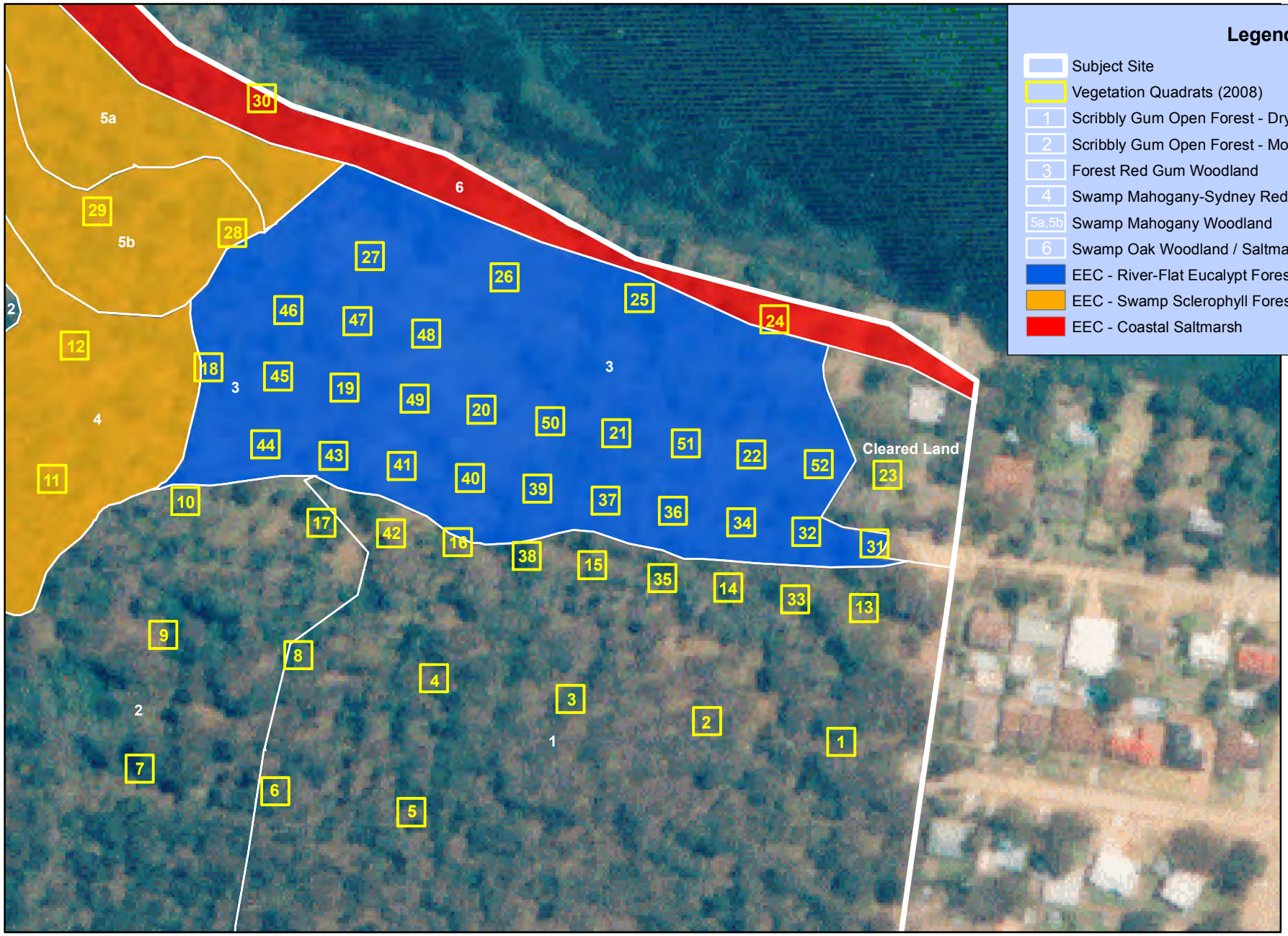
Drawing No.	8108	Date
Drawn By	TM/KF	05/11/08
Amendment		Date
B	Amended Vege Comms	29/10/08
C	Amended Labels	30/10/08
D	Amended Vege Boundaries	27/01/09

Figure 4a -
Flora Survey Locations
Ramsgate, Wyee Point

Source: DLWC 1:25,000 Aerial Photograph, n:/gis storage/n drive/6272 - ramsgate/



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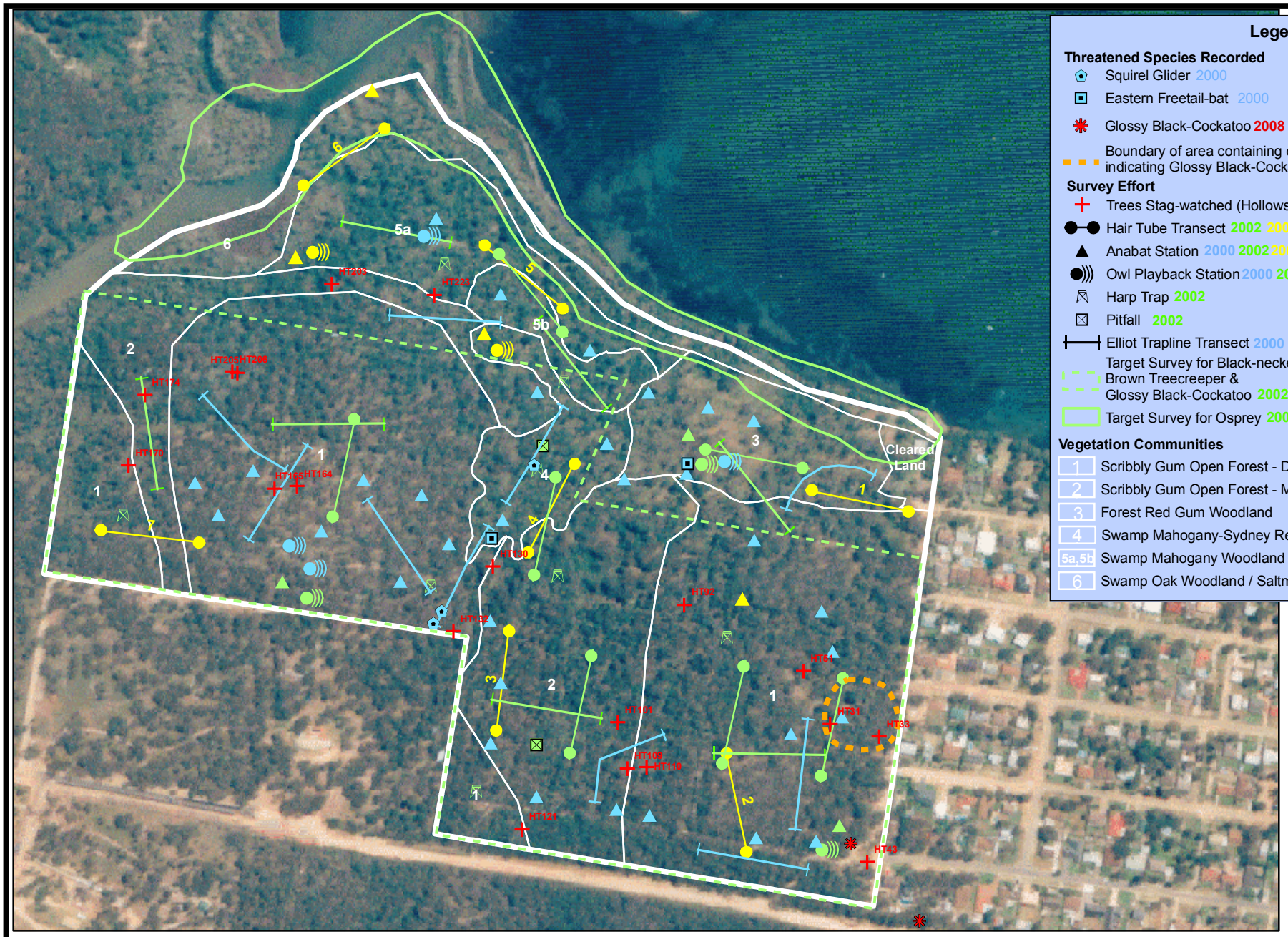
1:2,000
Original plan produced in A4 colour

Drawing No.	8108	Date
Drawn By	TM/KF	20/10/08
Amendment		Date
B	Amended Vege Comms	29/10/08
C	Amended Labels	30/10/08
D	Amended Vege Boundaries	27/01/09

Figure 4b -
Flora Survey Locations (North East Zoom)
Ramsgate, Wyee Point

Source: DLWC 1:25,000 Aerial Photograph, *n:/gis storage/n drive/6272 - ramsgate/*



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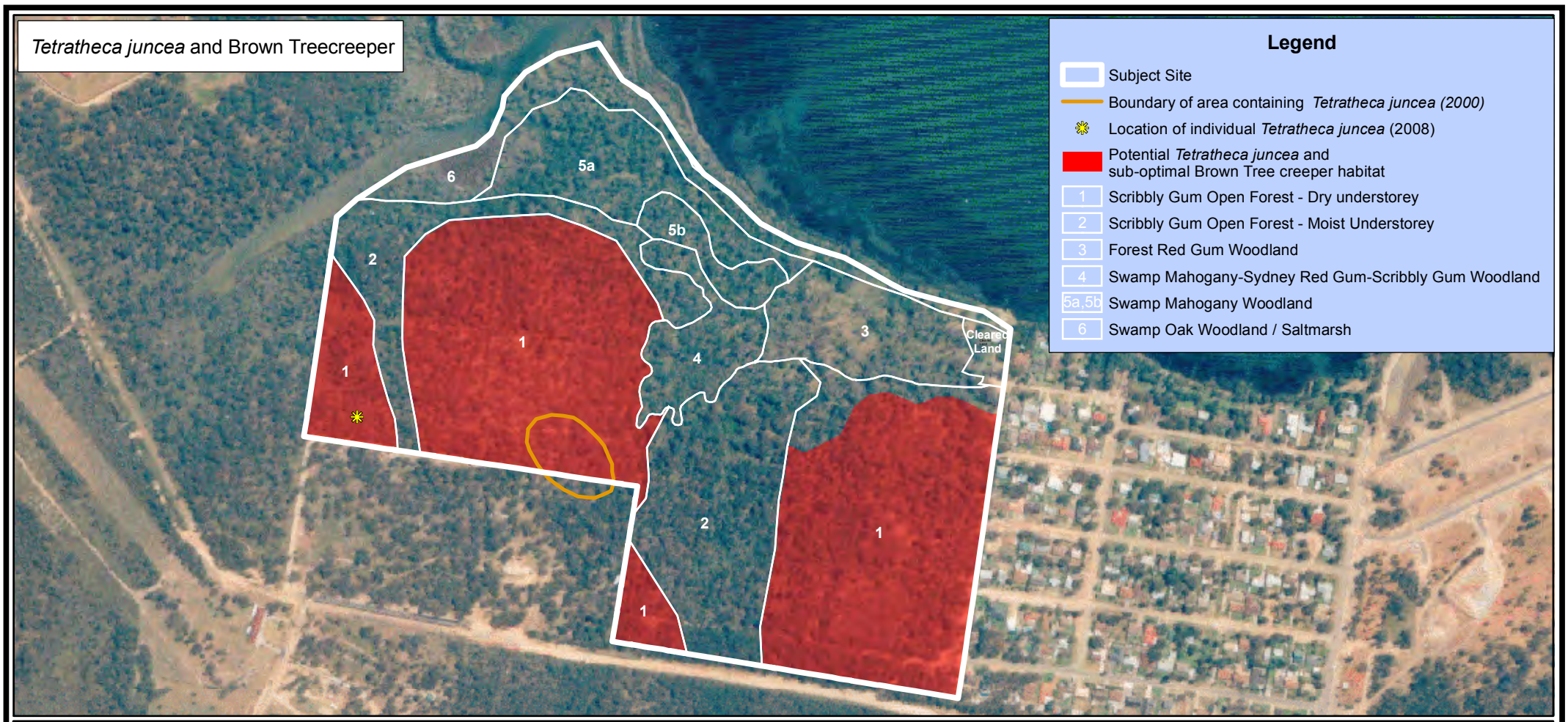
Drawing No.	7323 / 8108	Date
Drawn By	TM/KF	05/11/08
Amendment		Date
A	Added GBC Locations	30/10/08
B	Amended Vege Boundaries	27/01/09
C		

Figure 5 -
Fauna Survey Locations
2000, 2002, 2007, 2008
Ramsgate, Wyee Point

Source: DLWC 1:25,000 Aerial Photograph, *n:/gis storage/n drive/6272 - ramsgate/*

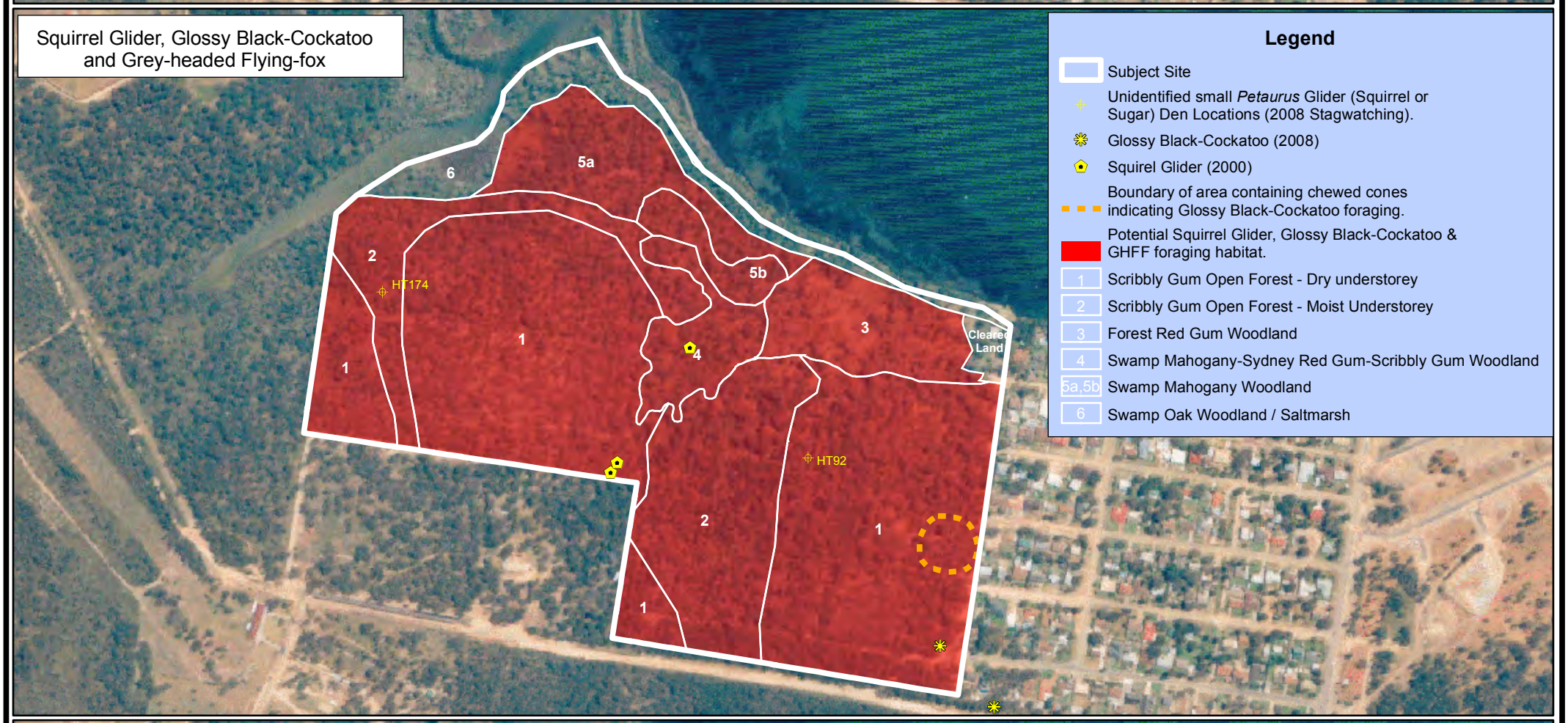
Tetratheca juncea and Brown Treecreeper



Legend

- Subject Site
- Boundary of area containing *Tetratheca juncea (2000)*
- Location of individual *Tetratheca juncea* (2008)
- Potential *Tetratheca juncea* and sub-optimal Brown Tree creeper habitat
- 1 Scribbly Gum Open Forest - Dry understorey
- 2 Scribbly Gum Open Forest - Moist Understorey
- 3 Forest Red Gum Woodland
- 4 Swamp Mahogany-Sydney Red Gum-Scribbly Gum Woodland
- 5a,5b Swamp Mahogany Woodland
- 6 Swamp Oak Woodland / Saltmarsh

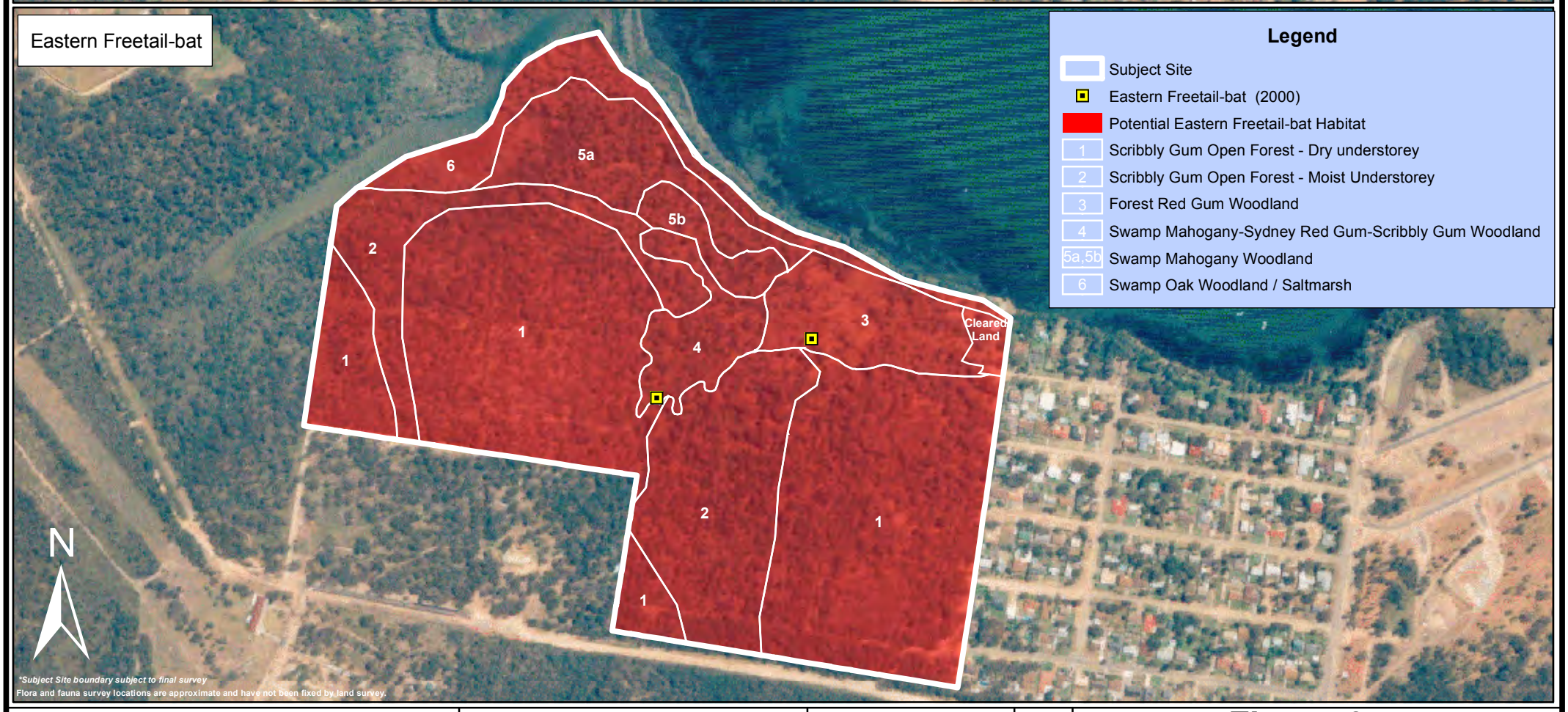
Squirrel Glider, Glossy Black-Cockatoo and Grey-headed Flying-fox



Legend

- Subject Site
- Unidentified small *Petaurus* Glider (Squirrel or Sugar) Den Locations (2008 Stagwatching).
- Glossy Black-Cockatoo (2008)
- Squirel Glider (2000)
- Boundary of area containing chewed cones indicating Glossy Black-Cockatoo foraging.
- Potential Squirrel Glider, Glossy Black-Cockatoo & GHFF foraging habitat.
- 1 Scribbly Gum Open Forest - Dry understorey
- 2 Scribbly Gum Open Forest - Moist Understorey
- 3 Forest Red Gum Woodland
- 4 Swamp Mahogany-Sydney Red Gum-Scribbly Gum Woodland
- 5a,5b Swamp Mahogany Woodland
- 6 Swamp Oak Woodland / Saltmarsh

Eastern Freetail-bat



Legend

- Subject Site
- Eastern Freetail-bat (2000)
- Potential Eastern Freetail-bat Habitat
- 1 Scribbly Gum Open Forest - Dry understorey
- 2 Scribbly Gum Open Forest - Moist Understorey
- 3 Forest Red Gum Woodland
- 4 Swamp Mahogany-Sydney Red Gum-Scribbly Gum Woodland
- 5a,5b Swamp Mahogany Woodland
- 6 Swamp Oak Woodland / Saltmarsh

**Subject Site boundary subject to final survey*

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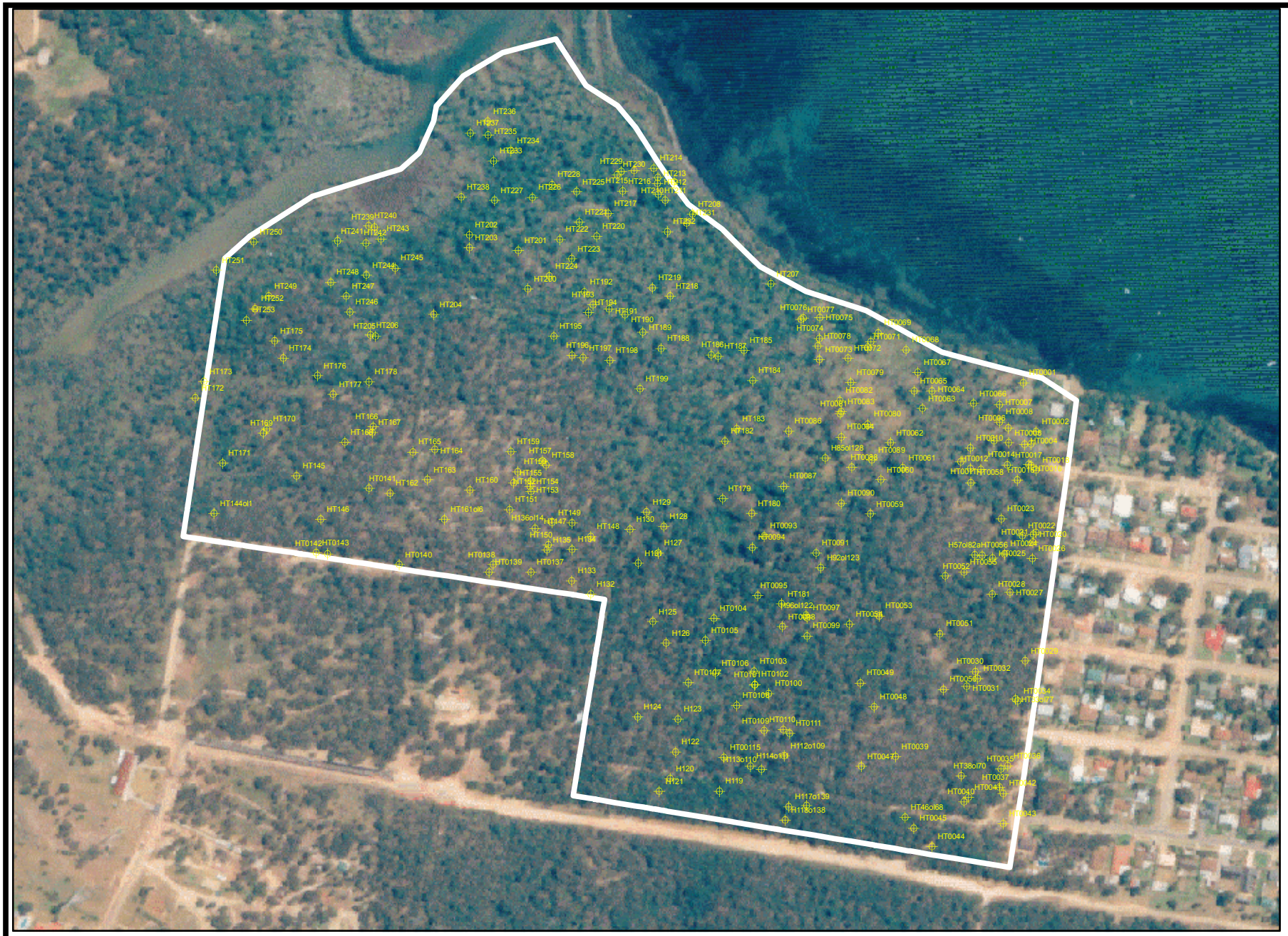
Drawing No.	8108	Date	
Drawn By	KF/TM	07/11/08	
Amendment		Date	
A	Amended Vege Boundaries	27/01/09	
B			
C			

Figure 6 -
Recorded Threatened Species Locations and Potential Habitat
Ramsgate, Wyee Point

Source: DLWC 1:25,000 Aerial Photograph, *n:/gis storage/n drive/6272 - ramsgate/*



Flora and fauna survey locations are approximate and have not been fixed by land survey.

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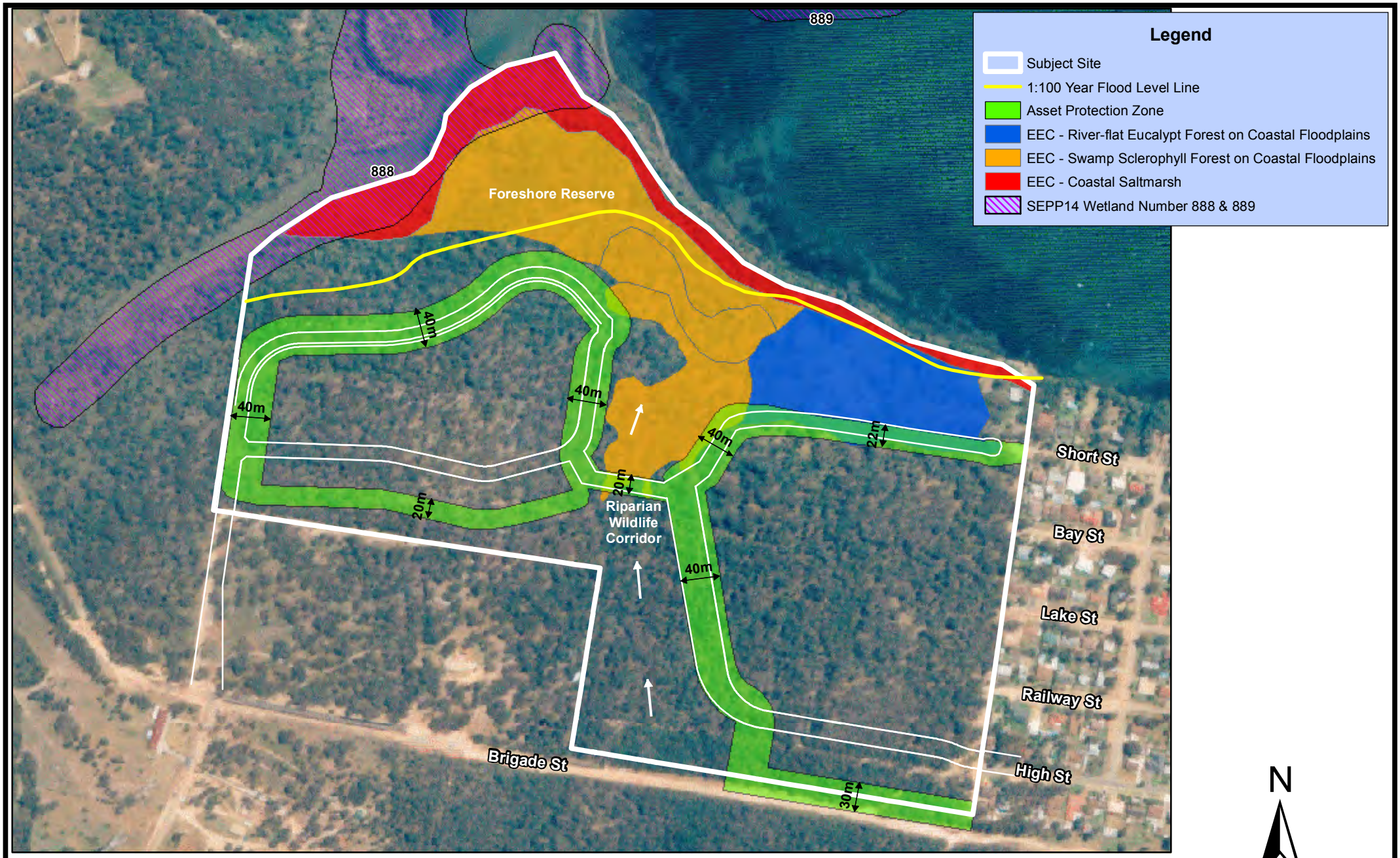
Drawing No.	8108		Date
Drawn By	TM		05/11/08
Amendment			Date
A	Figure Amendments	KF	30/10/08
B			
C			

Figure 7 -
Location of Hollow-bearing Trees
Ramsgate, Wyee Point

Source: DLWC 1:25,000 Aerial Photograph, *n:/gis storage/n drive/6272 - ramsgate/*



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0 50 100 150
Metres
1:5,000
Original plan produced in A4 colour

		Drawing No. 8108	Date
		Drawn By KF/TM	05/11/08
		Amendment	Date
C		Figure updates TM	12/12/08
D		Amended Vege Boundaries	27/01/09
E		Road & APZ ammends KF	29/01/09

Figure 8 -
Ecological & Bushfire Contraints
Ramsgate, Wyee Point

Source: DLWC 1:25,000 Aerial Photograph, n:/gis storage/n drive/6272 - ramsgate/