# Ecological Assessment Report

For
Southern Lake Macquarie Lands

Prepared for
Rosegroup Pty Ltd
51 Riley Street
Woolloomooloo NSW 2011

HARPER SOMERS O'SULLIVAN
PLANNING › SURVEYING › ECOLOGY
A member of RPS Group Plc

Job Reference 24619 - December 2007


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|---|---|
| *PROJECT: ECOLOGICAL ASSESSMENT REPORT: SOUTHERN LAKE MACQUARIE LANDS* | |
| *CLIENT:* | *ROSEGROUP PTY LTD* |
| *OUR REF.* | *24619* |
| *DATE:* | *DECEMBER 2007* |
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# Executive Summary

## *Introduction*

RPS Harper Somers O'Sullivan Pty Ltd (RPS HSO) has been commissioned by Rosegroup Pty Ltd to undertake an *Ecological Assessment Report* (EAR) over land at Catherine Hill Bay (CHB) and Gwandalan, for proposed development and conservation offsets as outlined within the Lower Hunter Regional Strategy. The proposal is to be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*. The proposal is also being assessed under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.*

The report herewith builds on previous works undertaken over several years by Wildthing and EcoBiological, and provides an overall summation of ecological findings to date, impact assessment of development / conservation outcomes, and recommendations for moving forward.

## *Background*

A Memorandum of Understanding (MoU) covering the site was made on 16 October 2006 between the NSW Minister for the Environment, the NSW Minister for Planning, Coastal Hamlets Pty Ltd and Lakeside Living Pty Ltd (attached as Appendix A). Both Coastal Hamlets Pty Ltd and Lakeside Living Pty Ltd are Rosegroup companies. The MoU outlines the intention to implement an Environmental Lands Offset Scheme. The proposal includes the development of up to 60ha of land at CHB and up to 26ha of land at Gwandalan and the provision of 310ha of land to conservation (transferred to DECC estate).

Previous ecological investigations have been undertaken across various portions of the land covered by the MoU over the past four years. RPS HSO was commissioned to produce an EAR that collates and builds on previous ecological investigations and provides the necessary level of detailed information for the assessment of the proposal under relevant legislation.

The majority of land subject to the proposal, collectively referred to as 'the site' is located between the coast at CHB and the shores of Lake Macquarie at Crangan Bay, with a smaller portion of land located at Kanangara Drive, Gwandalan. The site includes two proposed residential developments; incorporating development of up to 60ha at CHB and up to 26ha at Gwandalan, referred to as the 'Catherine Hill Bay (CHB) development lands' and the 'Gwandalan development lands' respectively. This report also includes consideration of the proposed provision of approximately 310ha of land to offset potential ecological impacts, referred to as the 'offset lands'. Where suitable, offset lands are proposed to be transferred to the management of the Department of Environment and Climate Change (DECC). This report has been prepared with due reference to the Draft Guidelines for Threatened Species Assessment as relates to Part 3A applications.

## *Methods*

The DGEAR's stipulate assessment should have due regard to DECC's Threatened Species Assessment Guidelines. These guidelines refer the user to consult the Threatened Biodiversity Survey and Assessment Guidelines – Working Draft (DEC 2004) and any relevant recovery plans and threat abatement plans for ecological

assessment. In brief the methods employed to assess the ecological merit of the site involved the following:

- Literature review
- Field investigations incorporating flora identification and vegetation mapping, and targeted surveys for significant flora species
- Habitat identification and assessment
- Fauna survey work, including targeted surveys for significant fauna species
- Data collation and interpretation, leading to EAR production

The works undertaken are considered to provide a detailed baseline dataset that enables a sufficient level of assessment and reporting to occur to satisfy the DGEAR's.

***Results***

*Flora*

The combined results of various flora surveys undertaken have confirmed the presence of two threatened flora species and four Endangered Ecological Communities within the site.

Threatened species recorded include:

- *Cryptostylis hunteriana*

*C. hunteriana* was identified within the Narrabeen Doyalson Coastal Woodland within the northern section (Hamlet 6) of the CHB Development Lands. This population was small but significant due to the low numbers of this species which have been located within the locality. It is recommened that these individuals and their surrounding habitat be retained under the proposal.

- *Tetratheca juncea*

A total of 583 *Tetratheca juncea* plants were located during the targeted surveys within the site. A total of 369 *T.juncea* clumps would be removed as part of the proposal (189 recorded within the CHB development lands and 180 recorded by Wildthing (2003b) within the Gwandalan development lands). It must be noted that no targeted searches for this species has been undertaken in the offset lands and the number located there is expected to be at least four-fold this figure. This is supported by large populations being located within the immediate vicinity of the site within land owned by Coal & Allied.

A number of other threatened flora species were considered to have potential habitat within the site. Separate targeted searches were undertaken by previous surveys which have occurred within the site (Wildthing, 2003a; 2003b; 2004a; 2004b; 2004c; EcoBiological, 2006a; 2006b)

Endangered Ecological Communities included:

- Coastal Sand Mahogany-Paperbark Swamp Forest **(EEC Swamp Scerlophyll Forest);**

- Estuarine Swamp Oak Forest **(EEC Swamp Oak Floodplain Forest);**
- Estuarine Mangrove-Saltmarsh Complex **(EEC Saltmarsh);**
- Freshwater Wetland Complex **(EEC – Freshwater Wetlands on Coastal Floodplains);**

Only a very small amount of one EEC would be affected by the proposal. Additionally, any long-term discernable impacts are considered likely to be minimal. The conservation offset outcomes far exceed the areas to be affected either directly or indirectly by development.

*Fauna*

A total of 15 threatened fauna species were recorded or considered likely to occur within the development lands and had a moderate chance of potential impact. These species included Wallum Froglet, Glossy Black-Cockatoo, Regent Honyeater, Swift Parrot, Powerful Owl, Masked Owl, Eastern Pygmy Possum, Grey-headed Flying-fox, Little Bentwing-bat, Eastern Bentwing Bat, Eastern Freetail Bat, Yellow-bellied Sheathtailed Bat, Eastern False Pipistrelle, Large-footed Myotis and Greater Broad-nosed Bat.

Potential breeding habitat exists within the Gwandalan development lands for the Masked Owl and Glossy Black Cockatoo which were recorded onsite.

Relevant recommendations are provided below to assist in minimising any potential impacts on the abovementioned species / communities.

***Conclusion & Recommendations***

The outcomes for the site as per the MoU were formulated on existing ecological information available at that time. The studies undertaken herewith have confirmed that development of a small portion of the site as a whole would provide a mechanism for adequate ecological outcomes within the proposed offset lands (that would be dedicated to conservation) for the vast majority of species and communities contained therein. The quantum of the offset lands, when viewed holistically with proximate existing and proposed conservation reserve areas, provides a robust long-term outcome for all species and communities.

Some concerns are raised in regards to the presence of *Cryptostylis hunteriana* within the CHB development lands, SEPP 14 wetland to the south of the CHB development lands and potential breeding habitat for the Masked Owl and Glossy Black-Cockatoo within the Gwandalan development lands. Further investigations and mitigation measures have been recommended to reduce potential impacts associated with the proposal.

The field and desktop studies have recorded the following parameters of ecological significance within both the offset lands and the development estate:

- native vegetation commensurate with those listed as EEC's;
- threatened flora species recorded within and adjacent to the proposed development;
- threatened fauna species recorded within and adjacent to the proposed development;

- habitat for threatened flora and fauna species known from within and adjacent to the proposed development; and
- other areas containing native vegetation with varying degrees of modification / degradation.

Given that the measures have been taken to avoid ecological impacts and that where native vegetation may be affected, efforts have been made to avoid particularly sensitive areas where practical, it is considered unlikely that any significant impacts would occur upon threatened species, communities or populations. The large areas of offset lands that have been set aside as part of the development provide excellent long-term ecological outcomes across the site. As a result of conservation of these offset lands, coupled with other large land parcel dedications in the locality, a large vegetation corridor will be created across the Wallarah Peninsula. These offset lands will link three state conservation areas of Lake Munmorah State Conservation Area, Lake Macquarie State Conservation Area and Wallarah National Park. This large tract of native vegetation will provide conserved habitat for a wide variety of native flora and fauna.

Therefore, it has been concluded that, providing the recommended mitigation measures are adopted, the proposed development should not significantly impact upon threatened or regionally significant flora and fauna, ecological communities or populations. The implementation of operative environmental management practices should also ensure that the ecological impact of the project is minimised.

The following recommendations have been outlined to ensure that the ecological impact of the proposal is minimised as far as possible:

- Retain the *Cryptostylis hunteriana* individuals that were identified and the surrounding Narrabeen Doyalson Coastal Woodland at CHB development lands which is habitat for this species. Implement a buffer of at least 50m to protect this sensitive orchid from any proposed development areas. A management plan should be prepared to ensure the conservation and long term survival of this threatened species within the CHB development lands.
- Whilst the Littoral Rainforest EEC identified within the CHB development lands was considered to be significantly degraded by weeds by EcoBiological (2006b), the extent of the community may actually be less than the area of 3.9ha given by EcoBiological (2006b) since this figure included surrounding scrub. As such, further survey and analysis should be undertaken to map the exact extent of the community within the CHB development lands and to provide a more detailed flora survey.
- Whilst searches were conducted for the evidence of owl activity within potential Masked Owl roosts within Gwandalan development lands, further investigation of breeding activity is required. Targeted Masked Owl surveys within the Gwandalan development lands should be undertaken prior to any vegetation removal and should include stagwatching of potential roosts, spotlighting and call playback.
    - In the case that Masked Owl breeding is recorded within the Gwandalan development lands the following recommendations apply:
        - Vegetation removal should not commence until young have fledged. This may require ongoing monitoring by experienced ecologists. Once the nest is no longer being used, vegetation

clearance should occur within the next 3 months to prevent nesting re-occurring.

- The high concentrations of Glossy Black-Cockatoo chewed cones observed within Gwandalan development lands in August 2007 and the high abundance of potential nesting hollows may indicate that the species may breed within the Gwandalan development lands. Targeted searches for Glossy Black-Cockatoo nesting sites within the Gwandalan development lands should be undertaken during the appropriate season (March to August) prior to vegetation removal (ie during March - August in the same year as vegetation removal is proposed). Multiple visits would be required during this survey period to assess whether the species breeds within the site.
    - In the case that Glossy Black Cockatoo is found to be breeding within the Gwandalan development lands:
        - Vegetation removal should not commence until young have fledged. This may require ongoing monitoring by experienced ecologists. Once the nest is no longer being used, vegetation clearance may occur. Vegetation removal should not occur within the breeding period (March-August)
- Protection and minimisation of disturbance to White-bellied Sea-eagle nest occurring in the offset lands in consultation with DECC.
- Strict management of stormwater runoff from both CHB and Gwandalan development lands must occur to minimise potential impacts on EECs, SEPP 14 wetlands and known Wallum Froglet habitat.
- Implement the following SEPP 14 buffers:
    - A primary riparian buffer of 50 m from wetland vegetation, where no land uses are permitted that significantly detract from the potential of the buffer to achieve the goal of wetland protection. This buffer would consist predominantly of existing fringing vegetation.
    - Where these buffers are unable to be implemented within the proposed development design, additional control measures should be investigated in consultation with experienced wetland hydrologists and engineers to ensure that potential impacts on the SEPP 14 wetland are minimised.
- A weed management and monitoring plan for the CHB development lands should be developed and implemented to minimise the potential for the invasion of aquatic and terrestrial weed species into the SEPP 14 wetland and buffer zones. The weed management and monitoring plan for CHB development lands should be developed in consultation with DECC to ensure consistency with management strategies undertaken for the adjacent Munmorah SCA and offset lands which would be transferred to DECC;
- The management of the development and conservation land interface is critical to ensure that no direct or indirect impacts occur in the short and long term on dedicated offset lands. As such, appropriate management plans should be prepared and implemented within the CHB and Gwandalan development lands in consultation with DECC to ensure consistency of management strategies with adjacent offset lands.

- The minimum amount of clearing should take place as a general objective of the project, particularly within those areas that currently contain identified native vegetation communities. These areas have been described within this report. This is especially important within those areas identified as containing vegetation consistent with EEC's.

- It is recommended that a *Tetratheca juncea* management plan be prepared for the CHB and Gwandalan development lands to ensure the conservation and long term survival of this threatened species within the retained areas of the development estate. The *T. juncea* management plan for the CHB and Gwandalan development lands should be developed in consultation with DECC to ensure consistency with management strategies undertaken for adjacent offset lands (which would be transferred to DECC).

- Mature and / or hollow-bearing trees should be retained wherever feasible and with regards to public safety within the development framework, particularly within Gwandalan development lands where there are no offsets immediately adjacent to the site.

- Pre-clearing inspections should be undertaken by an ecologist in wooded areas where threatened fauna species have been recorded or are considered likely to occur. This is particularly important in areas where threatened fauna have been noted during recent surveys either breeding or nest-building. No breeding attempts should be disrupted during the course of the project, particularly by threatened fauna.

- During the construction phase, for any tree removal within forested areas, and in particular where hollow-bearing trees may be removed, all works should be supervised by an ecologist to recover any native fauna that are potentially displaced. Furthermore, where such risks occur, site-specific ecological advice should be sought to minimise impacts during the entire process. A clearing protocol should be adopted for the removal of trees containing suitable habitat hollows as follows (this is considered as a guideline, variations on the methods employed may be required to accommodate site specific factors):

    - All hollow bearing trees are to be flagged by an ecologist prior to the commencement of works on site.

    - Underscrubbing of the entire site should be carried out by a 4x4 tractor with a slashing deck, this will minimise the establishment of degradation processes and leave a layer of mulch to aid in soil retention in the event of adverse weather. At this time felling of non habitat trees can take place, however a matrix of trees *must* be maintained to allow animal movement into the designated refuge area.

    - After a period of two weeks, clearing of habitat trees should commence. Clearing must be carried out moving from the fringe of the matrix towards the refuge area. Trees should be 'soft felled' and inspected immediately by an ecologist for displaced fauna. All trees must be left for a minimum of two nights prior to being moved to a stockpile, to allow resident fauna to vacate tree hollows.

  *<u>Note:</u> Clearing should ideally take place outside of the main breeding seasons of resident fauna, preferably during late Autumn and Winter.*

- Species selection for future landscaping works and seed stock for revegetation should be limited to locally occurring native species to maintain local genetic diversity. This should include *Eucalyptus robusta* and other regionally significant species.

- Appropriate vegetation, habitat and bushfire management plans should be included under an overarching Environmental Management Plan for the Gwandalan and .

- Where possible, earthworks (and certainly all works in the vicinity of drainage lines) should be undertaken during appropriate (i.e. dry) weather conditions. This will ensure that any potential erosion events will be intercepted and that no downstream impacts occur within any of the drainage lines. This will help to maintain existing habitat characteristics for native fauna in those areas, including those for threatened species.

- Nutrient and sediment control devices should be erected pre-clearing and post-construction works in sensitive areas where degradation processes may be triggered such as areas adjacent to watercourses until suitable rehabilitation has occurred to maintain surface integrity. Furthermore, stockpiles should be subject to individual sediment and nutrient control devices.

- Where possible, landscape sediment retention ponds with fringing wetland vegetation (eg *Typha* sp.) to provide habitat for species such as Green and Golden Bell Frog.

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## GLOSSARY OF TERMS AND ABBREVIATIONS

aff. – Affinity

CHB - Catherine Hill Bay

CHB development lands - proposed lands to be developed at Catherine Hill Bay

CMA – Catchment Management Authority

DBH – Diameter at Breast Height (centimetres)

DECC – NSW Department of Environment and Climate Change (formerly NSW Department of Environment and Conservation)

DEW – Commonwealth Department of Environment and Water Resources (formerly Department of Environment and Heritage)

DGEAR's - Director General's Environmental Assessment Requirements

DLHRCP – Draft Lower Hunter Regional Conservation Plan

DNR – NSW Department of Natural Resources (formerly Department of Infrastructure, Planning and Natural Resources)

DoP- NSW Department of Planning

EAR – Ecological Assessment Report

EEC – Endangered Ecological Community

EMP – Environmental Management Plan

*EPA Act – NSW Environmental Planning and Assessment Act 1979*

*EPBC Act* – Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

*FM Act* – NSW *Fisheries Management Act 1994*

ha – hectare

HBOC – Hunter Bird Observers Club

Hwy – Highway

LGA – Local Government Area

LHRS - Lower Hunter Regional Strategy

MoU – Memorandum of Understanding

NPWS – NSW National Parks and Wildlife Service

Offset lands - proposed lands to be dedicated to conservation

PFC – Projected Foliage Cover

RPS HSO – RPS Harper Somers O'Sullivan

ROTAP – Rare or Threatened Australian Plants (Briggs & Leigh 1995)

Ssp. or subsp. – Subspecies

Sp – Singular Species

Spp – Multiple Species

SSS - State Significant Site

*TSC Act* – NSW *Threatened Species Conservation Act 1995*

Var. – Variety

# 1 INTRODUCTION

RPS Harper Somers O'Sullivan Pty Ltd (RPS HSO) has been commissioned by Rosegroup Pty Ltd to undertake an *Ecological Assessment Report* (EAR) over land at Catherine Hill Bay (CHB) and Gwandalan, for proposed development and conservation offsets as outlined within the Lower Hunter Regional Strategy. The proposal is to be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*, as amended by the *Environmental Planning and Assessment Amendment Act 1997*. Due recognition and consideration of the *Threatened Species Conservation Act 1995* and the *Fisheries Management Act 1994* has been made throughout this assessment. The proposal is also being assessed under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.*

## 1.1 Background

A Memorandum of Understanding (MoU) covering the site was made on 16th October 2006 between the NSW Minister for the Environment, the NSW Minister for Planning, Coastal Hamlets Pty Ltd and Lakeside Living Pty Ltd (attached as Appendix A). Both Coastal Hamlets Pty Ltd and Lakeside Living Pty Ltd are Rosegroup companies. The MoU outlines the intention to implement an Environmental Lands Offset Scheme. The proposal includes the development of up to 60ha of land at CHB and up to 26ha of land at Gwandalan and the provision of 310ha of land to conservation (transferred to DECC estate).

Previous ecological investigations have been undertaken over the past four years across various portions of the land covered by the MoU. RPS HSO was commissioned to produce an EAR that collates and builds on previous ecological investigations and provides the necessary level of detailed information for the assessment of the proposal under relevant legislation.

## 1.2 Site Particulars

**Locality** – The site occurs on the Wallarah Peninsula and at Gwandalan on the south-eastern side of Lake Macquarie.

**LGA –** Lake Macquarie City Council and Wyong Shire Council

**Title(s) –** *CHB* - Lot 2 DP 809795, Lot 2031 DP 841175, Lot 6 DP 774923, Lot 5 DP 774923; *Gwandalan* – Lot 3 DP588205.

**Area** – The site includes 60ha of land to be developed at CHB, 26ha of land to be developed at Gwandalan and 310ha of land that would be dedicated as offset lands to the NSW Government.

**Boundaries –** The land at Gwandalan is bounded by the shores of Lake Macquarie to the north-east, Lake Macquarie State Conservation Area (SCA) to the north, private vegetated land to the west and existing residential development to the south-east. The remainder of the site extends from the coast at CHB in the east, to the shores of Lake Macquarie at Crangan Bay in the west, by the Village of CHB and lands owned by Coal and Allied to the north and finally by Munmorah SCA to the south.

**Current Land Use –** Landuse at Gwandalan includes residential and recreational facilities, pastures for grazing, maintenance of parkland-type vegetation and relatively unmanaged remnant bushland. The lands at CHB include portions that have been highly disturbed by mining and large tracts of natural bushland that are not in current use.

**Topography –** The majority of the site is characterised by undulating low coastal hills, gently sloping to the shores of Lake Macquarie. The site rises to the headland at CHB where a steep drop to the ocean occurs.

## 1.3 Description of the Proposal

The majority of land subject to the proposal, collectively referred to as 'the site' is located between the coast at CHB and the shores of Lake Macquarie at Crangan Bay, with a smaller portion of land located at Kanangara Drive, Gwandalan. The site includes two proposed residential developments; the first includes development of up to 60ha at CHB and up to 26ha at Gwandalan, referred to as the 'CHB development lands' and the 'Gwandalan development lands' respectively. This report also includes consideration of the proposed provision of approximately 310ha of land to offset potential ecological impacts, referred to as the 'offset lands'. Where suitable, offset lands are proposed to be transferred to the management of the Department of Environment and Climate Change (DECC). This report has been prepared with due reference to the Draft Guidelines for Threatened Species Assessment as relates to Part 3A applications.

Rosegroup companies owns approximately 400ha of land in the Lower Hunter Region which is included in the Lower Hunter Regional Strategy (LHRS) (DoP, 2007) and the Draft Lower Hunter Conservation Plan (DLHCP) (DECC, 2006) for urban development and conservation. Rosegroup companies is one of four major landowners within the region that play a significant role in achieving the LHRS's environmental and conservation outcomes and sustainable growth. In finalising the LHRS, the NSW Government reached agreement with Rosegroup companies for the dedication of 310ha (over 80 per cent) of land for conservation corridors upon receipt of development rights on 86ha (under 20 per cent).

The details of the negotiations are set out in a MoU (Appendix A) between Rosegroup companies and the NSW Government. The MoU also provides for completion of a binding agreement between the NSW Government and Rosegroup companies, a Part 3A approval process for the development proposals and a proportional adjustment of the area of offset lands to be transferred in the event that developable land areas approved vary from the scheduled areas.

The proposed offset lands are areas of high conservation value in nominated green corridors that will be dedicated to the public. The offset lands are similarly identified in the draft LHCP prepared by DECC.

The locality of the site within a regional context is presented in Figure 1-1, whilst the arrangement of the CHB development lands, Gwandalan development lands and offset lands is presented in Figure 1-2.

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

LAKE MACQUARIE
Gwandalan Development Lands
NORDS WHARF
PACIFIC HIGHWAY
WALLARAH NATIONA PARK
Crangan Bay
GWANDALAN
Middle Camp
Catherine Hill Bay
LAKE MACQUARIE STATE RECREATION AREA
MUNMORAH STATE RECREATION AREA
0 0.5 1km

**TITLE:** Figure 1-1 Site Locality

**SCALE:** 1: 21000 at A3 Size **DRAWN:** S. Bishop **APPROVED:** D. Landenberger

**DATUM:** MGA Zone 56 (GDA 94) **DATE:** 17/8/2007

**LAYOUT REF:** J:\JOBS\24k\24530 Hunter Valley\Draft .... ology\Southern Lands\ALL WORKSPACES\24530 Southern Lands Location FIGURE 1-3 A-A3.wor

**CONTOUR INTERVAL:** N/A

**JOB REF:** 24619

**CLIENT:** Rosecorp Pty Ltd



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**WARNING**

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

**TITLE:**
Figure 1-2
Site Layout

**CLIENT:**
ROSECORP PTY LTD

**PLANNING SURVEYING ECOLOGY**

**SCALE:** 1: 29000 at A4 Size **DRAWN:** E. Graham **APPROVED:** D. Landenberger

**DATUM:** MGA Zone 56 (GDA 94) **DATE:** 22/11/2007

**LAYOUT REF:** J:\JOBS\24k\24619 - Gwandalan\Draftin .... nfo\24619.FIG2.SiteLayout.221107.wor

**CONTOUR INTERVAL:** N/A

**JOB REF:** 24619



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## 1.4 Scope of the Study

This study is intended to investigate the potential ecological impacts of the proposal, and to meet the relevant requirements as outlined within the DGEAR's released for the project. The primary impacts are likely to be associated with the removal of vegetation both in terms of direct impacts upon native stands of vegetation and to a lesser extent, upon habitat for native fauna within and directly adjacent to the development estates.

The purpose of this EAR is to collate and review information from previous investigations and to provide further information to fill any knowledge gaps. This report relies on the findings of previous investigations (Wildthing, 2003a; 2003b; 2004a; 2004b; 2004c; EcoBiological, 2006a; 2006b; and RPS HSO, 2007) and should be read in conjunction with these reports.

Whilst the primary focus of ecological investigations has been the proposed development lands, due consideration has been given to the ecological attributes of offset lands.

At the state level, the proposal is to be assessed pursuant to Part 3A of the EPA Act. To this end, in August 2007, the DGEARs were issued for the site (Appendix B). The 'Key' Assessment requirement for investigations as relevant to this report is:

*"Address the impact of the development on threatened species and their habitats having regard to DECC's Threatened Species Assessment Guidelines and detailed measures proposed to avoid or mitigate impacts on threatened species and their habitat."*

## 1.5 Definitions

The definitions given below are relevant to the Director-General's requirements:

**'development'** has the same meaning as in the NSW *Environmental Planning and Assessment Act 1979*.

**'activity'** has the same meaning as in the NSW *Environmental Planning and Assessment Act 1979*.

**'proposal'** is the development, activity or action proposed. Other terminology used for the 'proposal' includes the **'current proposal'** or **'development proposal'**.

The **'Site'** refers to the entire land holding, inclusive of development and conservation areas.

The **'Development Estate'** refers to the area(s) scheduled for development.

The **'Offset lands'** refers to the area(s) scheduled for dedication to the NSW Government. Other terminology used for the 'Offset lands' includes the **'Offset Lands'** or **'Dedication Lands'**.

All other definitions are the same as those contained in the NSW *TSC Act*.

## 1.6 Qualifications and Licensing

***Qualifications***

The principal author of this report was Craig Anderson BAppSc (EAM) of RPS Harper Somers O'Sullivan Pty Ltd, with additional input from Deborah Landenberger BSc (Hons) and Anna McConville BEnvSc. The academic qualifications and professional experience of all RPS HSO ecologists involved in the project are documented in Appendix E.

***Licensing***

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2007);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2008);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2010); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 26 May 2008).

## 1.7 Certification

As the principal author, I, Craig Anderson, make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the site;
- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995, National Parks and Wildlife Act 1974* and the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes*.

Signature of Principal Author and Certifier:

**Craig Anderson**
**Director**
**RPS Harper Somers O'Sullivan**

**December 2007**

# 2 METHODS

The development of the EAR for the Gwandalan and CHB development lands comprised of the following aspects:

- **Literature Review -** Collation and review of existing flora and fauna datasets and survey reports relevant to the locality of the site.

- **Vegetation survey & mapping datasets** – The vegetation assessment included a review of the Lower Hunter Central Coast Regional Environmental Management Strategy (LHCCREMS) regional vegetation mapping (House, 2003). Broad-scale vegetation mapping was undertaken for lands not previously surveyed, and combined with existing vegetation mapping undertaken during previous investigations to enable a complete lands vegetation map to be produced.

- **Threatened species surveys and habitat investigations** – Targeted surveys for threatened flora and fauna species considered likely to occur within the site were undertaken as part of previous investigations. Further threatened species surveys were undertaken to ensure adequate survey effort and coverage was achieved as part of this EAR.

Table 2-1 below summarises the field survey methods and survey effort carried out within the site in comparison with DECC's Threatened Species Assessment Guidelines. The following sections contain a detailed description of the methods undertaken for this EAR. The methods used to conduct previous ecological investigations are contained within the relevant reports (Wildthing, 2003a; 2003b; 2004a; 2004b; 2004c; EcoBiological, 2006a; 2006b; and RPS HSO, 2007a) and should be read in conjunction with this EAR for completeness. The survey coverage covered during the different surveys within the site is summarised in Figure 2-1.

The works undertaken are considered to provide a detailed baseline dataset that enables a sufficient level of assessment and reporting to occur to satisfy the DGEAR's.

**Table 2-1 Combined survey effort of flora and fauna investigations within proposed development and offset lands at Catherine Hill Bay (CHB) and Gwandalan**

| | **Wildthing (2003a) SEE for Part Lot 6 DP774923, December** | **Wildthing (2003b) Ecological Constraints Study for Lot 3 DP588206, October** | **Wildthing (2004a) SEE for Part Lot 2 DP809795, February** | **Wildthing (2004b) SEE for Part Lot 6 DP774923, February** | **Wildthing (2004c) SEE for Part Lot 5 DP774923 and Part Lot 2031 DP841175, July** | **EcoBiological (2006a) Targeted Threatened Species Assessment for Lot 6 DP 774923, Lot 2 DP 809795 and Lot 4 DP 129341, May** | **EcoBiological (2006b) Environmental Constraints Assessment: Lot 6 DP 774923, Lot 2 DP 809795, Lot 5 DP 774923, Lot 2031 DP 841175 and Lot 4 DP 129341, October** | **RPS HSO (2007d) EPBC Act Addendum Report, Lot 3 DP 588206, Kanangara Drive, September** | **RPS HSO (2007) current investigations Catherine Hill Bay and Gwandalan development and offset lands, November** | **Combined Total** | **Minimum DECC (2004) Requirements** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Season** | Spring (November) | Winter (June and August) and Spring (October) | Summer (December) | Summer (February) | Winter (June) | Various see each component below | Spring (October) | Winter (August) and Spring (September) | Spring (November) | Spring, Summer and Winter | All seasons preferred |
| **Location** | Southern Crangan Bay offset lands (site 90 ha) | Gwandalan development lands - Kanangara Drive (site 26 ha) | CHB development lands (site 90 ha) | CHB development lands - Coal Prep Plant (site 4 ha) | CHB Coal storage area - part development lands and part offset lands (site 34 ha) | CHB development lands (site 71.2 ha) | CHB development lands (site 72.7 ha) | Gwandalan development lands - Kanangara Drive (site 26 ha) | All lands - see each component below | All CHB and Gwandalan lands subject to MoU. | - |
| **Flora Survey Work** | 10 x quadrats, 7 x transects and random meanders | 6 x quadrats, 6 x transects and random meanders. | 7 x quadrats, 6 x transects and random meanders | 2 x quadrats, 2 x transects and random meanders | 2 x quadrats, 6 x transects and random meanders | Targeted surveys for:<br>*Tetratheca juncea* - Aug-Dec;<br>*Caladenia tessellata* - Sept-Oct;<br>*Cryptostylis hunteriana* - Dec-Feb;<br>*Diuris praecox* - July-Aug;<br>*Microtis angusii* - Sept-Nov. | Random meanders undertaken for vegetation mapping.<br>Targeted *Tetratheca juncea* surveys. | Random meanders undertaken for the following targeted flora species:<br>*Caladenia tessellata*<br>*Diuris praecox*<br>*Microtis angusii*<br>*Syzygium paniculatum*<br>Habitat assessment was carried out for *Cryptostylis hunteriana* | *Tetratheca juncea* counts (November) - CHB development lands<br>Vegetation mapping (November) - previously unmapped offset lands<br>18 Quadrats and random meanders were undertaken.<br>Targeted *Cryptostylis hunteriana* - Gwandalan and CHB development lands<br>SEPP 14 wetland boundary determined via vegetation assemblages | 45 x quadrats, 27 x transects. Random meanders. Delineation of vegetation community boundaries.<br>Targeted threatened flora surveys undertaken in appropriate seasons within CHB and Gwandalan development areas. | Transects - 1 x 100m transect per stratification unit <2 ha; Quadrats - 1 x quadrat per stratification unit <2 ha; Random Meander - One 30 minute random meander per quadrat. |
| **Diurnal Bird Survey** | Census points, general observation and call identification | Census points, general observation and call identification | Census points, general observation and call identification | Census points, general observation and call identification | Census points, general observation and call identification | - | - | - | General observations and call identification | Census and general observations. | Area search, wetland census, water source census. |
| **Effort** | Undertaken during each site visit | Undertaken during each site visit | Undertaken during each site visit | Census points - 2 over 2 days<br>General observation - undertaken during each site visit | Census points - 4 over 2 days<br>General observation - undertaken during each site visit | - | - | - | Undertaken during other field tasks | Undertaken during all site visits | 1ha sample for 20 mins per habitat. |
| **Nocturnal Bird Survey** | Spotlighting, call playback and call identification | Spotlighting, stagwatching, call playback and call identification | Spotlighting, call playback and call identification | Spotlighting and call identification | Spotlighting, call playback and call identification | Hollow-bearing tree assessment for large forest owls | - | - | General observations | Stagwatching (Gwandalan only), spotlighting, call playback and call identification | Call playback, day habitat search, stagwatching, spotlighting. |
| **Effort** | Spotlighting - 12 hours over 5 nights<br>Call playback - 5 nights | Stagwatching - 3.5 hours over 5 nights<br>Spotlighting - 10.75 hours over 8 nights<br>Call playback - 5 nights | Spotlighting - 9 hours over 3 nights<br>Call playback - 3 nights | Spotlighting - 1.5 hours over 2 nights | Spotlighting - 12 person hours over 3 nights<br>Call playback - 3 nights | Undertaken as necessary | - | - | Undertaken during other field tasks | Stagwatching - 3.5 hours over 5 nights<br>Spotlighting - 45.25 hours over 21 nights<br>Call playback - 16 nights | Call playback - 5 visits per site for Powerful Owl, Barking Owl and Grass Owl; 6 visits per site for Sooty Owl; 8 visits per site for Masked Owl.<br>Stagwatching - 30 minutes prior and 60 minutes following sunset. |
| **Herpetofauna Survey** | Diurnal habitat searches, nocturnal spotlighting and | Diurnal habitat searches, nocturnal spotlighting and frog call playback | Diurnal habitat searches, nocturnal spotlighting and | Diurnal habitat searches, nocturnal spotlighting and | Diurnal habitat searches, nocturnal spotlighting and | Targeted amphibian survey:<br>Diurnal habitat searches, nocturnal spotlighting, | - | - | General observations | Diurnal habitat searches, nocturnal spotlighting, call playback and dip | REPTILES: Diurnal hand searches, spotlighting and pitfall trapping. November to March.<br>AMPHIBIANS: Diurnal and nocturnal |

| | **Wildthing (2003a) SEE for Part Lot 6 DP774923, December** | **Wildthing (2003b) Ecological Constraints Study for Lot 3 DP588206, October** | **Wildthing (2004a) SEE for Part Lot 2 DP809795, February** | **Wildthing (2004b) SEE for Part Lot 6 DP774923, February** | **Wildthing (2004c) SEE for Part Lot 5 DP774923 and Part Lot 2031 DP841175, July** | **EcoBiological (2006a) Targeted Threatened Species Assessment for Lot 6 DP 774923, Lot 2 DP 809795 and Lot 4 DP 129341, May** | **EcoBiological (2006b) Environmental Constraints Assessment: Lot 6 DP 774923, Lot 2 DP 809795, Lot 5 DP 774923, Lot 2031 DP 841175 and Lot 4 DP 129341, October** | **RPS HSO (2007d) EPBC Act Addendum Report, Lot 3 DP 588206, Kanangara Drive, September** | **RPS HSO (2007) current investigations Catherine Hill Bay and Gwandalan development and offset lands, November** | **Combined Total** | **Minimum DECC (2004) Requirements** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | frog call playback | | frog call playback | frog call playback | frog call playback | call playback and dip netting for tadpoles | | | | netting for tadpoles | habitat searches. Playback of recorded calls. |
| **Effort** | Diurnal habitat searches - 3 hours over 3 days<br>Spotlighting - 12 hours over 5 nights | Diurnal habitat searches - 4 hours over 4 days<br>Spotlighting - 10.75 hours over 8 nights<br>Call playback - 4 nights | Diurnal habitat searches - 3 hours over 3 days<br>Spotlighting - 9 hours over 3 nights | Diurnal habitat searches - 2 hours over 2 days<br>Spotlighting - 1.5 hours over 2 nights | Diurnal habitat searches - 2 hours over 2 days<br>Spotlighting - 12 person hours over 3 nights<br>Call playback - 3 nights | Early March during suitable conditions<br>Spotlighting - 2 nights at each of 9 sites<br>Call playback - 2 nights at each of 9 sites | - | - | Undertaken during other field tasks | Diurnal habitat searches - 16 hours over 14 days<br>Spotlighting - 57.25 person hours over 23 nights<br>Call playback - 9 nights | REPTILES: Diurnal - 30 minute searches on 2 separate days. Nocturnal - 30 minute search on 2 separate nights.<br>AMPHIBIANS: Diurnal habitat search - 1 hour per stratification unit. Spotlighting - 30 mins on 2 separate nights; Playback - Once on each of 2 separate nights; Nocturnal habitat search - 2 hrs per 200 metre of water body edge. |
| **Bat Survey** | Harp trapping, bat call recording (ANABAT) and spotlighting | Harp trapping, bat call recording (ANABAT) and spotlighting | Harp trapping, bat call recording (ANABAT) and spotlighting | Bat call recording (ANABAT) and spotlighting | Bat call recording (ANABAT) and spotlighting | - | - | - | - | Bat call recording, harp trapping and spotlighting | Harp trapping, ultrasonic call recording, spotlighting and habitat searches. Trip lines and mist netting for targeted surveys. |
| **Effort** | Harp trapping - 10 nights at 5 sites<br>Mobile ANABAT recording - 4.5 hours over 4 nights<br>Spotlighting - 12 hours over 5 nights | Harp trapping - 12 nights at 6 sites<br>Mobile and stationary ANABAT recording - 4 hours over 5 nights<br>Spotlighting - 10.75 hours over 8 nights | Harp trapping - 8 nights at 4 sites<br>Mobile ANABAT recording - 3 hours over 3 nights<br>Spotlighting - 9 hours over 3 nights | Mobile ANABAT recording - 0.75 hours on one night<br>Spotlighting - 1.5 hours over 2 nights | Mobile ANABAT recording - 2.25 hours over 3 nights<br>Spotlighting - 12 person hours over 3 nights | - | - | - | - | Harp trapping - 30 trap nights at 15 sites<br>Mobile ANABAT recording - 14.5 hours over 16 nights<br>Spotlighting - 45.25 hours over 21 nights | Harp trapping - 4 trap nights over 2 consecutive nights (October - March) per stratification unit.<br>Ultrasonic call recording - 2 sound recording devices for the entire night (minimum 4 hours) for two nights (October - March) per stratification unit.<br>Spotlighting - 2 x 1 hour spotlighting on 2 separate nights (October - March) per stratification unit. |
| **Terrestrial Mammal Survey** | Elliott and cage trapping, spotlighting | Elliott and cage trapping and spotlighting | Elliott and cage trapping, spotlighting | Spotlighting | Spotlighting | - | - | - | - | Elliott and cage trapping and spotlighting | Elliott 'A', Elliott 'B' and / or cage traps and hair tubes. |
| **Effort** | Elliott 'A ' traps - 60 traps for 4 nights = 240 trap nights<br>Cage traps - 36 medium traps for 4 nights = 144 trap nights<br>Spotlighting - 12 hours over 5 nights | Elliott 'A ' traps - 60 traps for 4 nights = 240 trap nights<br>Cage traps - 12 medium traps for 4 nights = 48 trap nights<br>Spotlighting - 10.75 hours over 8 nights | Elliott 'A ' traps - 40 traps for 4 nights = 160 trap nights<br>Cage traps - 24 medium traps for 4 nights = 96 trap nights<br>Spotlighting - 9 hours over 3 nights | 1.5 hours over 2 nights | 12 person hours over 3 nights | - | - | - | - | Elliott 'A ' traps - 160 traps for 4 nights = 640 trap nights<br>Cage traps - 72 medium traps for 4 nights = 288 trap nights<br>Spotlighting - 45.25 hours over 21 nights | Elliott 'A' and Elliott 'B' traps - 100 trap nights over 3-4 consecutive nights per stratification unit. Cage traps - 24 trap nights over 3-4 consecutive nights per stratification unit. Hair tubes - 10 large and 10 small placed in pairs for four days and four nights per stratification unit. |
| **Arboreal Mammal Survey** | Arboreal trapping and spotlighting | Arboreal trapping, stagwatching, spotlighting and call playback | Arboreal trapping and spotlighting | Spotlighting | Spotlighting | - | - | - | Targeted Pygmy Possum Elliott trapping within CHB development lands | Arboreal trapping, stagwatching (Gwandalan only), spotlighting and call playback (Gwandalan only) | Arboreal Elliott 'B' traps, arboreal hairtubes and spotlighting. |
| **Effort** | Elliott 'B' traps - 30 traps mounted on trees for 4 | Elliott 'B' traps - 30 traps mounted on trees for 4 nights = | Elliott 'B' traps - 15 traps mounted on trees for 4 | 1.5 hours over 2 nights | 12 person hours over 3 nights | - | - | - | Elliott 'E' trapping - 45 traps over 4 nights = 180 trap nights | Elliott 'B' traps - 75 traps mounted on trees for 4 nights = | Arboreal Elliot 'B' trapping - 24 trap nights over 3-4 consecutive nights per stratification unit. Arboreal |

| | **Wildthing (2003a) SEE for Part Lot 6 DP774923, December** | **Wildthing (2003b) Ecological Constraints Study for Lot 3 DP588206, October** | **Wildthing (2004a) SEE for Part Lot 2 DP809795, February** | **Wildthing (2004b) SEE for Part Lot 6 DP774923, February** | **Wildthing (2004c) SEE for Part Lot 5 DP774923 and Part Lot 2031 DP841175, July** | **EcoBiological (2006a) Targeted Threatened Species Assessment for Lot 6 DP 774923, Lot 2 DP 809795 and Lot 4 DP 129341, May** | **EcoBiological (2006b) Environmental Constraints Assessment: Lot 6 DP 774923, Lot 2 DP 809795, Lot 5 DP 774923, Lot 2031 DP 841175 and Lot 4 DP 129341, October** | **RPS HSO (2007d) EPBC Act Addendum Report, Lot 3 DP 588206, Kanangara Drive, September** | **RPS HSO (2007) current investigations Catherine Hill Bay and Gwandalan development and offset lands, November** | **Combined Total** | **Minimum DECC (2004) Requirements** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | nights = 120 trap nights<br>Modified Elliott 'A' traps - 6 traps mounted on trees for 4 nights = 24 trap nights<br>Spotlighting - 12 hours over 5 nights | 120 trap nights<br>Modified Elliott 'A' traps - 6 traps mounted on trees for 4 nights = 24 trap nights<br>Stagwatching - 3.5 hours over 5 nights<br>Spotlighting - 10.75 hours over 8 nights<br>Call playback - 4 nights | nights = 40 trap nights<br>Spotlighting - 9 hours over 3 nights | | | | | | | 300 trap nights<br>Modified Elliott 'A' traps - 12 traps mounted on trees for 4 nights = 48 trap nights<br>Elliott 'E' traps - 50 traps mounted on shrubs for 4 nights = 200 trap nights<br>Stagwatching - 3.5 hours over 5 nights<br>Spotlighting - 45.25 hours over 21 nights<br>Call playback - 4 nights | hairtubes - 3 tubes in each of 10 habitat trees for at least 4 days and 4 nights.<br>Spotlighting: 2 x 1 hour and 1km, walking at approximately 1km per hour on 2 separate nights. |
| **Koala Survey** | SEPP 44 plots, scat searches, spotlighting and general observation | SEPP 44 plots, scat searches, spotlighting and general observation | SEPP 44 plots, scat searches, spotlighting and general observation | SEPP 44 plots, scat searches, spotlighting and general observation | SEPP 44 plots, scat searches, spotlighting and general observation | - | - | - | - | SEPP 44 plots, scat searches, spotlighting and general observation | Call playback, spotlighting and habitat searches. |
| **Effort** | SEPP 44 plots - 35 plots<br>Spotlighting - 12 hours over 5 nights | SEPP 44 plots - 12 plots<br>Spotlighting - 10.75 hours over 8 nights | SEPP 44 plots - 27 plots<br>Spotlighting - 9 hours over 3 nights | SEPP 44 plots - 4 plots<br>Spotlighting - 1.5 hours over 2 nights | SEPP 44 plots - 11 plots<br>Spotlighting - 12 person hours over 3 nights | - | - | - | - | SEPP 44 plots - 89 plots<br>Spotlighting - 45.25 hours over 21 nights | Call playback - 2 sites per stratification unit on 2 separate nights. Spotlighting: 2 x 1 hour and 1km, walking at approximately 1km per hour on 2 separate nights. |
| **Secondary indications and incidental observations** | General observation and habitat searches | General observation and habitat searches | General observation and habitat searches | General observation and habitat searches | General observation and habitat searches | Pygmy Possum habitat mapping<br>Hollow-bearing tree survey<br>Glossy Black Cockatoo habitat mapping | - | - | Searches under potential Masked Owl Roost trees within Gwandalan development lands for evidence of occupation by the species.<br><br>General observation and habitat searches | Searches for Masked Owl presence, general observation and habitat searches | Searches of suitable habitat |
| **Effort** | Undertaken during each site visit | Undertaken during each site visit | Undertaken during each site visit | Undertaken during each site visit | Undertaken during each site visit | Undertaken as necessary | - | - | Undertaken during each site visit | Undertaken during each site visit | As necessary |

**WARNING**

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

**LEGEND**

- Site Boundary
- Wildthing Ecological Constraints Study October 2003
- Wildthing Environmental Consultants December 2003
- Wildthing Environmental Consultants February 2004
- Wildthing Environmental Consultants July 2004
- EcoBiological October 2006
- Wildthing Environmental Consultants February 2006 Ecobiological May 2006

0 250 500 metres

**TITLE:**

Figure 2-1

Previous Survey Coverage

**CLIENT:** Rosecorp Pty Ltd

**SCALE:** 1: 20000 at A3 Size **DRAWN:** E. Graham **APPROVED:** D.L.

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

**LAYOUT REF:** J:\JOBS\24k\24619 - Gwandalan\Draftin .... nfo\Workspaces \24619.FIG7 Previous Ecological Studies A-A3.221107.WOR

**CONTOUR INTERVAL:** N/A

**JOB REF:** 24619



**PLANNING SURVEYING ECOLOGY**

HARPER SOMERS O'SULLIVAN

241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303

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

## 2.1 Literature review

A review of existing literature relevant to the project was undertaken in an effort to glean as much information as possible on the existing environment and ensure a holistic approach to ecological assessment. Notably several specific flora and fauna investigations and impact assessments within the site and the general locality have been undertaken in recent times. An account of the information considered is listed below.

*Note the following list is not considered comprehensive. Additional references can be viewed within Section 9 of this report.*

- EcoBiological (2006a) *Targeted Threatened Species Assessment: Lot 6 DP 774923, Lot 2 DP 809795, No. 595 Pacific Highway Crangan Bay*, Rosegroup Pty Ltd.

- EcoBiological (2006b) *Environmental Constraints Assessment: Lot 6 DP 774923, Lot 2 DP 809795, Lot 5 DP 774923, Lot 2031 DP 841175 and Lot 4 DP 129341, No. 595 Pacific Highway Crangan Bay*, Rosegroup Pty Ltd.

- RPS Harper Somers O'Sullivan (2007a) *EPBC Act Addendum Report, Lot 3 DP588206*, Rosegroup Pty Ltd.

- Wildthing Environmental Consultants (2003a) *Statement of Effect on Threatened Flora and Fauna for the proposed development of Part Lot 6 DP 774923, Catherine Hill Bay, NSW, December 2003*, Coastal Hamlets Pty Ltd.

- Wildthing Environmental Consultants (2003b) *Ecological Constraints Study for Lot 3 DP 588206, Kanangara Drive, Gwandalan, NSW, October 2003*, Lakeside Living Pty Ltd.

- Wildthing Environmental Consultants (2004a) *Statement of Effect on Threatened Flora and Fauna for the proposed development of Part Lot 2 DP 809795, Catherine Hill Bay, NSW, February 2004*, Coastal Hamlets Pty Ltd.

- Wildthing Environmental Consultants (2004b) *Statement of Effect on Threatened Flora and Fauna for the proposed development of Part Lot 2031 DP 841175, Catherine Hill Bay, NSW, February 2004*, Coastal Hamlets Pty Ltd.

- Wildthing Environmental Consultants (2004c) *Statement of Effect on Threatened Flora and Fauna for the proposed development of Part Lot 5 DP 774923 and Part Lot 2031 DP 841175, Catherine Hill Bay, NSW, July 2004*, Coastal Hamlets Pty Ltd.

**Ecological Surveys within the Local Area**

- Conacher Travers (2004) *EPBC Referral for the Lake Sector Wallarah Peninsula NSW.*

- Conacher Travers (2006) *EPBC Referral for the Coastal Sector Wallarah Peninsula NSW.*

- Conacher Travers (2007) *EPBC Referral for the Northern Sector Wallarah Peninsula NSW.*

- DEC (2005) *Conservation Assessment of Lands South Wallarah Peninsula.*

- Harper Somers O'Sullivan (2005) *Phase One Vegetation Assessment Report, over Various Land Holdings in the Lower Hunter/Central Coast, NSW*. A report Prepared for Coal & Allied.

- RPS Harper Somers O'Sullivan (2007b) *Ecological Constraints Investigations Phase 1, Over Various Land Holdings in the Lower Hunter/Central Coast NSW*. A report prepared for Coal & Allied.

- RPS Harper Somers O'Sullivan (2007c) *Ecological Constraints Investigations Phase 1, Over Various Land Holdings in the Lower Hunter/Central Coast NSW – Addendum Report*. A report prepared for Coal & Allied.

- RPS Harper Somers O'Sullivan (2007d) *Ecological Assessment Report for Southern Lands at Catherine Hill Bay.* A report prepared for Coal & Allied November 2007).

- RPS Harper Somers O'Sullivan (2007e) *Ecological Assessment Report for Southern Lands at Gwandalan.* A report prepared for Coal & Allied November 2007).


**Scientific Papers**


- Barrett, G.W., Ford, H.A. and Recher, H.F. (1994). Conservation of woodland birds in a fragmented rural landscape. *Pacific Conservation Biology* 1, 245-256.

- Bell S.A.J. (2001) Notes on population size and habitat of the vulnerable *Cryptostylis hunteriana* (Orchidaceae) from Central Coast of New South Wales. *Cunninghamia* **7(2) 195-204.**

- Driscoll C. (2003) The pollination Ecology of *Tetratheca juncea* (Tremandraceae): Finding the Pollinators. *Cunninghamia* **8(1) 133-140.**

- Payne R.J. (1993) Predication of the Habitat for *Tetratheca juncea* in the Lake Munmorah Area near Wyong NSW. *Cunninghamia* **3(1) 147-154.**

- Kavanagh, R. (2002). *Comparative Diets of the Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (Tyto novaehollandiae) in South-eastern Australia*. In: Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (eds)(2002). Ecology and Conservation of Owls, pp 175-188.

- Quin, D.G. (1995). Population Ecology of the Squirrel Glider (*Petaurus norfolcensis*) and the Sugar Glider (*P. breviceps*) (Marsupialia : Petauridae) at Limeburners Creek, on the Central North Coast of New South Wales. In: Australian Wildlife Research 22: pp 471-505.

- Tierney D.A. (2004) Towards an understanding of population change for the long lived resprouting tree *Angophora inopina* (Myrtaceae). *Australian Journal of Botany* **52(1) 31-38.**


**Vegetation Mapping Projects**


- Bell, S.A.J. (1998) *Lake Macquarie State Recreation Area, Pulbah Island Nature Reserve (NR) and Tingira Heights NR Vegetation Survey – A Fire*

*Management Document, Volumes 1 and 2*. Unpublished Report prepared for NSW National Parks and Wildlife Service, Hunter District by Eastcoast Flora Survey.

- Bell, S.A.J. (2002) *The Natural Vegetation of the Wyong Local Government Area, Central Coast, NSW*. A report prepared for Wyong Shire Council.

- Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) (2000). Updated by House (2003). *Lower Hunter and Central Coast Extant Vegetation*. Draft Report.

**Threatened Species Management Plans**

- Gunninah Environmental Consultants (2003). *Wyong Ground Orchid Survey* Wyong Shire.

- Payne R. J. (2000) *Lake Macquarie Tetratheca juncea Conservation Management Plan*, Robert Payne Ecological Surveys and Management. An unpublished Report Prepared for Lake Macquaire City Council.

- Payne R.J. (2001) *Addendum to the Final November 2000 Tetratheca juncea Conservation Management Plan*. Robert Payne Ecological Surveys and Management and Lake Macquarie City Council.

**Fauna Surveys / Reports**

- Eby, P. (2001). *Surveys for roost sites/camps for the Grey-headed Flying Fox* (excel file). Surveys commissioned by the Northern Directorate of NPWS.

- Environment Australia (2001). *A Directory of Important Wetlands in Australia*, Third Edition. Environment Australia, Canberra.

- Forest Fauna Surveys (2002). *Current Status of the Squirrel Glider (Petaurus norfolcensis) in the Eleebana Area.* Draft Report (version no.4) to Lake Macquarie City Council, November 2002.

- Garnett, S. and Crowley, G. (2000). *The Action Plan for Australian Birds 2000*. Environment Australia, Canberra, ACT.

- Gibbons, P. and Lindenmayer, D. (2002). *Tree Hollows and Wildlife Conservation in Australia*. CSIRO Publishing Collingwood, Victoria.

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- Quin, D.G. (1993). *Sociology of the Squirrel Glider and the Sugar Glider. PhD Thesis, Department of Ecosystem Management*, University of New England.

- Recher, H.F (1995) The conservation and management of Eucalypt forest birds: resource requirements for nesting and foraging. *Conservation of Australia's Forest Fauna*. Royal Zoological Society of NSW, Mosman.

- Shortland Wetlands Consultancy (1996). *Eleebana Local Squirrel Glider Study*. Report to Lake Macquarie City Council, February 1996.

- Smith, A., Watson, G. and Murray, M. (2002). *Fauna Habitat Modelling and Wildlife Linkages in Wyong Shire.* Report to Wyong Shire Council by Austeco Environmental Consultants.

- Smith, A. (1998). *Effects of Residential Subdivision on the Squirrel Glider: Apollo Drive, Lake Macquarie City Council LGA.* Prepared by Austeco Environmental Consultants.

- Smith, A. P. (2002). *Squirrel Glider (Petaurus norfolcensis) Conservation Management Plan: Wyong Shire*. Wyong Shire Council. Wyong.

- Young, J. (1999). *Northlakes Forest Owl Project*. Report to Lake Macquarie City Council, January 1999.


**Biodiversity Databases**

| | |
|---|---|
| The Atlas of NSW Wildlife | BioNet |
| CANRI | Australian Museum Fauna Database |
| Atlas of Australian Birds | PlantNet |
| FaunaNet | EPBC Act Database |
| LMCC Wildlife Database | |

## 2.2 Supplementary Field Investigations – RPS HSO Nov 2007

### *2.2.1 Broad-scale vegetation mapping*

Flora surveys and vegetation mapping carried out on the site as a part of recent efforts by RPS HSO (Nov 2007) has been undertaken as follows:

- Aerial Photograph Interpretation (API) to map the community(s) extent into definable map units;

- Confirmation of the community type(s) present (dominant species) via the undertaking of detailed flora surveys and identification;

- Review of previous environmental studies conducted by Wildthing (2003a, 2003b, 2004a, 2004b, 2004c), Ecobiological (2006a, 2006b), and RPSHSO (2007);

- Review of the Natural Vegetation of the Wyong Local Government Area, Central Coast, New South Wales (Bell 2002);

- Review of the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) Vegetation Mapping (NPWS 2000: House 2003) for the site and surrounding areas;

- The conservation status of the derived vegetation communities was considered in light of the findings of the LHCCREMS Vegetation Mapping (2003). Assessment of the potential for the derived vegetation communities to constitute EEC's as listed within the *TSC Act (1995*) and the *EPBC Act (1999)* was also undertaken. The floristic composition, geomorphological characters

and geographic distribution were considered when determining whether an EEC was present.

- Flora surveys were carried out across the areas of the site that had not been previously surveyed, with an emphasis on potentially significant species, as outlined below. The general flora survey also included 17 20m X 20m quadrats and one 10m X 40m quadrat throughout the native vegetation within the site (Figure 2-2), as well as Random Meanders in line with methodology termed as the "Random Meander Technique" by Cropper (1993).

The literature review indicated that portions of the site were not covered by previous vegetation mapping. Broadscale vegetation mapping was undertaken by RPS HSO Ecologists within portions of the site that were not previously surveyed to ensure a complete vegetation map of the lands could be produced.

A vegetation map was created for the entire site by combining mapping undertaken previously by Wildthing (2003a, 2003b, 2004a, 2004b, 2004c,) and EcoBiological (2006a, 2006b) with broadscale mapping undertaken recently by RPS HSO Ecologists in areas not previously surveyed.

Note that the current survey was undertaken utilising broadscale vegetation mapping only. Previous surveys have been more extensive and detailed, particularly within the development areas.

### *2.2.2 Targeted Flora Survey*

The literature review indicated that the development lands may require additional targeted threatened flora surveys for the following species listed under TSC Act and EPBC Act, namely:

- *Tetratheca juncea* population counts within the CHB development lands and reconnaissance within offset lands to confirm suspected extensive occurrences; and
- *Cryptostylis hunteriana* searches within both the CHB and Gwandalan development lands.

***Tetratheca juncea***

Whilst sub-populations of *Tetratheca juncea* were identified during previous investigations (EcoBiological, 2006a; 2006b), no attempt was made to quantitatively assess the population size. Population counts for *T. juncea* were undertaken within the CHB development lands using the counting method outlined by Payne *et al.* (2002). Sub-populations within the CHB development lands identified by EcoBiological (2006b) were targeted for detailed survey consisting of transects spaced 10m apart through suitable habitat. Suitable habitat within the remainder of the CHB development lands was searches for *T. juncea* using the Random Meander method described by Cropper (1993). These targeted *T. juncea* surveys within the CHB development lands were undertaken 12 - 16 November 2007.

The identification of the extent of *T. juncea* within the offset lands was performed by random meander techniques and no parallel transects or individual counts were undertaken.

***Cryptostylis hunteriana***

Previous searches for *Cryptostylis hunteriana* within the Gwandalan development lands were undertaken outside of the flowering period for the species. As such further targeted surveys were undertaken within the Gwandalan development lands

on 20 November 2007. Transects were undertaken 10m apart through suitable habitat. At the CHB development lands where habitat for this species was similar to that of *T.juncea* this species was also searched for.