Riverside at Tea Gardens
Concept Plan and Project Application

Environmental Assessment Report
Volume 3B

for Crighton Properties Pty Ltd

January 2009

0043707 - Final

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for
Crighton Properties Pty Ltd

January 2009

0043707 - Final

Principal Consultant:	*Steve O'Connor*
Date:	*January 2009*

Environmental Resources Management Australia Pty Ltd Quality System

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Volume 3B:

Ecological Site Assessment (Threatened Species Assessment) including:

Koala Management Strategy

Ecological Site Management Strategy

Wetland Assessment

Aboriginal Heritage Assessment

Servicing Strategy

Review of s93 and s94 Requirements

Traffic Impact Assessment

Bushfire Protection Assessment

Volume 3B: Ecological Site Assessment including:

Koala Management Strategy

Ecological Site Management Strategy

ECOLOGICAL SITE ASSESSMENT
(INCLUDING THREATENED SPECIES ASSESSMENT)

RIVERSIDE
TEA GARDENS

OCTOBER 2008
(REF: 8020)

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ECOLOGICAL SITE ASSESSMENT
(INCLUDING THREATENED SPECIES ASSESSMENT)

RIVERSIDE
TEA GARDENS

OCTOBER 2008

Conacher Environmental Group

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TABLE OF CONTENTS

SECTION 1
INTRODUCTION

1.1 INTRODUCTION....1
1.2 SITE DETAILS....1
1.3 DEVELOPMENT & BIODIVERSITY CONSERVATION PROPOSALS....2
1.4 SCOPE OF WORKS....2
1.5 RELEVANT BACKGROUND INFORMATION....3
1.6 SUPPLEMENTARY REPORTS....5

SECTION 2
BIODIVERSITY CHARACTERISTICS OF THE SITE

2.1 FLORA CHARACTERISTICS....8
2.2 VEGETATION CHARACTERISTICS....9
2.3 FAUNA CHARACTERISTICS....10
2.4 THREATENED BIODIVERSITY....10
2.5 VEGETATION / HABITAT CONNECTIVITY....14
2.6 RIPARIAN AREAS....14

SECTION 3
ECOLOGICAL CONSIDERATIONS AND ASSESSMENTS

3.1 APPLICATION OF THE PRECAUTIONAY PRINCIPLE....17
3.2 EXTENT AND IMPACT OF VEGETATION/HABITAT REMOVAL....17
3.3 PROVISION OF CONSERVATION OFFSETS....18
3.4 ENVIRONMENTAL PROTECTION & BIODIVERSITY CONSERVATION ACT....18
3.5 STATE ENVIRONMENTAL PLANNING POLICIES....19
3.6 THREATENED SPECIES CONSERVATION ACT....19
3.7 FISHERIES MANAGEMENT ACT....27
3.8 NATIVE VEGETATION ACT....27
3.9 POTENTIAL TO IMPACT ON DECC ESTATE....28
3.10 POTENTIAL TO IMPACT REGIONAL WILDLIFE CORRIDOR....29
3.11 ASSESSMENT OF PROPOSAL AGAINST RELEVANT RECOVERY PLAN....30

SECTION 4
THREATENED BIODIVERISTY IMPROVE OR MAINTAIN ASSESSMENT

4.1 BACKGROUND....43
4.2 CONSIDERATON OF IMPROVEMENT OR MAINTENANCE OF BIODIVERSITY VALUES....44

SECTION 5
CONCLUSION

5.1 DOES THE PROPOSAL AFFECT ANY THREATENED SPECIES OR POPULATION AT THE LIMIT OF ITS KNOWN DISTRIBUTION....57
5.2 HOW IS THE PROPOSAL LIKELY TO AFFECT CURRENT DISTURBANCE REGIMES....57
5.3 HOW IS THE PROPOSAL LIKELY TO AFFECT HABITAT CONNECTIVITY....57
5.4 HOW IS THE PROPOSAL LIKELY TO AFFECT CRITICAL HABITAT....58
5.5 CONCLUDING COMMENTS....59

REFERENCES....61

APPENDIX 1 FLORA AND FAUNA SURVEY REPORT
APPENDIX 2 HOLLOW BEARING TREE SURVEY
APPENDIX 3 KOALA MANAGEMENT STRATEGY
APPENDIX 4 ECOLOGICAL SITE MANAGEMENT STRATEGY
APPENDIX 5 EPBC ACT ASSESSMENT
APPENDIX 6 THREATENED FAUNA SPECIES – IMPROVE OR MAINTAIN ASSESSMENT

EXECUTIVE SUMMARY

A Masterplan proposal has been developed for the subject land at Tea Gardens which incorporates areas of residential development and open space areas while retaining significant areas of natural vegetation within conservation zones.

The site covers approximately 229 hectares of land situated between Myall Road and the Myall River, and located north of the existing residential area of Tea Gardens.

Detailed ecological surveys have been completed over several seasons to address the Director General's Requirements issued for the Part 3A (State Significant Development) Application for the site.

The detailed surveys have identified a range of threatened fauna species within the site during 2007/08 surveys. These are:

- Wallum Froglet (*Crinia tinnula*);
- Osprey (*Pandion haliaetus*);
- Barking Owl (*Ninox connivens*);
- Little Bentwing-bat (*Miniopterus australis*);
- Grey-headed Flying-fox (*Pteropus poliocephalus).*

No threatened flora species were identified on the site. Three endangered ecological communities were identified onsite. These are:

- Coastal Saltmarsh;
- Swamp Sclerophyll Forest on Coastal Floodplains;
- Swamp Oak Floodplain Forest.

The areas of vegetation proposed to be retained contain areas of habitat for the threatened fauna species observed.

The proposal will result in the removal of approximately 270m^2 of Coastal Saltmarsh and approximately 12.1ha of Swamp Sclerophyll Forest. Approximately 27.4 hectares of Swamp Sclerophyll Forest and 25.1 hectares of Saltmarsh will be retained within conservation zones.

Biodiversity conservation attributes of the proposal will result in a variety conservation outcomes being achieved. These include:

- Retention of connective habitat through the site to areas of higher biodiversity values;
- Restoration of areas of disturbed land within the proposed wildlife corridors within the site;
- Enhancement of habitat within retained vegetation and corridors through the control of access, fire and weeds;
- Provision of nest boxes within retained habitat areas to offset for the removal of hollow bearing trees;
- Implementation of Ecological Site Management Plan;
- Ongoing biodiversity monitoring and reporting.

The biodiversity conservation proposals will be supported to implementation and monitoring stages by the Ecological Site Management Strategy for the site.
The implementation of the biodiversity conservation proposals will result in the proposal improving or maintaining biodiversity values.

SECTION 1

INTRODUCTION

1.1 INTRODUCTION

Conacher Environmental Group has been engaged to complete an Ecological Site Assessment for the proposed mixed use commercial and residential development at Myall Road, Tea Gardens known as Riverside. This report provides details on the vegetation, fauna and ecological characteristics present on the site in relation to the local area.

This report utilises information and results from a range of ecological studies undertaken in the local area in addition to the results of detailed ecological surveys completed on the site. Details are provided to address various federal and state legislation, state and local council planning policies in relation to ecological and biodiversity issues.

1.2 SITE DETAILS

The planning and cadastral details of the subject site are provided in Table 1.1 while Table 1.2 summarises the geographical characteristics of the site.

TABLE 1.1
SITE DETAILS

Location	Lots 1, 10, 19, 30, 38 DP 270100 Myall Road, Tea Gardens.
Area	Approximately 229 ha.
Topographic Map	Port Stephens 1:25 000
Grid Reference	421000 E, 6387750 N
Local Government Area	Great Lakes Council
Existing Land Use	Vacant / Rural
Zoning (current)	2(f) Mixed Residential / Commercial and Conservation Zones
Proposed Development	Commercial and residential development

TABLE 1.2
SITE CHARACTERISTICS

Topography	Mostly flat with elevations of approximately 2 to 20m AHD in the low ridgelands to the north of the site
Slope	0-8% - mostly less than 2%
Aspect	Various – generally south / south-east
Soil Type	Deep sandy Podzols within Tea Gardens Soil Landscape
Catchment	Port Stephens Catchment
Drainage	Dispersed drainage into Myall River via several small drainage lines and wetlands.
Vegetation	A Mosaic of open forest types wetland and cleared areas.

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1.3 DEVELOPMENT AND BIODIVERSITY CONSERVATION PROPOSALS

The proposed development is for a mixed use commercial and residential development. According to the Concept Plan the proposal will include the following:

- Development of approximately 1045 dwellings to be created under Community Title;
- Proposed home based business precinct of approximately 108 allotments (included in the 1045 dwellings);
- Conference and Clubhouse facilities and low rise Townhouse accommodation (15 townhouses included within the 1045 dwellings);
- 50 low density "Lodge Houses" associated with Conference facilities (included within the 1045 dwellings);
- Public Reserve areas;
- Community park incorporating walking trails, gazebo and other facilities;
- Widening of the outlet channel to the existing lake area;
- Extension to existing commercial areas;
- Implementation of Water Sensitive Urban Design features such as storm water detention lake, basins and ponds, drainage corridors;
- Landscaped areas for fauna habitat creation within drainage corridors;
- Areas revegetated to enhance existing habitat values.

The proposal incorporates the following actions and land uses to address biodiversity conservation within the site:

- Incorporation of wildlife corridors to facilitate wildlife movement through the site;
- Retention of SEPP 14 wetland areas;
- Retention of areas of Endangered Ecological Communities;
- Retention of the majority of hollow bearing trees;
- Implementation of an integrated water cycle management strategy;
- Enhancement of frog habitat within water treatment wetlands;
- Provision of open space linkages within drainage corridors which also provide fauna habitat;
- Implementation of detailed Ecological Site Management Strategy for areas of retained vegetation and wildlife movement corridors;
- Restoration and revegetation of disturbed areas of land which are proposed to be retained within corridors and undeveloped land.

The site management zones within the subject site to be developed conserved and subjected to various habitat enhancement measures are identified in Figure 1.1.

1.4 SCOPE OF WORKS

This report has been prepared to detail ecological investigations within the Riverside area and to provide an assessment of the site in relation to the proposed development. This Ecological Site Assessment has been prepared in accordance with the relevant sections of the Director General's Environmental Assessment Requirements (DGEAR's) provided by the Department of Planning as the terms of reference for the preparation of an Environmental Assessment of the site. This Ecological Site Assessment addresses those relevant sections of the DGEAR's relating to Flora and Fauna as identified in Issue 10 and Issue 11 of the DGEAR's.

Issue 10

Outline measures for the conservation of flora and fauna and their habitats within the meaning of the Threatened Species Conservation Act 1995, Native Vegetation Act 2003 and the Fisheries Management Act 1994, including but not limited to Koala populations, and other EEC's.

Issue 11

The EA must consider how the proposal has been managed to conserve flora and fauna habitats on the subject site and subject area. The measures proposed to mitigate any effects of the proposal must be provided, including any long term strategies to protect areas within the study area with threatened species. This may include elements that restore or improve habitats. Pre-construction monitoring plans or on-going monitoring of the effectiveness of the mitigation measures must be outlined in detail.

The following policies and guidelines, as provided within the DGEAR's, are also considered or addressed as part of this Ecological Site Assessment:

- Draft Guidelines for Threatened Species Assessment (DEC 2004);
- Draft Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC & DPI July 2005);
- National Parks and Wildlife Service Atlas of NSW Wildlife Data, GIPSICAM;
- Protection of the Environment Operations Act, 1997;
- Native Vegetation Act, 2003;
- State Environmental Planning Policy No. 26 Littoral Rainforests;
- State Environmental Planning Policy No. 14 Coastal Wetland;
- State Environmental Planning Policy No. 44 Koala Habitat.

This report also considers comments provided by the *Department of Planning*, *Department of Environment and Conservation* and *Great Lakes Council* as a result of their review of preliminary versions of reports prepared by Conacher Travers Pty Limited.

1.5 RELEVANT BACKGROUND INFORMATION

Table 1.3 contains summary details of the relevant previous studies and reports completed within the subject site and the locality which were used as background information for this report.

TABLE 1.3
RELEVANT LOCAL AREA STUDIES/REPORTS

Author	Date	Title	Comment
Gardner Browne Planning Consultants,	1991 1992	Local Environmental Study Myall Quays (and related Supplementary Reports)	Flora and fauna surveys and assessment, vegetation mapping of the subject site.
Mount King Ecological Surveys	1992	Fauna survey of Lot 10 DP733241 & Lot 31 DP808202 Myall Rd Tea Gardens	Fauna survey and recommendation to retain a strip of vegetation along Myall River containing Blackbutt forest, Mangroves and Casuarina.
R. Lembit	1992	Additional Vegetation and Mapping for the Myall Quays Local Environmental Study	Refinement of vegetation mapping completed by Gardner Browne.

TABLE 1.3 (Cont.) RELEVANT LOCAL AREA STUDIES/REPORTS			
Author	**Date**	**Title**	**Comment**
Integrated Site Planning & Management	1995	Flora & fauna report Myall Quays Estate.	Fauna survey and threatened species assessment
Ecotone Ecological Consultants	1995	Mammal & Herptofauna Surveys for the proposed Myall Quays development at Tea Gardens	Fauna survey and threatened species assessment of recorded threatened species.
ERM Mitchell McCotter	1997	Local Environmental Study - North Hawks Nest	Ecological surveys, mapping and assessment of land at North Hawkes Nest. Recommendations made in regard to zoning of land.
Hunter Wetlands Research & Management	1997	Flora and Fauna Assessment for Myall Quays Stage VI	Flora and Fauna Assessment
Shortland Wetlands Centre (SWC)	1988	Tea Gardens Environmental Study stage 1 – Wetlands Assessment	Detailed flora survey & mapping
PPK Environment and Infrastructure	2000	Myall River Downs Local Environmental Study - Great Lakes Council	Ecological surveys, mapping and assessment of Myall River Downs. Recommendations made in regard to zoning of land.
Conacher Travers	2002	Flora and Fauna Assessment Report - Myall Quays Estate	Detailed flora survey
Great Lakes Council	2003	Draft Vegetation Strategy - Eastern Portion	Detailed survey & mapping of the eastern portions of the Great Lakes LGA remnant veg communities including the subject site. Broad scale vegetation mapping.
Department of Environment and Conservation	2003	Recovery Plan - Hawkes Nest Tea Gardens Endangered Koala Population	Recovery Plan prepared for the protection of the Hawkes Nest and Tea Gardens endangered Koala population.
D. Sharpe and R. Goldingay	2006	Ecological Studies of the Squirrel Glider Myall River Downs	Squirrel Glider population analysis at Myall River Downs.
National Parks & Wildlife Service	2003	Key Habitats & Corridors of North-East NSW (Newcastle to Tweed Heads)	Mapping completed by NSW NPWS identifying key habitats and local and regional corridor areas in coastal northern NSW.
Conacher Travers	2007	Species Impact Statement - Myall River Downs	Detailed flora and fauna survey and assessment. Contains extensive local area survey and assessment information.
Harris Research Pty Ltd	2007	Fish Community Survey Riverside Lake	Fish and aquatic area survey and report

Results from various surveys for these reports and detailed surveys of the site have been utilised to generate composite species lists for locally occurring flora and fauna species, including threatened species. These reports have also been utilised to compare the vegetation and fauna habitats on the site with those known to occur in the local area and to allow for an assessment of the site in the context of the ecological attributes of the local area.

1.6 SUPPLEMENTARY REPORTS

The following reports have been prepared as part of the documentation for the Part 3A Application. The Koala Management Strategy and Ecological Site Management Strategy are included in the Appendices of this Report.

KOALA MANAGEMENT STRATEGY
As part of the environmental assessment and reporting a Koala Management Strategy has been prepared by *Conacher Environmental Group* (2008a) for the site for the management of Koalas and Koala habitats within the site. While no Koalas or evidence of recent use were observed within the site during surveys it was considered appropriate to prepare a management strategy for the Koala due to the known local occurrence of this species, including the Hawks Nest Tea Gardens Endangered Koala Population, as listed within the *Threatened Species Conservation Act* (1995), and presence of suitable habitat within the subject site.

The Koala Management Strategy includes information on the following:

- Details and results of Koala and habitat surveys within the site;
- Details on Koalas within the subject site and local area;
- Details on Koala habitats within the subject site and local area;
- Identification of threats to the Koala;
- Proposed management actions for the long term protection of Koalas and Koala habitats within the subject site;
- Timing and implementation of management actions.

ECOLOGICAL SITE MANAGEMENT STRATEGY
An Ecological Site Management Strategy has been prepared by *Conacher Environmental Group* (2008b) to provide information on the long term protection of vegetation, flora and fauna, threatened species and their habitats within the site. Details on the management of the following are provided within the Ecological Site Management Strategy:

- Vegetation and Bushland Management;
- Bushfire Management;
- Fauna and Habitat Management;
- Provision and Establishment of Environmental Corridors;
- Provision of Environmental Buffers;
- Erosion and Sediment Control;
- Stormwater Quality and Management;
- Cultural Values and Management;
- Community Education, Vigilance and Reporting;
- Access, Signage and Fencing;
- Prohibited Use Identification and Management;
- Feral Pest Species;
- Monitoring and Reporting Regime.

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WETLANDS ASSESSMENT FOR RIVERSIDE, TEA GARDENS

A Wetlands Assessment has been prepared and provides an assessment of the potential effects of the proposal on wetlands of the site and adjoining areas (Hunter Wetlands Research 2008). The report identifies the wetland vegetation communities present on site, discusses their significance in the context of the local area, and identifies potential direct and indirect impacts of the proposal on the communities.

Direct impacts identified include:

- The loss of some areas of wetland vegetation, which have been classified as endangered ecological communities.

Indirect impacts identified include:

- Changes in the quantity and quality of surface and groundwater flows into the wetlands;
- Pedestrian and vehicle intrusion;
- General edge effects including predation of native fauna by cats and dogs, light spill of street lights, dumping of rubbish and garden refuse, weed incursion and mowing of wetland margins.

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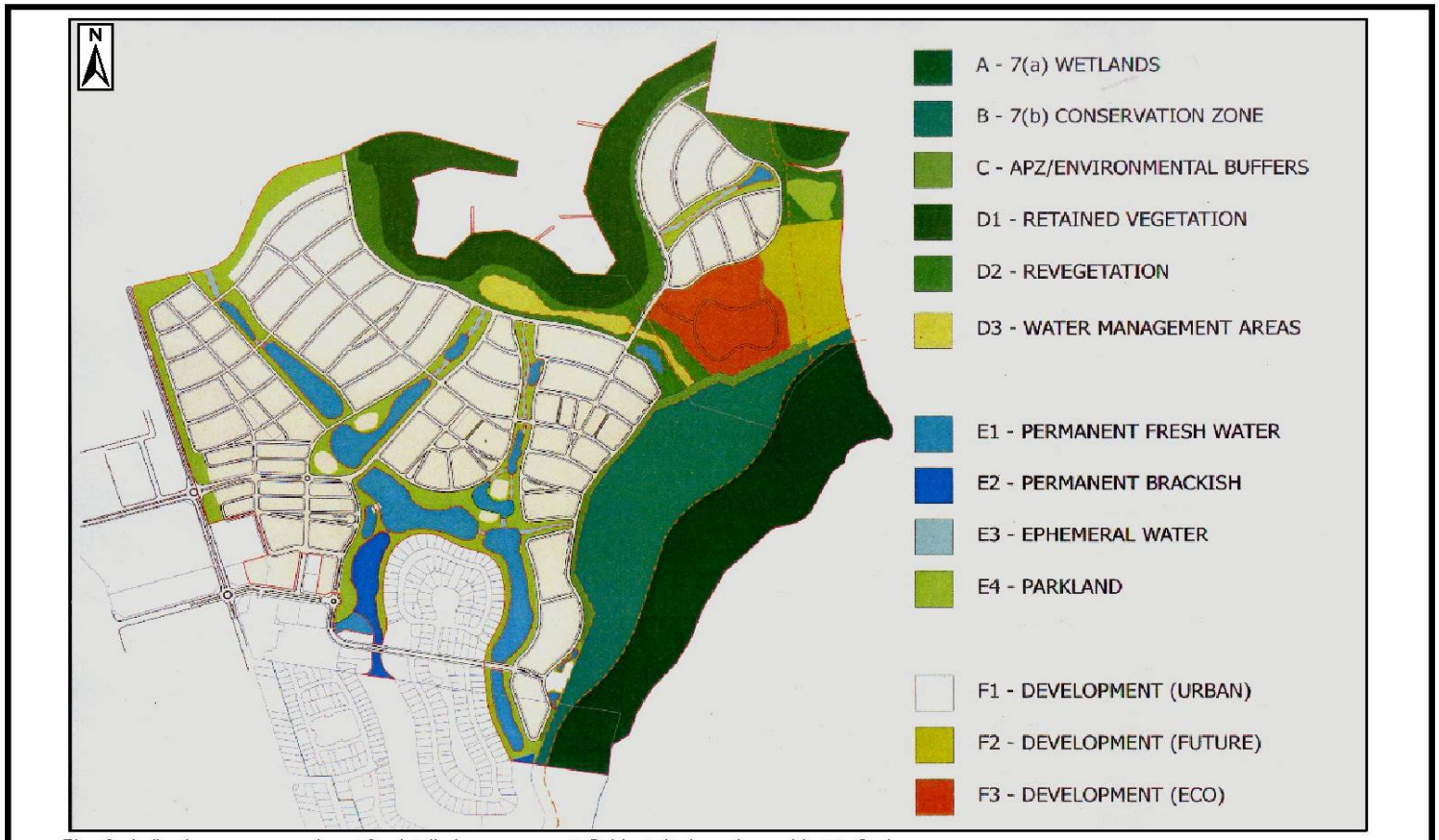

Plan for indicative purposes only not for detailed measurement. Subject site boundary subject to final survey.

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Approximate at A4

Original plan produced in A4 colour

Drawing No.	8020	Date
Drawn By	JM	21/08/08
Amendment		Date
A		
B		
C		

Figure 1.1

Site Management Zones

Riverside, Tea Gardens

Source: Crighton Properties 2008

SECTION 2

BIODIVERSITY CHARACTERISTICS OF THE SITE

2.1 FLORA CHARACTERISTICS

Flora Survey
The subject site, or portions of it, have previously been surveyed by a number of different consultants since 1992, including, Lembit (1992), Shortland Shortland Wetlands Centre (1988), Hunter Wetlands Research & Management (1997) and *Conacher Travers* (2002, 2007).

More recently (2007 and 2008) detailed field surveys were undertaken in accordance with the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004 (DEC 2004). The subject site was initially divided into five stratification units based on vegetation structure and floristic diversity. These units were further separated into vegetation communities based on dominant canopy species. Transects and quadrats were sampled within these stratification units in accordance with DEC 2004 draft guidelines. Detailed flora surveys were completed on a seasonal basis in 2007 and 2008 as identified in Appendix 1.

Fauna Survey
Fauna survey methods used by *Conacher Environmental Group* follow the methods detailed in the Department of Environment and Conservation (DEC 2004). Where necessary, these have been adapted to satisfy local site conditions. Survey methods may also vary dependant upon environmental conditions (eg. number of vegetation communities, level of disturbance). The following weather data is recorded for all surveys:

- Air temperature;
- Moon (where relevant) (eg none, 1/4 moon, 1/2 moon, 3/4 moon, full moon);
- Rain (eg none, light drizzle, heavy drizzle, heavy rain);
- Recent rain events (where relevant);
- Wind Strength eg calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns).

The subject site was classified into five stratification units for fauna survey based on biophysical characteristics. These units are:

A) Northern slopes open forest;
B) Western lowland woodlands;
C) Northern Central lowland open forest;
D) Eastern Swamp Forest;
E) Saltmarsh, *Juncus* and mangrove areas associated with the Myall River estuary.

These stratification units formed the basis for the location of the fauna survey methods used

Subject to the stratification units, the following Fauna Assemblages were surveyed within each of the stratification Units (A to E);

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- Diurnal Birds
- Nocturnal Birds
- Arboreal Mammals
- Terrestrial Mammals
- Bats
- Amphibians
- Reptiles
- Fish

Details on the various methods used for surveying the above Fauna Assemblages are provided in Appendix 1 – Flora and Fauna Survey Report.

2.2 VEGETATION CHARACTERISTICS

The subject site is characterised by a mosaic of vegetation communities reflecting the topographical and drainage characteristics and land use history. Eighteen vegetation communities have been described within the subject site. These communities are:

1. – Pasture with Scattered Trees;
2. – Acacia / Melaleuca Regrowth Scrub;
3. – Open Forest (*Corymbia gummifera*);
4. – Open Forest (*Corymbia maculata, Eucalyptus paniculata*);
5. – Open Forest (*Eucalyptus microcorys*);
6. – Open Forest (*Eucalyptus pilularis*);
7. – Woodland (*Eucalyptus resinifera*);
8. – Woodland / Open Forest (*Eucalyptus robusta*);
9. – Woodland (*Eucalyptus signata*);
10. – Woodland / Open Forest (*Eucalyptus umbra*);
11. – Pine Forest (*Pinus eliottii*);
12. – Disturbed Estuarine Vegetation;
13. – Casuarina Forest (*Casuarina glauca*);
14. – Mangroves (*Avicennia marina*);
15. – Saltmarsh (*Juncus kraussii*);
16. – Rushland (*Baumea juncea*);
17. – Scrub (*Melaleuca ericifolia*);
18. – Paperbark Forest (*Melaleuca quinquenervia*).

A detailed description of these communities and a cumulative flora species list is provided in Appendix 1 – Flora and Fauna Survey Report. The distribution of vegetation communities throughout the subject site is also shown in Figure 3.1 within Appendix 1.

Large areas of the subject site have been cleared of the native groundcover and shrub vegetation as part of the previous land uses of forestry and agriculture. Figure 2.1 shows the distribution of disturbances to the shrub and groundcover vegetation throughout the site.

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2.3 FAUNA CHARACTERISTICS

2.3.1 Fauna Habitats Present

The subject site was classified into five stratification units for fauna survey based on biophysical characteristics. These units are:

A) Northern slopes open forest;
B) Western lowland woodlands;
C) Northern Central lowland open forest;
D) Eastern Swamp Forest;
E) Saltmarsh, *Juncus* and mangrove areas associated with the Myall River estuary.

These stratification units formed the basis for the location of the fauna survey methods used.

The locations of fauna surveys are shown in Figure 2.2 within Appendix 1 – Flora and Fauna Survey Report.

The fauna habitats within the western parts of subject site have been highly disturbed due to a history of clearing and stock grazing. Impacts include soil compaction, trampling of undergrowth, moderate weed infestation and increased nutrient level in dams and watercourses. These areas offer only a low quality of habitat mainly for terrestrial herbivorous mammals and bird species.

The habitats within the eastern and northern foot-slope parts of the subject site are less disturbed and are consequently of better quality and are proposed to be retained. These areas do however, provide suitable foraging habitat within the flowering eucalypts and shrub layers for a number of bird and arboreal mammal species. Several trees within this community also contain hollows of varying size suitable for roosting by hollow dependant bird, reptile and mammal species.

2.4 THREATENED BIODIVERSITY

2.4.1 Threatened Flora Species

A search of the Atlas of NSW Wildlife (NPWS 2008) was undertaken to identify records of threatened flora species located within 10km of the site. In addition to the species listed within the Atlas of NSW Wildlife database, threatened species listed in the botanic gardens records, species identified by NPWS (2008) and local area records have been included for consideration. Details on threatened flora species as listed in Schedules 1 and 2 of the *TSC Act* (1995), with a known or possible occurrence within the local area, are provided in Appendix 1.

It is considered that within the subject site there is suitable or sub-optimal habitat for the following threatened species as listed in Schedule 1 (Endangered) or Schedule 2 (Vulnerable) of the *TSC Act* (1995) or the *EPBC Act* (1999):

- *Asperula asthenes*
- *Eucalyptus glaucina*
- *Galium australe*
- *Maundia triglochinoides*
- *Persicaria elatior*
- *Syzygium paniculatum*
- *Thesium australe*
- *Cryptostylis hunteriana*
- *Eucalyptus parramattensis* subsp. *decadens*
- *Lindernia alsinoides*
- *Melaleuca biconvexa*
- *Rhizanthella slateri*
- *Tetratheca juncea*

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None of these species were observed during detailed targeted searches.

2.4.2 Threatened Fauna Species

A search of the Atlas of NSW Wildlife (NPWS 2008) was undertaken to identify records of threatened fauna species located within 10km of the site. In addition to the species listed within the Atlas of NSW Wildlife database, species identified by NPWS (2008) and local area records have been included for consideration.

Details on threatened species (Schedule 1 or 2), which are known to occur within the area, are provided in Appendix 1.

It is considered that there is suitable or sub-optimal habitat within the subject site for the following threatened species, as listed in Schedule 1 (Endangered) or Schedule 2 (Vulnerable) of the *TSC Act* (1995) or the *EPBC Act* (1999):

- Wallum Froglet
- Green and Golden Bell Frog
- Green Thighed Frog
- Stephens' Banded Snake
- Magpie Goose
- Painted Snipe
- Black-necked Stork
- Sooty Oystercatcher
- Pied Oystercatcher
- Little Tern
- Osprey
- Square-tailed Kite
- Bush Stone-curlew
- Wompoo Fruit-dove
- Rose-crowned Fruit Dove
- Superb Fruit-dove
- Glossy Black-Cockatoo
- Gang-gang Cockatoo
- Swift Parrot
- Turquoise Parrot
- Barking Owl
- Powerful Owl
- Masked Owl
- Grass Owl
- Sooty Owl
- Regent Honeyeater
- Black-chinned Honeyeater
- Spotted-tailed Quoll
- Brush-tailed Phascogale
- Common Planigale
- Koala
- Eastern Pygmy-possum
- Yellow-bellied Glider
- Squirrel Glider
- Rufous Bettong
- Eastern Chestnut Mouse
- Long-nosed Potoroo
- Common Blossom-bat
- Grey-headed Flying-fox
- Yellow-bellied Sheathtail-bat
- Eastern Freetail-bat
- Long-eared Pied Bat
- Little Bentwing-bat
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Large-footed Myotis
- Greater Broad-nosed Bat

The detailed seasonal surveys undertaken during 2007 and 2008 or within the last five years, identified the following threatened fauna species within the subject site.

- Wallum Froglet (*Crinia tinnula*);
- Osprey (*Pandion haliaetus*);
- Barking Owl (*Ninox connivens*);
- Squirrel Glider (*Petaurus australia*);
- Little Bentwing-bat (*Miniopterus australis*);

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- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Grey-headed Flying-fox (*Pteropus poliocephalus).*

Additionally the following species have previously been recorded on the subject site but not within the last five years.

- Koala (*Phascolarctos cinereus*);
- Common Blossom-bat (*Syconycteris australis*);
- Large-footed Myotis (*Myotis adversus*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*).

The detailed surveys completed for the subject site have identified several threatened fauna species utilising habitats present for foraging purposes. Details of these species and other threatened fauna species with suitable habitat present are provided in Appendix 1.

2.4.3 Endangered Populations

There are no endangered flora populations within the local government area that require assessment for this proposal.

There are two endangered fauna populations listed on Schedule 1, Part 2 of the *Threatened Species Conservation Act (1995)* that occur in the local area. These are the Hawks Nest and Tea Gardens Endangered Koala (*Phascolarctos cinereus*) Population and the Emu population in the NSW North Coast Bioregion and Port Stephens Local Government Area.

Emu population in the NSW North Coast Bioregion and Port Stephens Local Government Area
This population is distinct from other populations in the Sydney Basin and New England Tableland Bioregions. The population in the NSW North Coast Bioregion and Port Stephens LGA represents the north-eastern limit of the species in NSW. The majority of recent records are concentrated between Coffs Harbour and Ballina.

There are no records of this species on the Atlas of NSW Wildlife (DECC, 2008) within the local area. It is considered that the subject site contains sub-optimal habitat for the endangered population of Emus. This species was not observed on site or in adjacent areas and has not been observed by any site workers or ecologists. The site is fully fenced by stock exclusion fencing which would exclude emu access to the site.

Hawks Nest and Tea Gardens Population of the Koala

General Description
This population is reliably reported as occurring in Hawks Nest and Tea Gardens and in the immediate vicinity of these towns in the Great Lakes Local Government Area.

Habitat Requirements
Suitable vegetation containing koala Feed Tree species such as *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus punctata* (Grey Gum), *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus microcorys* (Tallowwood), *Eucalyptus haemastoma* (Scribbly Gum), *Eucalyptus*

signata (Scribbly Gum), *Eucalyptus viminalis* (Manna Gum), *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus albens* (White Box) and *Eucalyptus populnea* (Bimble Box).

Conservation Status and Distribution
In 1989 the population was thought to contain at least 21 individuals, but by 1998 the population had fallen to about 12 with 2 or 3 in the vicinity of Tea Gardens and the remainder in Hawks Nest and environs (NSW Scientific Committee, Aug 1999). This population of koalas extends in the south-east to the Yaccaba Headland and in the south-west to the peninsula west of Winda Woppa. The population is limited in the west and north-west to the outskirts of the built-up area of Tea Gardens including the Shearwater Estate, where it is bounded by Toonang Drive. The population is limited in the north to an east-west line three kilometres north of the northern boundary of the Hawks Nest Golf Course, although occasional sightings have been made outside these boundaries. The population is bounded in the south and east by the ocean (NSW Scientific Committee, Aug 1999).

Key Threatening Processes
Small population, continuing sub-division and associated clearing of food and habitat trees, road mortality and attacks by dogs.

Occurrence in Subject Site
Habitat requirements and food tree species that characterise habitat for the Hawks Nest and Tea Gardens population of the Koala were located on the subject site and adjacent lands.

2.4.4 Endangered Ecological Communities

The Endangered Ecological Communities known within the Great Lakes LGA are:

- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions;
- Lowland Rainforest on Floodplain in the NSW North Coast Bioregion;
- Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion;
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions;

Descriptions and details of the diagnostic species and habitat requirements of these ecological communities are provided in Appendix 1.

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Endangered Ecological Communities observed within the subject site are:

- Coastal Saltmarsh;
- Swamp Sclerophyll Forest; and
- Swamp Oak Floodplain Forest

The Coastal Saltmarsh (29 hectares) and Swamp Oak Floodplain Forest (one hectare) are located in the eastern parts of the site within the areas proposed to be retained within the Conservation Zones.

The Swamp Sclerophyll Forest on Coastal Floodplains is predominantly located within the eastern parts of the site with small areas occurring in localised depressions within the central and northern parts of the site.

The locations and extent of these Endangered Ecological Communities are shown in shown in Figure 3.1 in Appendix 1.

2.5 VEGETATION/HABITAT CONNECTIVITY

2.5.1 Connectivity and Local Distribution of Vegetation

The subject site is bordered to the west by the Myall Road, disturbed grasslands with scattered trees, industrial and residential development; to the south, by predominately existing residential and commercial development; to the east, by the Myall River; and to the north, by a mixture of open forest vegetation communities, areas of isolated residential development and agricultural lands.

The majority of the vegetation of the site forms a mosaic of highly disturbed woodland with scattered trees and woodland/open forest communities. However, the eastern portion of the subject site is dominated by a large remnant of naturally vegetated Swamp Forests, Heaths and Estuarine vegetation communities associated with the low lying areas adjoining the Myall River. This remnant is largely isolated from adjoining vegetation to the south by existing residential development and to the north of the site by an area of cleared agricultural land. Connectivity of vegetation within the remnant is generally provided by the isolated canopies of the trees present which form a woodland to open forest canopy.

The northern areas of the subject site are dominated by a mixture of open forest vegetation communities and adjoin areas of isolated rural-residential development. There exists some connectivity between the sites eastern remnant vegetation and the areas of remnant open forest to the north, via a mosaic of disturbed woodland and open forest vegetation communities and scattered trees occupying the north-eastern areas of the site. However these vegetation communities provide only limited terrestrial connectivity as they have been significantly impacted by a history of agricultural use and grazing, resulting in a sparse understorey layer.

2.6 RIPARIAN AREAS

There are several drainage lines which contain various types of ephemeral, perennial and semi-permanent aquatic habitat present on the subject site. The northern and central-eastern parts of the subject site drain in an easterly direction via several ephemeral drainage lines containing occasional dams. These drainage lines flow directly into Myall River after passing through the

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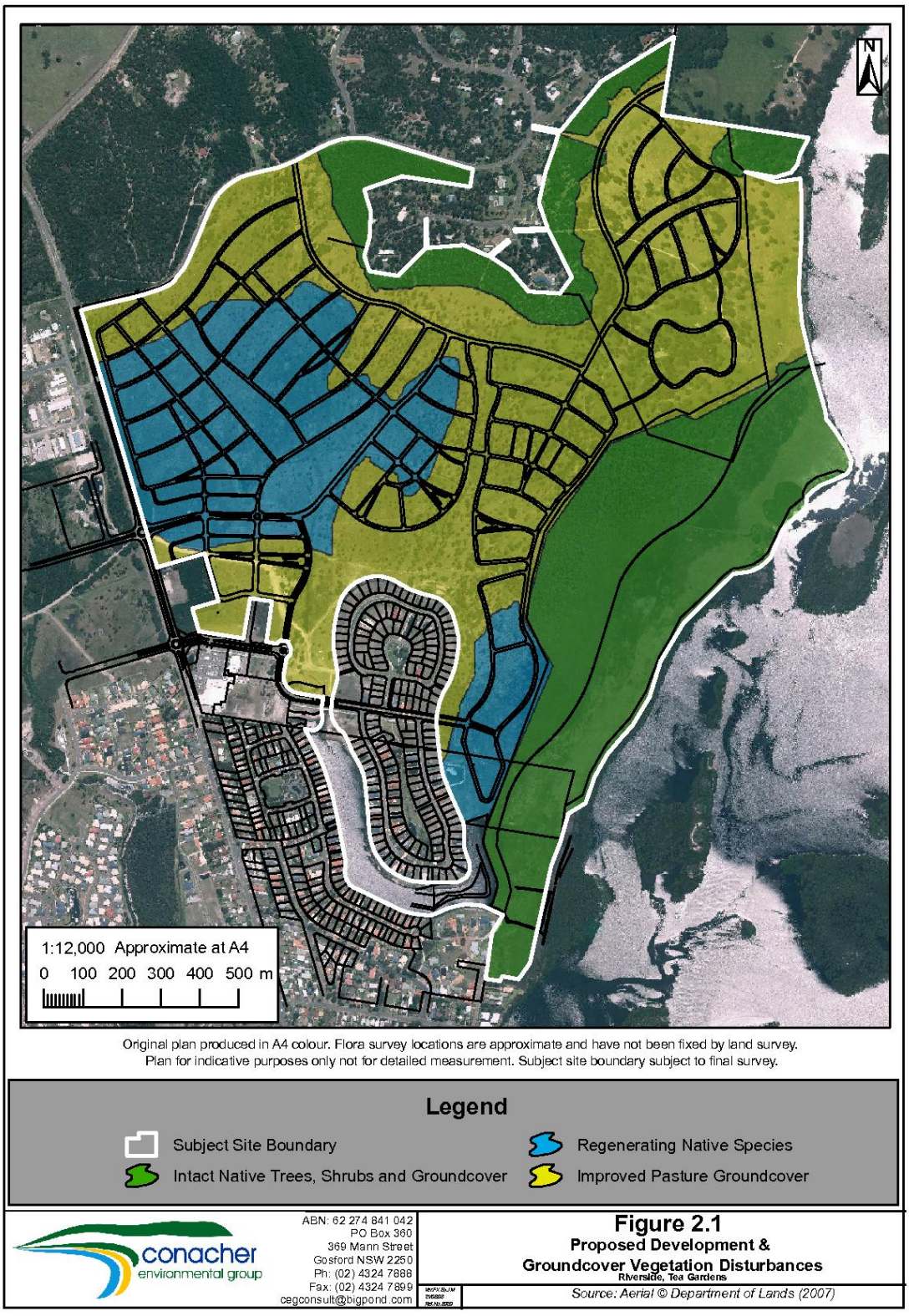
eastern swamp sclerophyll forest and Saltmarsh areas, or alternatively the northern drainage flows directly into the Myall River via well formed incised drainage gullies.

The drainage from the central and central-northern parts of the site is in a generally southerly direction into an area of impeded drainage near the south-western corner of the subject site. Drainage from the southern parts of the subject site is in a northerly direction which then joins the central drainage pattern and exits the site to the east.

The riparian areas are subject to the provisions of the Water Management Act and the various policies and protocols for works within the creekline areas or management of the riparian vegetation. A detailed Ecological Site Management Plan (ESMP) has been prepared for the subject site.


N
1:12,000 Approximate at A4
0 100 200 300 400 500 m
Original plan produced in A4 colour. Flora survey locations are approximate and have not been fixed by land survey.
Plan for indicative purposes only not for detailed measurement. Subject site boundary subject to final survey.
Legend
Subject Site Boundary
Intact Native Trees, Shrubs and Groundcover
Regenerating Native Species
Improved Pasture Groundcover
conacher environmental group
ABN: 62 274 841 042
PO Box 360
369 Mann Street
Gosford NSW 2250
Ph: (02) 4324 7888
Fax: (02) 4324 7899
cegconsult@bigpond.com
Figure 2.1
Proposed Development &
Groundcover Vegetation Disturbances
Riverside, Tea Gardens
Source: Aerial © Department of Lands (2007)

SECTION 3

ECOLOGICAL CONSIDERATIONS AND ASSESSMENTS

3.1 APPLICATION OF THE PRECAUTIONARY PRINCIPLE

The precautionary principle is a component of the ecological sustainable development considerations identified in the Environmental Planning and Assessment Act. The precautionary principle can be defined as:

"*Where there are threats of serious or irreversible environmental damage, lack of full scientific uncertainty should not be used as a reason for postponing measures to prevent environmental degradation".*

The precautionary principle has been applied throughout the undertaking of this threatened biodiversity survey and in the preparation of this assessment report. For example when determining the various species for survey and assessment purposes various species that had not previously been located within the locality were included in the group of species subject to targeted survey and detailed assessment. It was accepted that there was no scientific certainty that these species did not exist, therefore measures (surveys and assessments) were put in place to include these species as species with potential habitat present or suitable habitat present. This enabled consideration of these species, and their habitat, within the various assessments undertaken.

Likewise, in the absence of scientific certainty concerning the presence of various species and details concerning the movement patterns or life cycles of species the proposal has incorporated areas of habitat inclusion for into conservation and potential movement corridors to link retained habitats to larger areas of habitat and other possible corridor linkages.

The precautionary principle has been incorporated into the background investigations, detailed surveys and various assessments completed for this proposal.

3.2 EXTENT AND IMPACT OF VEGETATION/HABITAT REMOVAL

The proposal will result in the direct removal or modification of native vegetation from approximately 126 hectares of land. However much of this 126 hectares has previously been extensively disturbed, cleared and used for stock grazing. Approximately 78 hectares of the better quality native vegetation will be retained in conservation zones or wildlife corridors to connect to areas of vegetation external to the site. An additional 40 hectares (approximately) will be contained in open space and drainage corridors and other undeveloped areas of the site.

The removal and modification of vegetation is likely to result in the following impacts on the biodiversity of the site and its immediate adjoining area:

i) removal of native vegetation;
ii) removal and modification of fauna habitat;
iii) fragmentation of habitat;

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iv) direct loss of flora and fauna species during site development stages through loss of habitat;
v) ongoing disturbance to fauna species during site occupation;
vi) increased edge effects to adjoining vegetation (eg. increased light penetration, changes to soil nutrient levels, changed hydrology of surface water flows, weed invasion and fauna predation etc).

3.3 PROVISION OF CONSERVATION OFFSETS

The proposal has incorporated a number of off-set strategies to address the potential loss of native vegetation and impacts on fauna habitats. These strategies include:

i) Water cycle management strategy to treat water quality onsite prior to stormwater leaving the site;
ii) Retention and management of habitats and vegetation within Conservation Zones (approximately 50 hectares);
iii) Retention and improvement of vegetation contained within wildlife corridors (approximately 30 hectares);
iv) Enhancement of habitat within the wildlife corridor to improve the fauna habitat value of the corridor (covering 30 hectares);
v) Fencing of vegetation to be retained to control vehicle and pedestrian access;
vi) Implementation of a vertebrate pest control program within areas of retained vegetation (covering 80 hectares);
vii) Provision of drainage corridors with appropriate planting and landscaping of water ponding areas to enhance habitat for locally occurring frog, reptile and bird species.

3.4 ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION ACT

The *Environment Protection and Biodiversity Conservation Act, (1999)* requires that Commonwealth approval be obtained for certain actions. The Act provides an assessment and approvals systems 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, and 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 Department of Environment, Heritage, Water and Arts. A detailed assessment of this proposal in relation to the EP&BC Act is provided in the Appendices.

No threatened flora species or endangered ecological communities listed in the EPBC Act (1999) were identified on or near to the site. It is considered that a referral of this project to the

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Department of Environment, Heritage, Water and Arts is not required as it is not likely to impact on a significant population of threatened species or on an endangered ecological community.

3.5 STATE ENVIRONMENTAL PLANNING POLICIES

SEPP 14 – Coastal Wetlands
The site contains an area of wetland mapped under State Environmental Planning Policy No. 14 Coastal Wetlands and known as Wetland No. 746. The extension of the outlet from the existing lake area to the Myall River will not require disturbance to the SEPP 14 wetland. The SEPP 14 Wetland will be buffered by the retention of vegetation communities between the wetland boundary and the development edge.

SEPP 26 – Littoral Rainforests
No areas identified as SEPP 26 littoral rainforests are mapped on or adjoining the subject site. The proposal will not impact on any SEPP 26 littoral rainforest areas.

SEPP 44 – Koala Habitat Protection
An assessment has been undertaken in relation to SEPP 44 Koala Habitat Protection. It was determined that areas of the site contained Potential Koala Habitat according to the criteria of SEPP 44. No Koalas or signs of usage of the site by the Koala were observed within the site during surveys. As such it is considered that the subject site does not constitute Core Koala Habitat. A Management Strategy for Koalas and Koala habitat to be retained has been prepared for this proposal.

SEPP 71 – Coastal Protection
In relation to SEPP 71 it is identified in clause 2(i)(g) that the policy aims to protect and preserve native coastal vegetation.

The proposal has incorporated measures to retain, protect and preserve the areas of swamp forest and estuarine vegetation communities within the 7(a) Environmental Protection and 7(b) Conservation Zones. These areas are proposed to be retained and protected in biodiversity conservation zones. Approximately 80 hectares of coastal native vegetation will be retained and protected to provide protection for native vegetation, fauna habitats and wildlife corridors.

The areas of the proposed development will be limited to:

1) the residential zoned areas of the site which have been cleared of much of the natural vegetation with regrowth and remnant patches of vegetation present and used for a range of primary production purposes including cattle grazing and pine plantations.
2) an area of wetland, to the east of the existing lake, will be disturbed to widen the existing outlet channel. Widening of the channel will require the removal of a portion of the Endangered Ecological Communities (EECs), Swamp Sclerophyll Forest on Coastal Floodplains and Coastal Saltmarsh. These EECs are well represented within the surrounding area and as such the area of removal required for the proposed development is unlikely to have a significant impact on these communities. The assessment of the impact on these vegetation communities is detailed in Section 4, Tables 4.4 and 4.7-4.9.

The proposal will ensure the long term protection of areas of native coastal vegetation in locations that will significantly contribute to the continuance of vegetation along the shores of the Myall River.

3.6 THREATENED SPECIES CONSERVATION ACT

3.6.1 Threatened Species Impacted by the Proposal

Seven threatened fauna species were observed within the subject site during surveys conducted within the last five years. These species are:

- Wallum Froglet (*Crinia tinnula*);
- Osprey (*Pandion haliaetus*);
- Barking Owl (*Ninox connivens*);
- Grey-headed Flying-fox (*Pteropus poliocephalus);*
- Squirrel Glider (*Petaurus australis*).
- Little Bentwing-bat (*Miniopterus australis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);

Additionally a number of other threatened fauna species with suitable habitat present on-site were observed within the Tea Gardens area (within 5km) during recent local area surveys. These are:

- Powerful Owl (*Ninox strenua*);
- Masked Owl (*Tyto novaehollandiae*);
- Koala (*Phascolarctos cinereus*);
- Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*);
- Eastern Pygmy-possum (*Cercatetus nanus*).

The following threatened fauna species were observed within the subject site during previous surveys, however these have not been recorded within the last five years despite extensive fauna surveys:

- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Large-footed Myotis (*Myotis adversus*);
- Eastern Bentwing-bat (*Miniopterusschreibersii oceanensis*) ;
- Common Blossom-bat (*Syconycteris australis*);
- Koala (*Phascolarctos cinereus*).

The following threatened fauna species were identified by the Department of Environment and Climate Change and Department of Planning as requiring assessment despite not being recorded within the locality during recent surveys:

- Sooty Oystercatcher and Pied Oystercatcher;
- Turquoise Parrot;
- Swift Parrot;
- Spotted-tailed Quoll;
- Endangered Emu Population of the North Coast Bioregion.

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3.6.2 Direct and Indirect Impacts of the Proposal upon Threatened Species

Table 3.1 provides a summary of potential direct and indirect impacts of the proposal of those threatened species observed within the subject site during surveys.

Table 3.2 provides an assessment of potential impacts of the proposal on threatened fauna species either observed within the locality during recent surveys, observed within the subject but not within the last five years or nominated for assessment by the Department of Environment and Climate Change or Department of Planning (as identified in Section 4.6.1).

TABLE 3.1
ASSESSMENT OF POTENTIAL IMPACTS OF PROPOSED DEVELOPMENT ON THREATENED SPECIES OBSERVED WITHIN THE SUBJECT SITE

Impact	Wallum Froglet	Osprey	Barking Owl	Squirrel Glider	Grey-headed Flying-fox	Micro-bats
Altered Fire Regimes	Frequent or increased intensity of burning of habitat likely to negatively impact on species	No impact.	Loss of foraging habitat. Loss of roosting / nesting habitat. Loss of prey species habitat.	Loss of foraging and refuge habitat. Injury or mortality due to fire.	Loss of foraging habitat.	Loss of foraging habitat. Loss of roosting / nesting habitat. Loss of prey species habitat.
Increased Exposure to Exotic Predators	Mortality risk to exotic predators such as cats, dogs and foxes.	Mortality risk to exotic predators such as cats, dogs and foxes.	No impact.	Mortality risk to exotic predators such as cats, dogs and foxes.	Mortality risk to exotic predators such as cats, dogs and foxes.	Mortality risk to exotic predators such as cats, dogs and foxes.
Loss of Foraging or Nesting Habitat	Decreased amount of habitat. Increased competition for suitable habitat.	No impact.	Loss of nesting / foraging habitat. Increased competition for suitable habitat.	Decreased amount of habitat. Increased competition for suitable habitat.	Decreased amount of habitat. Increased competition for suitable habitat.	Decreased amount of habitat. Increased competition for suitable habitat.
Increased Threat During Clearing and Development	Loss of nesting / foraging habitat. Injury / death during development.	No impact.	Loss of nesting / foraging habitat. Injury / death during development.	Loss of nesting / foraging habitat. Injury / death during development.	Loss of foraging habitat. Injury / death during development.	Loss of nesting / foraging habitat. Injury / death during development
Fragmentation or Isolation of Habitat	Reduction and interruption to movement and dispersal areas.	No impact.	No impact.	Reduction and interruption to movement and dispersal areas.	No impact.	No impact.
Threat of Vehicle Injury / Death	Increased exposure to vehicle injury / death.	Increased exposure to vehicle injury / death.	Increased exposure to vehicle injury / death. Increased exposure of prey to vehicle injury / death.	Increased exposure to vehicle injury / death.	Increased exposure to vehicle injury / death.	Increased exposure to vehicle injury / death.
Soil Erosion	Modification of foraging, refuge and breeding habitat.	Modification of prey habitat.	Modification of prey habitat.	Modification of foraging habitat.	Modification of foraging habitat.	Modification of foraging habitat.
Altered Hydrology	Modification of foraging, refuge and breeding habitat.	Modification of prey habitat.	Modification of foraging habitat.	Modification of foraging habitat.	Modification of foraging habitat.	Modification of foraging habitat.
Increased Runoff	Modification of foraging, refuge and breeding habitat.	Modification of prey habitat.	Modification of foraging habitat.	Modification of foraging habitat.	Modification of foraging habitat.	Modification of foraging habitat.
Flooding	Temporary increase in amount of breeding, refuge and foraging areas.	Temporary modification upon prey habitat.	No impact.	No impact.	No impact.	No impact.
Increased Weed Invasion	Modification of foraging habitat.	No likely impact.	Modification of prey and foraging habitat.	No impact.	No impact.	No impact.
Grazing	Modification of foraging habitat.	No impact.	Modification of prey habitat.	Modification of habitat due to loss of understorey species.	Modification of foraging habitat.	Modification of foraging habitat.

TABLE 3.1 (Cont.)
ASSESSMENT OF POTENTIAL IMPACTS OF PROPOSED DEVELOPMENT ON THREATENED SPECIES OBSERVED WITHIN THE SUBJECT SITE

Impact	Wallum Froglet	Osprey	Barking Owl	Squirrel Glider	Grey-headed Flying-fox	Micro-bats
Mowing / Slashing	Modification of foraging, refuge and breeding habitat.	No impact.	Modification of prey habitat.	Modification of habitat due to loss of understorey species.	Modification of foraging habitat.	Modification of foraging habitat.
Rubbish Dumping	Pollution of foraging, refuge and breeding habitat.	No impact.	No impact.	No impact.	No impact.	No impact.
Physical Damage eg. Trampling	Modification of foraging, refuge and breeding habitat.	No impact.	No impact.	No impact.	No impact.	No impact.

* Micro-bats = Little Bentwing-bat, Eastern Freetail-bat & Greater Broad-nosed Bat

TABLE 3.2
ASSESSMENT OF POTENTIAL IMPACTS OF PROPOSED DEVELOPMENT ON THREATENED SPECIES KNOWN FROM LOCAL AREA OR IDENTIFIED FOR ASSESSMENT

Impact	Sooty & Pied Oyster-catcher	Powerful Owl	Masked Owl	Swift Parrot	Koala	Spotted-tailed Quoll	Eastern Pygmy-possum	Eastern Chestnut Mouse	Common Blossom-bat	Micro-bats*
Altered Fire Regimes	No impact.	Loss of foraging habitat. Loss of roosting / nesting habitat. Loss of prey species habitat.	Loss of foraging habitat. Loss of roosting / nesting habitat. Loss of prey species habitat.	Modification of foraging habitat.	Loss of foraging and refuge habitat. Injury or mortality due to fire.	Loss of foraging and refuge habitat. Loss of prey habitat.	Loss of foraging and refuge habitat. Injury or mortality due to fire.	Loss of foraging habitat. Successional impacts.	Loss of foraging habitat.	Loss of foraging habitat. Loss of roosting / nesting habitat. Loss of prey species habitat.
Increased Exposure to Exotic Predators	Mortality risk to exotic predators such as cats, dogs and foxes.	No impact.	No impact.	Mortality risk to exotic predators such as cats, dogs and foxes.	Mortality risk to exotic predators such as dogs and foxes.	Mortality risk to exotic predators such as cats, dogs and foxes.	Mortality risk to exotic predators such as cats, dogs and foxes.	Increased exposure to exotic predators such as cats, dogs and foxes.	Mortality risk to exotic predators such as cats, dogs and foxes.	Mortality risk to exotic predators such as cats, dogs and foxes.

TABLE 3.2 (Cont.)
ASSESSMENT OF POTENTIAL IMPACTS OF PROPOSED DEVELOPMENT ON THREATENED SPECIES KNOWN FROM LOCAL AREA OR IDENTIFIED FOR ASSESSMENT

Impact	Sooty & Pied Oyster-catcher	Powerful Owl	Masked Owl	Swift Parrot	Koala	Spotted-tailed Quoll	Eastern Pygmy-possum	Eastern Chestnut Mouse	Common Blossom-bat	Micro-bats*
Loss of Foraging or Nesting Habitat	No impact.	Decreased amount of foraging habitat. Increased competition for suitable habitat.	Decreased amount of foraging habitat. Increased competition for suitable habitat.	Decreased amount of foraging habitat.	Decreased amount of foraging habitat. Home range impacts.	Decreased amount of foraging habitat. Home range impacts.	Decreased amount of foraging and nesting habitat. Increased competition for suitable habitat.	Decreased amount of foraging and nesting habitat. Increased competition for suitable habitat.	Decreased amount of habitat. Increased competition for suitable habitat.	Decreased amount of habitat. Increased competition for suitable habitat.
Increased Threat During Clearing and Development	No impact.	Loss of nesting / foraging habitat. Injury / death during development.	Loss of nesting / foraging habitat. Injury / death during development.	Disturbance impacts during clearing.	Disturbance impacts during clearing. Injury/death during works.	Disturbance impacts during clearing. Injury/death during works.	Loss of nesting / foraging habitat. Injury / death during development.	Loss of nesting / foraging habitat. Injury / death during development	Loss of foraging habitat. Injury / death during development.	Loss of nesting / foraging habitat. Injury / death during development
Fragmentation or Isolation of Habitat	No impact.	No impact.	No impact.	No impact.	No isolation or further fragmentation	Reduction in size of movement areas.	Isolation of habitat areas.	Isolation of habitat areas.	No impact.	No impact.
Threat of Vehicle Injury / Death	Increased exposure to vehicle injury / death.	Increased exposure to vehicle injury/death. Increased exposure of prey to vehicle injury / death.	Increased exposure to vehicle injury/death. Increased exposure of prey to vehicle injury / death.	Increased exposure to vehicle injury/death.	Increased exposure to vehicle injury/death.	Increased exposure to vehicle injury/death. Increased exposure of prey to vehicle injury/death.	Increased exposure to vehicle injury/death.	Increased exposure to vehicle injury/death.	Increased exposure to vehicle injury/death.	Increased exposure to vehicle injury/death.
Soil Erosion	No impact.	Modification of prey habitat.	Modification of prey habitat.	No impact.	Modification of foraging habitat.	Modification of prey habitat.	Modification of foraging habitat.	Modification of foraging and refuge habitat.	Modification of foraging habitat.	Modification of foraging habitat.
Altered Hydrology	No impact.	Modification of prey habitat.	Modification of prey habitat.	No impact.	Modification of foraging habitat.	Modification of prey habitat.	Modification of foraging habitat.	Modification of foraging and refuge habitat.	Modification of foraging habitat.	Modification of foraging habitat.

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TABLE 3.2 (Cont.)
ASSESSMENT OF POTENTIAL IMPACTS OF PROPOSED DEVELOPMENT ON THREATENED SPECIES KNOWN FROM LOCAL AREA OR IDENTIFIED FOR ASSESSMENT

Impact	Sooty & Pied Oyster-catcher	Powerful Owl	Masked Owl	Swift Parrot	Koala	Spotted-tailed Quoll	Eastern Pygmy-possum	Eastern Chestnut Mouse	Common Blossom-bat	Micro-bats*
Increased Runoff	No impact.	Modification of prey habitat.	Modification of prey habitat.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.
Flooding	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.
Increased Weed Invasion	No impact.	Modification of prey and foraging habitat.	Modification of prey and foraging habitat.	Modification of foraging habitat.	Modification of habitat.	Modification of foraging habitat.	Modification of habitat.	Modification of foraging and refuge habitat.	No impact.	No impact.
Grazing	No impact.	Modification of prey habitat.	Modification of prey habitat.	No impact.	Increased exposure when on ground.	Modification of refuge habitat.	Modification of habitat due to loss of understorey species.	Modification of foraging habitat.	Modification of foraging habitat.	No impact.
Mowing / Slashing	No impact.	Modification of prey habitat.	Modification of prey habitat.	No impact.	Increased exposure when on ground.	Modification of refuge habitat.	Modification of habitat due to loss of understorey species.	Modification of foraging habitat.	Modification of foraging habitat.	No impact.
Rubbish Dumping	Modification of foraging habitat.	No impact.	No impact.	No impact.	Modification of foraging habitat.	Modification of foraging habitat.	Modification of foraging habitat..	Modification of foraging habitat.	No impact.	No impact.
Physical Damage e.g. Trampling	Modification of foraging habitat.	No impact.	No impact.	No impact.	Modification of foraging habitat.	Modification of foraging habitat.	Modification of foraging habitat..	Modification of foraging habitat.	No impact.	No impact.

TABLE 3.3
ASSESSMENT OF POTENTIAL IMPACTS OF PROPOSED DEVELOPMENT ON ENDANGERED ECOLOGICAL COMMUNITIES OCCURING WITHIN THE SUBJECT SITE

	Coastal Saltmarsh	Swamp Oak Floodplain Forest	Swamp Sclerophyll Forest on Coastal Floodplains
Altered Fire Regimes	Inappropriate fire regime will slow community regeneration and alter species composition.	Inappropriate fire regime will slow community regeneration and alter species composition	Inappropriate fire regime will slow community regeneration and alter species composition
Increased Threat During Clearing and Development	Potential physical damage to vegetation, soil compression, run-off, trampling and waste management issues.	Potential physical damage to vegetation, soil compression, run-off, trampling and waste management issues.	Potential physical damage to vegetation, soil compression, run-off, trampling and waste management issues.
Fragmentation or Isolation of Habitat	No impact.	No impact.	No impact.
Soil Erosion	Reduced soil fertility through loss of organic topsoil. Diminished soil seed reserves.	Reduced soil fertility through loss of organic topsoil. Diminished soil seed reserves.	Reduced soil fertility through loss of organic topsoil. Diminished soil seed reserves.
Altered Hydrology	Changes to sediment chemistry and saltmarsh community composition. Damage to condition of the community.	Changes to community structure and composition. Damage to condition of the community.	Changes to community structure and composition. Damage to condition of the community.
Increased Runoff	Weed incursion from soil and water nutrification. Accumulation of contaminants in soil and sediment.	Weed incursion from soil and water nutrification. Accumulation of contaminants in soil and sediment.	Weed incursion from soil and water nutrification. Accumulation of contaminants in soil and sediment.
Flooding	Freshwater pollution and associated salinity changes associated with inappropriate flood regimes.	No impact.	No impact.
Increased Weed Invasion	Competition with native species. Modification of community structure and floristic composition. Loss of species diversity. Hydrological changes.	Competition with native species. Modification of community structure and floristic composition. Loss of species diversity. Hydrological changes.	Competition with native species. Modification of community structure and floristic composition. Loss of species diversity. Hydrological changes.
Grazing	Hydrological changes associated with soil compaction and modification of soil microtopography. Modification of community structure and floristic composition. Weed incursion.	Hydrological changes associated with soil compaction and modification of soil microtopography. Modification of community structure and floristic composition. Weed incursion.	Hydrological changes associated with soil compaction and modification of soil microtopography. Modification of community structure and floristic composition. Weed incursion.
Mowing / Slashing	Modification of community structure and floristic composition. Will slow or prevent vegetation regeneration.	Modification of community structure and floristic composition. Will slow or prevent vegetation regeneration.	Modification of community structure and floristic composition. Will slow or prevent vegetation regeneration.
Rubbish Dumping	Hydrological changes through sediment trapping. Contamination and nutrification of soils and water.	Hydrological changes through sediment trapping. Contamination and nutrification of soils and water.	Hydrological changes through sediment trapping. Contamination and nutrification of soils and water.
Physical Damage e.g. Trampling	Soil compaction. Hydrological changes. Damage to groundcover and understorey species. Will slow or prevent vegetation regeneration.	Soil compaction. Hydrological changes. Damage to groundcover and understorey species. Will slow or prevent vegetation regeneration.	Soil compaction. Hydrological changes. Damage to groundcover and understorey species. Will slow or prevent vegetation regeneration.

3.7 FISHERIES MANAGEMENT ACT

The proposed development is adjacent to the Myall River, associated aquatic habitats and includes the constructed lake and outlet channel to the lake. As such it is considered that there are issues of relevance to the *Fisheries Management Act*. The proposed extension of the existing outlet in to the constructed lake, will result in an area of disturbance to the endangered ecological communities, Swamp Sclerophyll Forest on Coastal Floodplains and Coastal Saltmarsh. The level of disturbance to the wetland and vegetation is considered unlikely to significantly impact aquatic habitat. The assessment of the impact on these vegetation communities is detailed in Section 4, Tables 4.4 and 4.7-4.9.

In addition, there are no threatened fish species listed within the *Fisheries Management Act* (1994) with normal distributional limits that include the Myall River. A detailed report on the impact of the development on fish species present in the lake has been prepared by Harris Research (2007).

3.8 NATIVE VEGETATION ACT

The Native Vegetation Act (2003) (NVAct) is a principal piece of legislation applicable to native vegetation in non-residential zoned areas. Land zoned for residential purposes is excluded from the provisions of the NVAct under Part 1 Section 5 (clause 2), as identified in Schedule 1 Part 3 of the NVAct.

In relation to the subject site the NVAct applies to the areas zoned 7(a) and 7(b) as these zones are not residential zones. The NVAct does not apply to the area of the proposal within the residential zoned parts of the site. The areas of vegetation proposed to be cleared and disturbed for the widening of the lake outlet are subject to the provisions of the NVAct.

An assessment of the proposal in relation to the objectives of the NVAct is provided below. The objective of the NVAct are provided in *italic* print below.

(a) to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State

The widening of the lake outlet will require the removal of a portion of the EECs, Swamp Sclerophyll Forest on Coastal Floodplains and Coastal Saltmarsh. The assessment of the impact on these vegetation communities is detailed in Section 4, Tables 4.4 and 4.7-4.9. However, the majority of this vegetation will be retained and conserved under the 7(a) - environmental protection and 7(b) – conservation zonings. These areas of land may be subject to future negotiations to enable their incorporation into the estate of the Department of Environment and Climate Change (DECC). This will provide opportunities for the vegetation to be managed on a regional basis for the social, economic and environmental interests of the State.

(b) to prevent broadscale clearing unless it improves or maintains environmental outcomes

Areas of vegetation requiring removal as a result of the proposed channel widening are considered to be of a small, localised scale and will be offset through the restoration

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and protection of areas of disturbed estuarine vegetation. This will achieve an outcome that maintains or improves the existing vegetation.

(c) to protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation.

The native vegetation to be retained and conserved under the 7(a) - environmental protection and 7(b) – conservation zonings is located within a SEPP 14 wetland and contains the EECs, Swamp Sclerophyll Forest on Coastal Floodplains and Coastal Saltmarsh. In addition, areas of degraded vegetation will be restored and as such will maintain or improve the existing water quality and biodiversity.

(d) to improve the condition of existing native vegetation, particularly where it has high conservation value.

Degraded areas of vegetation will be improved through the erection of protective fencing to restrict pedestrian and vehicle access. This will enable the existing vegetation opportunities to regenerate and improve in condition. Areas disturbed for the widening of the outlet channel will be restored in the accordance with the Wetland Restoration Strategy for this area.

(e) to encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation.

The area of the retained native vegetation will be allowed to regenerate naturally following previous wildfires and uncontrolled stock grazing. Weed management will assist in the regeneration process. Any restoration works, such as those proposed along the area of channel widening, will utilise locally occurring native species.

From the above assessment it is concluded that the proposed development will maintain or improve the existing vegetation and is compatible with the objective of the NVAct (2003). Vegetation of high conservation value located within the SEPP 14 wetland will be retained and enhanced through the restriction of foreshore access, weed management activities and restoration works. Any impacts associated with the proposed channel widening will be offset by these management measures.

3.9 POTENTIAL TO IMPACT ON DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE ESTATE

There are no lands administered by the Department of Environment and Climate Change adjoining the site. The subject site is located approximately four kilometres up river of the Corrie Island Nature Reserve and approximately two kilometres down river of the Myall Lakes National Park. Some areas of the Myall Lakes National Park are also located along the eastern shoreline areas of the Myall River within two kilometres of the subject site.

The proposal will not cause any direct disturbance to these areas of nature reserve or national park administered by the Department of Environment and Climate Change. Some increased visitor activity may result to those areas due to possible increased recreational boating along the Myall River. Any increase in visitor use cannot be quantified at this stage.

Hydrological flows of the Myall River are not expected to be significantly altered by the proposal. Any changed water levels within the Myall River which might impact on the shoreline of Myall Lakes National Park or Corrie Island Nature Reserve are not likely to be attributed to the proposal.

3.10 POTENTIAL TO IMPACT REGIONAL WILDLIFE CORRIDOR

The subject site is included within an area mapped as a regional corridor (Scotts 2003). The subject site has also been mapped as an area of key habitat by Scotts (2003). In a review of a previous assessment report for the site (Conacher Travers 2007) DECC have identified that…"*locally this corridor would facilitate wildlife movement from the north-west to the fringes of Tea Gardens and contribute to fauna from the Myall River through the Shearwater locate to suitable habitats in the Kore Kore Creek area".* DECC also states that…"*Typically Corridors are in the order of kilometres wide to maintain habitat, facilitate movement between areas of significant intact habitat (eg. DECC estate – Myall Lakes National Park)…. and buffer against the fragmentation of corridors*".

DECC acknowledges that this corridor is patchy and discontinuous.

The location of the regional corridor is shown in Figure 3.1. This figure shows the regional corridor extending through the site in a northerly direction over the cleared agricultural area and through a large pine plantation. To the west of the site the corridor includes the industrial areas of Tea Gardens. The corridor also includes areas of residential and commercial development associated with Tea Gardens.

As identified in Figure 3.1 the corridor does not connect to areas of land included in the DECC estate (eg. Myall Lakes National Park and Corrie Island Nature Reserve). Additionally, areas within the DECC estate have not been identified as key habitats by Scotts (2003).

While the concept of establishing regional corridors has ecological merit the reliance on the mapping of corridors by Scotts (2003) and the interpretation of this information should be used cautiously. As identified by Scotts (2003) the mapping is based on faunal models and the corridors derived from them are computer modelled representations of potential habitat or linking habitat for species assemblages at a regional scale. Additionally the corridors have not yet been ground truthed in the field.

Notwithstanding the problems associated with the mapping of regional corridors and exclusion of areas of national parks, nature reserves and state forests from key habitat and corridor mapping the proposal has incorporated wildlife corridors within the site to facilitate possible movement of biodiversity to and from areas of retained habitat both within and external to the site.

As shown in Figure 4.1 the proposed corridor continues in a north-west direction from the Swamp Forest vegetation of the 7(b) environmental zone towards the slopes below Shearwater Estate. The corridor separates into two sections with the northern section extending to the land adjoining the northern boundary which is incorporated into the Regional Corridor mapped by Scott (2003). The western section of the corridor continues in a western then northern direction linking into the public reserves associated with Shearwater Estate. The vegetation within this public reserve area is relatively undisturbed vegetation with low levels of weed invasion present.

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The site corridor area varies in width between 60 to 120 metres wide. This corridor will require some areas of regeneration and habitat enhancement (placement of ground hollows, tree mounted nest boxes, weed management etc) as identified in the Ecological Site Management Strategy. Bushfire asset protection zones and water management structures should be located on the outside extremities of the corridor.

This corridor is proposed to be managed as community titled land however the future inclusion in a conservation zone might be appropriate for this corridor to ensure long term protection and appropriate management.

3.11 ASSESSMENT OF PROPOSAL AGAINST RELEVANT RECOVERY PLANS

The following Threatened Species Recovery Plans exist for threatened fauna observed within the subject site or within the locality:

- National Recovery Plan for the Wallum Sedge Frog and Other Wallum Dependant Frogs (QLD EPA 2006);
- Approved Recovery Plan for the Large Forest Owls Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*), Masked Owl (*Tyto novaehollandiae*) (DEC 2006);
- Draft Recovery Plan for the Barking Owl (*Ninox connivens*) (DEC 2003);
- Approved Recovery Plan for the Koala (*Phascolarctos cinereus*) (DEC 2003).

An assessment of the proposal against the recovery plans for these species is provided below. The Department of Planning requested an assessment for the endangered population of the Koala only, however an assessment for all other relevant species covered by recovery plans has been completed.

Each recovery plan contains several objectives, which relate to conservation initiatives of the relevant government departments. An assessment of the proposal in relation to the recovery plan objectives and actions is provided.

NATIONAL RECOVERY PLAN FOR THE WALLUM SEDGE FROG AND OTHER WALLUM DEPENDANT FROGS (QLD EPA 2006)

The National Recovery Plan for the Wallum Sedge Frog and other Wallum Dependent Frogs states;

"*This recovery plan includes four species of frog, however adoption as a national recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 refers only to the wallum sedge frog Litoria olongburensis.*"

Recovery Plan objectives have been addressed for the Wallum Froglet regardless of this.

Action 1: Identify and assess essential habitat

Suitable Wallum Froglet habitat within the subject site has been identified as part of the Ecological Site Assessment. The extent of habitat was determined during fauna surveys completed as part of the initial Flora and Fauna Assessment for the site. Seasonal follow-up surveys have been completed to determine the extent of Wallum Froglet habitat within the site.

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Action 2: Protect wallum frog populations and manage habitat

An Ecological Site Management Plan has been prepared for the site that details management strategies in relation to protection of the Wallum Froglet within the site.

The amphibian disease Chytridiomycosis has not yet been observed in the Wallum Froglet and tends to affect amphibian species inhabiting higher altitudes. As such, it is considered that Chytridiomycosis does not present a major threat to the survival of the Wallum Froglet. Should this illness be detected in frog populations on the subject site, management strategies will be implemented as per the 'Threat Abatement Plan for Infection of Amphibians with Chytrid Fungus resulting in Chytridiomycosis'.

The Mosquito Fish (*Gambusia holbrooki*) is likely to be present within drainage lines and creeks within the site. Since the Wallum Froglet is more dependant on semi-permanent wetland areas for breeding, predation on eggs and tadpoles by the Mosquito fish does not present a major threat for survival of the species within the site.

Action 3: Acquire additional information on threats to inform management

The following have been identified as threats to the Wallum Froglet in NSW (DECC 2008).

- Destruction and degradation of coastal wetlands as a result of roadworks, coastal developments and sandmining;
- Reduction of water quality and modification to acidity in coastal wetlands;
- Grazing and associated frequent burning of coastal wetlands.

As such the proposal represents a threat to the Wallum Froglet.

Action 4: Engage stakeholders and the broader community in recovery of wallum frog species

Actions associated with community engagement on Wallum Froglet recovery are primarily the responsibility of management authorities. However, the Ecological Site Management Plan prepared for the site includes management strategies for public education programs in relation to threatened species within the subject site.

Action 5: Rehabilitate degraded wallum frog habitat

The proposal includes areas of identified Wallum Froglet habitat within the subject site to be retained, protected and rehabilitated. This information is detailed in Section 5.

Rehabilitation strategies include weed removal, regeneration of native vegetation, rubbish removal, exclusion of cattle, maintenance of current hydrological regime and water quality.

Action 6: Monitor frog numbers and distribution

Wallum Froglet populations will be regularly assessed as part on an ongoing monitoring program implemented for the site. Monitoring will review the persistence and extent of Wallum Froglet populations, and will follow survey methodology used during the initial Flora and Fauna Assessment. Where detrimental impacts are identified, management strategies will be re-

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evaluated and modified to ensure protection of the species. The proposal is therefore consistent with this Recovery Plan objective.

RECOVERY PLAN FOR THE LARGE FOREST OWLS
POWERFUL OWL (*Ninox strenua*) SOOTY OWL (*Tyto tenebricosa*) and MASKED OWL (*Tyto novaehollandiae*)

Model and Map Owl Habitat and Validate with Surveys

Objective 1: Assess the distribution and amount of high quality habitat for each owl species across public and private lands to get an estimate of the number and proportion of occupied territories of each species that are, and are not, protected.

Recovery Actions: Recovery actions will be directed towards updating existing owl habitat models, mapping modelled habitat across public and private lands, and carrying out field surveys to validate models and enable estimation of the number of territories for each species supported by public versus private land.

It is considered that this objective and action is not relevant to the proposal. Information on the recorded occurrence of the owl species recorded within the local area are provided to the Department of Environment and Climate Change (DECC) as part of licensing agreements for inclusion on the Atlas of NSW Wildlife for use as part of any updating of owl habitat models.

Monitor Owl Population Parameters

Objective 2: To monitor trends in population parameters (numbers, distribution, territory fidelity and breeding success) across the range of the three species and across different land tenures and disturbance histories).

Recovery Actions: Recovery actions will be directed towards developing and implementing a set of regional monitoring programs for the three species throughout their ranges in NSW that assess occupancy of potential habitat, fidelity to occupied territories and breeding success across a range of land tenures and disturbance histories. Synergies with the field validation component of modelled habitat and monitoring actions will be investigated.

It is considered that this objective and action is not relevant to the proposal. Information on the recorded occurrence of the owl species recorded within the local area are provided to the Department of Environment and Climate Change (DECC) as part of licensing agreements for inclusion on the Atlas of NSW Wildlife for use as part of any updating of owl habitat models.

Audit Forestry Prescriptions

Objective 3: To assess the implementation and effectiveness of forest management prescriptions designed to mitigate the impact of timber-harvesting operations on the three owl species and, (if necessary), to use this information to refine the prescriptions so that forestry activities on state forests are not resulting in adverse changes in species abundance and breeding success.

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Recovery Actions: Recovery actions will be directed towards assessing the implementation and effectiveness of forest management prescriptions, and if necessary, refining them so that forestry activities on state forests are not resulting in adverse changes in species abundance and breeding success.

These objectives and actions are specific to state Forests' management and as such are not relevant to the proposal.

Manage and Protect Habitat off Reserves and State Forests

Objective 4: Ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes.

Recovery Actions: Recovery actions are directed towards the development, maintenance and evaluation of tools used by consultants, consent and determining authorities for assessing and mitigating the impact of development activities on large forest owls and their habitats.

No environmental impact assessment guidelines for the large forest owls were available at the time of this report. Surveys for the large forest owls within the site were undertaken in accordance with standard survey methodologies (DEC 2005).

This Ecological Site Assessment includes a full assessment of the impacts of the proposal upon threatened owl species.

Objective 5: Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites).

Recovery Actions: Recovery actions will be directed towards encouraging the protection and management of significant habitat.

None of these three owl species have been recorded within the subject site despite extensive surveys. The Powerful Owl and Masked Owl have been recorded recently within the Tea Gardens area. It is not considered that the subject site constitutes significant owl habitat.

Undertake Research

Objective 6: To improve the recovery and management of the three large forest owls based on an improved understanding of key areas of their biology and ecology.

Recovery Actions: Recovery actions will be directed towards encouraging and facilitating scientific investigation into key aspects of the biology and ecology of the three large forest owls that are likely to provide information that is valuable to the recovery and/or management of these species.

It is considered that this objective and action is not relevant to the proposal. This is due mostly to a lack of evidence of these species within the subject site.

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Increase Community Awareness and Involvement in Owl Conservation

Objective 7: To raise awareness of the conservation requirements of the three large forest owls amongst the broader community, to involve the community in owl conservation efforts and in doing so increase the information base about owl habitats and biology.

Recovery Actions: Recovery actions will be directed towards raising awareness within the community about the conservation requirements of the three large forest owls and encouraging community involvement in recovery actions and information gathering.

It is considered that this objective and action is not directly relevant to the proposal. The Ecological Site Management Plan prepared for the site includes management actions for the raising of local awareness in relation to threatened species.

Provide Organisational Support and Integration

Objective 8: To coordinate the implementation of the recovery plan and continually seek to integrate actions in this plan with actions in other recovery plans or conservation initiatives.

It is considered that this objective and action is not relevant to the proposal.

DRAFT RECOVERY PLAN FOR THE BARKING OWL (*Ninox connivens*)

Specific Objective 1: Increase understanding of the biology, ecology and management of the Barking Owl

Action 1.1: Assess the size, viability and status of the Barking Owl population in NSW.

Action 1.2: Establish a program to monitor the NSW Barking Owl Population and study its demographics.

Action 1.3: Investigate conservation management strategies.

Action 1.4: Support biological and ecological studies.

Action 1.5: Support population genetics studies.

Action 1.6: Investigate the cultural and historic significant of the Barking Owl.

The actions within this objective relate to the coordination of various NPWS (DECC) and other agencies in gathering together information on the biology, ecology and management of the Barking Owl through research and monitoring programs. The proposal includes a monitoring program for threatened species, including the Barking Owl, within the subject site. The results of this monitoring program will be made available to DECC if required.

Specific Objective 2: Increase education and awareness of and involvement in the conservation of the Barking Owl and its' habitat in NSW

Action 2.1: Develop and distribute the Barking Owl information package.

Action 2.2: Develop and distribute best practice guidelines for Barking Owl conservation to Regional Vegetation management Committees (RVMC's).

Action 2.3: Prepare a poster and undertake a community survey and media campaign in rural and regional NSW.

Action 2.4: Establish formal conservation arrangement for properties with Barking Owls.

It is considered that this objective and action is not directly relevant to the proposal. The actions relate to the establishment of programs by various government agencies in increasing public education and awareness of the Barking Owl. The Ecological Site Management Plan prepared for the site includes management actions for the raising of local awareness in relation to threatened species.

Specific Objective 3: Undertake threat abatement and mitigation

Action 3.1: Protect known Barking Owl nest sites and surrounding habitat.

Action 3.2: Assist with the protection of Barking Owl habitat from disturbance due to developments and activities.

Action 3.3: Assess forestry prescriptions and Threatened Species Licences for their effectiveness in conserving the Barking Owl in State Forests.

Action 3.4: Incorporate the consideration of Barking Owl habitat and potential habitats as a high priority in the assessment of property for reserve establishment.

Action 3.5: Support studies into the effects of agricultural poisons upon the species.

Specific actions within this objective involve the protection of Barking Owl nest sites and suitable habitats. While no nest sites for this species are known from the subject site, given the Barking Owls occurrence during surveys, the proposal will remove areas of foraging habitat.

Specific Objective 4: Gain efficiencies through links with other conservation plans and conservation groups

Action 4.1: Integrate the Barking Owl plan with other plans.

Action 4.2: Maintain the NPWS threatened owl working group and links with owl researchers.

Action 4.3: Maintain links with the community.

These recovery actions refer to the co-ordination and integration of the recovery plan with other plans, research groups, institutions and community conservation groups in facilitating Barking Owl recovery. It is not considered that these objectives and actions are relevant to the proposal.

Specific Objective 5: Provide organisational support

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Action 5.1: Coordinate the implementation of the recovery plan

Action 5.2: Review the plan in its final year and prepare a seconds recovery plan.

These objectives and actions refer specifically to the implementation and review of the plan by the NPWS (DEC) and as such it is not considered that these objectives and actions are relevant to the proposal.

RECOVERY PLAN FOR THE HAWKS NEST AND TEA GARDENS ENDANGERED KOALA POPULATION

Objective 1: To co-ordinate the recovery of the Hawks Nest and Tea Gardens Koala Population

Action 1.1: The NPWS, with the support of GLC, will coordinate the implementation of the action outlined in the Recovery Plan.

Action 1.2: The NPWS and the GLC will develop a Koala Working Group (KWG).

The proposal is not inconsistent with the actions contained within the Recovery Plan as part of this objective. These actions relate to the Councils and NPWS co-ordination of the Recovery Plan in particular the establishment of a Koala Working and monitoring program. The Koala Management Strategy developed for this proposal includes a monitoring program for the Koala. The results of monitoring will be made available to the Koala Working Group if required.

Objective 2: To identify and map the distribution of Koala habitat in the Hawks Nest and Tea Gardens area

Action 2.1: The NPWS, with support from GLC, will coordinate the identification and mapping of Koala habitat in the Hawks Nest and tea Gardens area and produce a supporting document.

As part of the actions for this objective the NPWS with support from Council are to coordinate the mapping of Koala habitat. As part of this and other local area proposals detailed vegetation mapping has been supplied to Council that will aid in identifying Koala habitat within the area. No detailed Koala habitat mapping of the site has been completed as part of the proposal. No mapping of Koala habitat within the Hawks Nest Tea Gardens area was available at the time of this report.

Objective 3: To conserve the Hawks Nest and Tea Gardens Population in its existing habitat

Action 3.1: Areas of Koala habitat identified through Action 2.1 will be prioritised for active management and monitoring and/or conservation by the KWG in consultation with the local community. This will include an assessment of the need for a Critical Habitat declaration in the Hawks Nest and Tea Gardens area.

Action 3.2: The NPWS and GLC will establish a survey program to determine if areas to the north and west of Hawks Nest and Tea gardens represent a source of new individuals into the Endangered Koala Population. Methods utilised will be low impact and involve the local community.

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Action 3.3: The NPWS, with support from GLC, will prepare survey and assessment guidelines for the Hawks Nest and Tea Gardens Koala Population and distribute them to relevant authorities.

Action 3.4: The KWG will establish an ongoing program of blackspot identification.

Action 3.5: Subsequent to Action 3.4, the KWG will develop and implement of a program of works that integrates strategic streetscaping and street calming.

Action 3.6: The GLC, with assistance from NPWS, will develop a policy that facilitates the effective enforcement of CA Act.

Action 3.7: The NPWS and GLC will coordinate exisiting programs to appropriately manage feral dogs and dingoes in the wider Hawks Nest and tea Gardens area.

The actions contained within this object refer to prioritisation of areas for active management based on Koala habitat mapping. No detailed habitat mapping within the local area has been completed to date. It is identified that Swamp Sclerophyll communities in north Hawks Nest are essential to the existence of the endangered population. A large amount of the Swamp Sclerophyll Forest present within the subject site will be retained as part of the proposal. The small proportion to be removed is degraded and has low habitat value.

The recovery actions also refer to the development of survey and assessment guidelines for the endangered population. No survey and assessment guidelines are currently available.

The recovery actions also refer to identification of black spots and traffic calming and street scape initiatives. Traffic management and road design has been addressed within the Koala Management Strategy prepared for the proposal.

The Koala Management Strategy also addresses companion animal management as referred to in the recovery plan actions of this objective.

Objective 4: To incorporate Koala conservation into planning processes

Action 4.1: The NPWS will recommend to GLC that identified Koala habitat be appropriately zoned to maximise its long-term protection.

Action 4.2: Further to Action 4.1, the NPWS will ensure that public authorities, relevant landholders and land managers are aware of the long-term protection measures available to assist in the conservation of the Hawks Nest and Tea Gardens population.

Action 4.3: The NPWS will provide information to the Bush Fire Management Committee (BFMC) in the Hawks Nest and Tea Gardens area to encourage consideration of Koalas and Koala habitat in the preparation and implementation of Bush Fire Risk Management Plans and Plans of Operations.

Action 4.4: The GLC will consider threatened species, populations and ecological communities in their habitat in the preparation and implementation of Plans of Management for Council owned and managed land and reserves. Specific emphasis would include the management

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of resources for the Hawks Nest Tea Gardens Koala population on Council owned and managed lands.

Action 4.5: The NPWS will consider threatened species, populations and ecological communities and their habitat in the preparation and implementation of Plans of Management for Myall Lakes National Park, including Yacaada Head.

The actions within this objective refer to the appropriate zoning of suitable Koala habitat within the local area. The majority of the site is zoned 2(f) Mixed Residential/Commercial. This area is proposed for the development. The conservation zoned areas (7a Wetlands and 7b Buffer) will be retained as part of the proposal. Other actions refer to bushfire management and Council and NPWS managed lands.

Objective 5: To rehabilitate and restore Koala habitat in the Hawks Nest and Tea Gardens area

Action 5.1: The KWG will provide advice on appropriate habitat rehabilitation and restoration activities at priority sites identified through Action 2.1 to individuals, community groups and government agencies. The NPWS will support rehabilitation efforts where resources are available.

The actions within this objective refer to the Koala Working Group providing advice on appropriate rehabilitation and restoration activities of at priority sites identified through Koala habitat mapping. The proposal is not inconsistent with this objective and action. The proposal includes the protection and restoration of retained areas containing Koala habitat.

Objective 6: To ensure the broader community has access to information about the distribution, conservation and management of Koalas

Action 6.1: A database will be established by the KWG to maintain records of Koalas in the Hawks Nest and Tea Gardens area.

Action 6.2: The NPWS, in consultation with GLC, will develop and implement a broad scale education and awareness strategy.

The Koala Management Strategy prepared for the site includes information on Community education and Koala welfare programs. The proposal is consistent with this objective and its actions.

Objective 7: To manage sick, injured or orphaned Koalas with a consistent and high standard of care

Action 7.1: The KWG will facilitate information exchange to ensure that wildlife rehabilitation groups in the Hawks Nest and Tea Gardens area remain informed about the Koala recovery process and advances in Koala care and rehabilitation.

Action 7.2: The KWG will liaise with local wildlife rehabilitation groups to identify appropriate locations for the release of rehabilitated Koalas that cannot be released at point of capture. The KWG will encourage wildlife rehabilitation groups to consult with the NPWS prior to the relocation of rehabilitated Koalas.

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The Koala Management Strategy prepared for the site includes information on Community education and Koala welfare programs. The proposal is consistent with this objective and its actions.

The following matters are addressed as identified in Appendix 3 of the Guidelines for Threatened Species Assessments – Draft (DEC & DPI 2005) in relation to threatened species, endangered populations and endangered ecological communities.

i) Does the Proposal Affect any Threatened Species or Populations at the Limit of their known distribution

No threatened species or endangered ecological communities are at the limit of their known distribution in the locality of the subject site. As such the proposal is not likely to affect any threatened species or endangered ecological communities at the limits of their known distribution.

ii) How is the Proposal likely to affect current disturbance regimes

The site has been historically cleared for grazing and for pine plantations. Large areas of the site have had the understorey and tree cover removed and groundlayer altered as part of grazing use and previous forestry practices. The more highly disturbed areas have been mapped as Open Forest (*Angophora costata/Corymbia gummifera*), Open Forest (*Corymbia gummifera*), Open Forest (*Eucalyptus microcorys*), Open Forest (*Eucalyptus pilularis*), Woodland (*Eucalyptus resinifera*), Woodland/Open Forest (*Eucalyptus robusta*) and Pine Forest (*Pinus ellioti*).

The development footprint will be restricted to the currently disturbed vegetation types. While disturbance will ultimately increase as a result of the removal of vegetation for the construction of the development, the disturbance regime will decrease within those areas to be retained. The retained vegetation will have areas restored and managed in the long term as part of the proposal. These areas include SEPP 14 Wetlands, Conservation zoned lands, Asset Protection Zones and buffers, wildlife corridors and drainage corridors. The proposal includes the restoration of currently disturbed corridor areas within the development.

Edge effects are likely to occur at the interface between the development and retained vegetation. Vegetation management strategies and protocols will be established to control and minimise any potential edge effect as detailed in the Ecological Site Management Strategy. Thee establishment of Asset Protection Zones and buffers will aid in buffering the effects of development upon adjacent retained vegetation.

It is not considered that the proposal will alter fire frequencies within the site. The implementation of best practice erosion and sediment controls during construction and occupation will control impacts associated with runoff to lower lying Swamp Forest, Closed Heath and wetland vegetation communities and habitats associated with the Myall River.

Iii) How is the Proposal likely to affect Habitat Connectivity

The subject site is boarded to the west by the Tea Gardens Road, disturbed grasslands with scattered trees, industrial and residential development; to the south, by predominately existing residential and commercial development; to the east, by the Myall River; and to the north, by a

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mixture of open forest vegetation communities, areas of isolated residential development and agricultural lands.

The majority of the vegetation of the site forms a mosaic of highly disturbed grasslands with scattered trees and woodland/open forest communities. However, the eastern portion of the subject site is dominated by a large remnant of naturally vegetated Swamp Forests, Heaths and Estuarine vegetation communities associated with the low lying areas adjoining the Myall River. This remnant is largely isolated to the south by existing residential development and the Tea Gardens township and to the north by an area of cleared agricultural land.
The land beyond the northern boundary of the subject site is largely dominated by a mixture of open forest vegetation communities and areas of isolated residential development. There exists some marginal connectivity between the sites eastern remnant vegetation and the areas of remnant open forest to the north, via a mosaic of disturbed woodland and open forest vegetation communities occupying the north eastern areas of the site. However these vegetation communities provide only limited terrestrial connectivity as the have been significantly impacted by a history of agricultural use and grazing, resulting in a sparse understorey layer.

The development proposes the retention of the higher quality less disturbed vegetation types within the subject site. These vegetation types are located along the western bank of the Myall River and consist of wetland variant vegetation communities. The retention of these vegetation types will retain any current north-south connectivity through the site.

The proposal also includes key components of wildlife and drainage corridors within and through the development areas. The retention and restoration of these corridors will serve the purpose of providing threatened species habitat and movement of fauna through the site.

The Wildlife Corridors areas have been provided to retain connectivity within the post development landscape and provision of any fauna movement through the area. These consist of a north-west running corridor in the east of the site and an east-west running corridor at the northern boundary of the site. These areas will allow movement through the site to greater areas of habitat to the north, particularly for arboreal and terrestrial fauna species. These areas will also provide a lesser open space/recreational role.

Areas have also been set aside for water/drainage management. These areas will also serve a function in providing landscape linkage and providing habitat for semi-aquatic species within the site, particularly amphibian species. These areas will also provide a lesser open space/recreational role.

The ecological management strategies to be established within the site have been developed to alleviate and ameliorate for any partial fragmentation likely as a result of the proposal.

It is considered that the retained vegetation and habitats are of sufficient size and quality to support the long term viability of threatened species and endangered ecological communities known to occur within the site.

iv) How is the Proposal likely to affect critical habitat

No critical habitat relevant to these endangered ecological communities is declared under the *TSC Act 1995* within the subject site.

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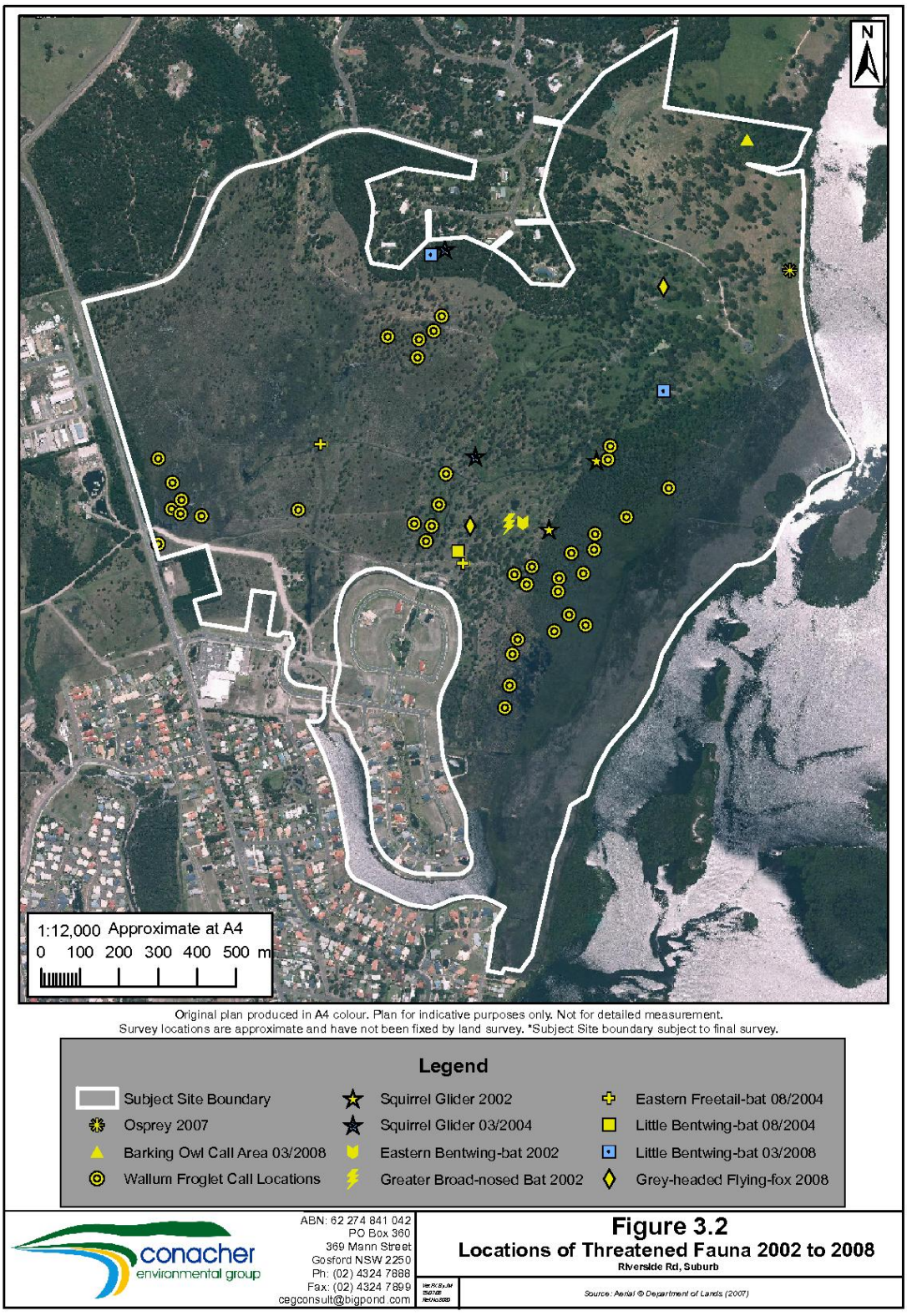
N
1:12,000 Approximate at A4
0 100 200 300 400 500 m
Original plan produced in A4 colour. Plan for indicative purposes only. Not for detailed measurement.
Survey locations are approximate and have not been fixed by land survey. *Subject Site boundary subject to final survey.
Legend
Subject Site Boundary
Osprey 2007
Barking Owl Call Area 03/2008
Wallum Froglet Call Locations
Squirrel Glider 2002
Squirrel Glider 03/2004
Eastern Bentwing-bat 2002
Greater Broad-nosed Bat 2002
Eastern Freetail-bat 08/2004
Little Bentwing-bat 08/2004
Little Bentwing-bat 03/2008
Grey-headed Flying-fox 2008
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Figure 3.2
Locations of Threatened Fauna 2002 to 2008
Riverside Rd, Suburb
Source: Aerial © Department of Lands (2007)

SECTION 4

THREATENED BIODIVERSITY IMPROVE OR MAINTAIN ASSESSMENT

4.1 BACKGROUND

The following threatened flora and fauna species and endangered ecological communities assessment relies on the ecological assessment provided in Sections 2 and 3 of this report and the flora and fauna details provided within Appendices. The assessment has been prepared in accordance with the *DRAFT Guidelines for Threatened Species Assessment* (DEC & DPI 2005) and in accordance with Part 3A of the *Environmental Planning and Assessment Act* (1979).

The proposal has incorporated a range of measures addressing the improvement, maintenance and retention of biodiversity values of the site. A detailed assessment of the proposal in relation to the concept of 'improve or maintain' biodiversity values is provided in within this Report.

A range of components of biodiversity have been assessed in relation to whether the proposal will improve or maintain the relevant biodiversity component. The following biodiversity components have been assessed.

1) Biodiversity outcomes in relation to land use and land conservation;
2) Flora biodiversity components
   - Vegetation Communities;
   - Endangered Ecological Communities.
3) Fauna biodiversity components
   - Threatened Fauna Species habitat;
   - Fauna habitat;
   - Hollow bearing trees.
4) Habitat Linkages/Connectivity
5) Mechanisms to achieve biodiversity outcomes.

The following criteria has been used to assess the potential impacts of the Riverside at Tea Gardens Concept Plan on threatened fauna species and endangered ecological communities recorded within the subject site or considered to have potential to occur within the subject site due to known local occurrence.

- Existing area of vegetation or habitat (ha)
- Area of vegetation or habitat to be removed (ha)
- Area of vegetation or habitat to be retained/restored/offset (ha)

The following information is provided to address the impacts of the proposed development on threatened f fauna species and endangered ecological communities. Assessments have been prepared for those threatened species recorded within the subject site during surveys and those recorded recently within local area studies and considered to utilise habitats within the subject site, at least on an occasional basis, due to the presence of suitable habitat.

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4.2 CONSIDERATION OF IMPROVEMENT OR MAINTENANCE OF BIODIVERSITY VALUES

4.2.1 Background

An assessment of the proposal in relation to improving or maintaining biodiversity values has been identified in the requirements for the Environmental Study.

The improve or maintain approach has been identified in documentation supporting various acts (eg. *Native Vegetation Act, Environmental Planning and Assessment Act* or *Threatened Species Conservation Act*. For example DECC (2007) identify some matters that should be included in improve or maintain assessments for Biodiversity Certification of Environmental Planning Instruments. However at this stage there are no formal or established quantification methods or procedures to measure prospective gains and losses in biodiversity values.

This particular project (Riverside) is not being assessed for biodiversity certification of the environmental planning instrument at this stage. However the completion of the improve or maintain assessment following similar procedures recently implemented for the Wyong Employment Zone Rezoning (Wyong Shire Council 2007) and Warnervale Town Centre Rezoning for the Department of Planning and Department of Environment and Climate Change (Ecological 2008) would be appropriate for this proposal as they are recent examples accepted by DECC and the Department of Planning. These two relevant case studies have identified the following components for inclusion in an 'improve or maintain' assessment:

1. Biodiversity outcomes for the proposal eg. land to be included in reserves, riparian corridors, public recreation areas etc.
2. Flora criteria for assessment:
    - Vegetation Communities;
    - Threatened Flora Species;
    - Endangered Ecological Communities.
3. Fauna criteria for assessment:
    - Fauna habitats types;
    - Threatened Fauna;
    - Habitat Trees.
4. Habitat Linkages/Connectivity;
5. Offset areas (offsite areas);
6. Mechanisms to achieve biodiversity outcomes eg. Ecological Management Plans, Water Cycle Management, Strategy Habitat Enhancement, Vegetation Management.

The biodiversity outcomes incorporated into the proposal are assessed in relation to improve or maintain in the following sections.

4.2.2. Land Use/Conservation Area Outcomes

The site is currently held in private ownership. The future development will be undertaken as a community title development with the undeveloped areas to be retained within the community title. Management of these areas will be undertaken in accordance with the Ecological Site Management Plan which is to be incorporated into the Community Management Statement.

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The areas incorporated into various components of land conservation and site development areas are provided in Table 4.1.

TABLE 4.1 LANDUSE/LAND CONSERVATION – IMPROVE OR MAINTAIN		
LAND USE/CONSERVATION CATEGORY	**AREA INCLUDED IN CATEGORY (HA)**	**% OF TOTAL SITE AREA**
Wetlands Conservation 7(a) Zone	28.4	12.4%
Conservation 7(b) Zone	22.0	9.5%
Corridor (Currently residential zone)	27.3	11.8%
Drainage Corridors	35.1	15.3%
Open Space Areas & Park	10.2	4.5%
Lake Area	7	3.1%
Proposed Development Area	99.3	43.4%
TOTAL SITE AREA	**229ha**	

Biodiversity Outcome: Approximately 77.7 hectares (33.7%) of the site will be retained in conservation areas or areas protected in the wildlife corridor. A further 45.3 hectares (19.8%) of the site will comprise of green space, in the form of drainage corridors and parks, which will supplement the conservation areas.

4.2.3 Flora Criteria for Assessment

Vegetation Communities

The extent of vegetation communities within the site in relation to proposed conservation or removal for development is provided in Table 4.2.

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TABLE 4.2 VEGETATION COMMUNITIES IMPROVE OR MAINTAIN					
Vegetation Community No.	**Biodiversity Component Vegetation Community**	**Existing Area of Vegetation (ha)**	**Area Subject to Development (Removal or Modification) (ha)**	**Area Improve or Maintain (ha)**	**Biodiversity Outcome**
1	Pasture with Scattered Trees	51.4	33.8	17.6	34.2% Maintained
2	Acacia / Melaleuca Regrowth Scrub	2.0	0	2.0	100% Maintained
3	Open Forest (*Corymbia gummifera*)	11.0	11.0	0	0% Maintained
4	Open Forest (*Corymbia maculata, Eucalyptus paniculata*)	7.9	0.1	7.8	98.7% Maintained
5	Open Forest (*Eucalyptus microcorys*)	8.6	2.1	6.5	75.6% Maintained
6	Open Forest (*Eucalyptus pilularis*)	11.5	6.6	4.9	42.6% Maintained
7	Woodland (*Eucalyptus resinifera*)	52.9	49.9	3.0	5.7% Maintained
8○	Woodland / Open Forest (*Eucalyptus robusta*)	37.4	21.0	16.4	43.9% Maintained
9	Woodland (*Eucalyptus signata*)	1.1	1.1	0	0% Maintained
10	Woodland / Open Forest (*Eucalyptus umbra*)	2.6	0.1	2.5	96.2% Maintained
11	Pine Forest (*Pinus eliottii*)	0.3	0.1	0.2	66.7% Maintained
12×	Disturbed Estuarine Vegetation	0.2	0.0	0.2	100% Maintained
13×	Casuarina Forest (*Casuarina glauca*)	1.2	0.0	1.2	100% Maintained
14∇	Mangroves (*Avicennia marina*)	0.3	0.0	0.3	100% Maintained
15∇	Saltmarsh (*Juncus krausii*)	17.2	0.018	17.182	99.8% Maintained
16∇	Rushland (*Baumea juncea*)	7.7	0.0	7.7	100% Maintained

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TABLE 4.2 (Cont.) VEGETATION COMMUNITIES IMPROVE OR MAINTAIN					
Vegetation Community No.	**Biodiversity Component Vegetation Community**	**Existing Area of Vegetation (ha)**	**Area Subject to Development (Removal or Modification) (ha)**	**Area Improve or Maintain (ha)**	**Biodiversity Outcome**
17○	Scrub (*Melaleuca ericifolia*)	9.5	0.01	9.49	99% Maintained
18○	Paperbark Forest (*Melaleuca quinquenervia*)	1.5	0.0	1.5	100% Maintained
TOTAL VEGETATED AREA		**224.3**	**125.828**	**98.472**	**43.9% Maintained**

∇ - denotes vegetation community commensurate with Coastal Saltmarsh EEC
○ - denotes vegetation community commensurate with Swamp Sclerophyll Forest on Coastal Floodplains EEC
✖ - denotes vegetation community commensurate with Swamp Oak Floodplain Forest EEC

Biodiversity Outcome: Components of almost all vegetation communities will be retained throughout the site. The Open Forest (*Corymbia gummifera*) and Woodland (*Eucalyptus signata*) will be completely removed or modified. It must be noted however that modification within each of these communities includes retention within managed parklands or asset protection areas, thus components of each of these communities will be retained in a modified condition.

The vegetation communities with highest biodiversity values, that is those with the least amount of disturbance and higher habitat qualities will be retained and protected within the development area within those area zoned for conservation and within retained corridor and restoration areas.

TABLE 4.3 GROUNDCOVER VEGETATION– IMPROVE OR MAINTAIN					
Biodiversity Component Groundcover	**Habitat Disturbance**	**Total Area (ha)**	**Area Subject to Development (ha)**	**Area Improve or Maintain (ha)**	**Biodiversity Outcome**
Improved Pasture with Scattered Trees	High	107.2	76.6	30.6	28.5% Improved
Regenerating Heath	Moderate	48.7	48.7	0	0% Retained
Intact Native Shrub and groundcover	Low	68.4	0.1	68.3	99.85% Maintained
TOTAL AREA (ha)		**224.3**	**125.4**	**98.4**	**43.9% Maintained/Improved**

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Biodiversity Outcome: The development area will predominately be located in the areas of the site which have been cleared and utilized for timber and agricultural production. Approximately 68.3ha (99.85% of the vegetation with intact native vegetation with low habitat disturbance) will be maintained in Conservation Zones and wildlife corridor. An area of approximately 30.6 hectares (28.5% of the improved pasture areas with scattered trees) will be retained and incorporated into areas subject to habitat and vegetation enhancement to improve the biodiversity value of this disturbed vegetation overall 98.4 hectares (43.9%) of the vegetated areas will be maintained or improved.

Threatened Flora Species

No threatened flora species have been identified within the subject site. There are habitats present within the site for a number of locally occurring threatened flora species which will be incorporated into conservation areas of corridor areas. These areas will generally comprise the vegetation communities with intact shrub and groundlayer stratums which have been identified as being within the low disturbance category.

Biodiversity Outcome:
Retention and protection of potential area for several threatened flora species known to occur locally even though these species have not been identified within the subject site.

Endangered Ecological Communities (Flora)

Three endangered ecological communities are present within the subject site. Their removal or retention within the subject site is detailed within Table 4.4.

TABLE 4.4
ENDANGERED ECOLOGICAL COMMUNITY IMPROVE OR MAINTAIN

Biodiversity Component	Total Area (ha)	Area Subject to Development (Removal or Modification) (ha)	Area Improve or Maintain (ha)	Biodiversity Outcome
Coastal Saltmarsh	25.2	0.018	25.182	99.9% Maintained
Swamp Oak Floodplain Forest	1.4	0	1.4	100% Maintained
Swamp Sclerophyll Forest on Coastal Floodplains	48.4	21	27.4	56.6% Maintained
TOTAL AREA (ha)	**75**	**21.1**	**53.9**	**71.8% Maintained**

Biodiversity Outcome: The proposal will result in the retention, protection and restoration of 71.8% of the areas occupied by these EEC's within the site. Approximately 21 hectares of EEC, Swamp Sclerophyll Forest on Coastal Floodplains and Coastal Saltmarsh will be removed as part of the development area or modified within parklands, asset protection areas or other managed lands.

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4.2.4 Fauna Criteria for Assessment

Fauna Habitat Types

The fauna habitat type is generally based on vegetation communities present with further considerations given to the presence or absence of native ground and shrub layer species, ground cover habitat (logs, dense undergrowth etc) and the presence of hollow bearing trees. Table 4.5 outlines the areas of fauna habitat within the site using vegetation community groups as surrogate values for suitable habitat. Wallum Froglet habitat has been determined from both ground vegetation cover and micro-topography, which influences temporary ponding and inundation within the site.

Threatened Fauna

Eleven threatened fauna species have been observed on the site during the various surveys completed. For the improve or maintain assessment for the threatened fauna species known to occur general habitat types have been grouped according to the major vegetation groups within the site. These are Terrestrial Woodland and Forest Communities, Wetland Fringing Woodland and Forest Communities and Wetland Communities.

Table 4.5 also provides details on the improve or maintain assessment for threatened fauna species.

TABLE 4.5
FAUNA HABITATS AND THREATENED FAUNA – IMPROVE OR MAINTAIN

Threatened Species	Total Area Suitable Habitat	Area Subject to Development (ha)	Area Improve or Maintain (ha)	Biodiversity Outcome
Osprey	1.7	0	1.7	100% retention
Swift Parrot	97.7	56.9	40.8	41.7% retention
Barking Owl	132.1	75.8	56.5	42.7% retention
Powerful Owl	132.1	75.8	56.5	42.7% retention
Masked Owl	132.1	75.8	56.5	42.7% retention
Koala	131.6	75.8	60.8	42.4% retention
Squirrel Glider	92.7	42.0	69.7	54.7% retention
Wallum Froglet	37.2	13.4	23.8	73.6% retention
Eastern Pygmy Possum	91.6	40.9	66.7	55.3% retained
Spotted-tailed Quoll	91.6	40.9	66.7	55.3% retained
Grey-headed Flying-fox/ Common Blossom-bat	186.5	125.7	66.2	32.6% retained
Microchiropteran Bat Species	222.2	125.8	96.2	43.5% retained

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Biodiversity Outcome: The less disturbed vegetation communities (Wetland Fringing Woodland and Forests, Wetlands) with higher habitat values are afforded a higher level of retention and protection. The development will require the removal or modification of higher proportions of threatened species habitats within the more disturbed terrestrial open forest and woodland communities.

The development will result in the retention of 23% of the terrestrial communities, 55% of the wetland fringing communities and 99% of the wetland communities.

Hollow Bearing Trees

Hollow bearing trees will be removed from most areas to be developed unless they can be classified as safe for retention by a qualified arborist. For the improve or maintain assessment hollow bearing trees have been assessed as removed if they occur in proposed development areas.

The total number of hollow bearing trees present is likely to exceed the numbers identified on the site during surveys as not all of the areas to be retained were surveyed in detail for hollow bearing trees due to access problems through the dense vegetation and other access issues.

TABLE 4.6
HOLLOW BEARING TREES– IMPROVE OR MAINTAIN

Biodiversity Component	Hollow Bearing Trees Observed	Hollow Bearing Trees in Development Area	Hollow Bearing Trees in Conservation area	Biodiversity Outcome
Hollow Bearing Trees	90	48	42	46% Retained

Biodiversity Outcome: Approximately 46% of the hollow bearing trees observed are to be retained. Additional trees not yet surveyed are also likely to occur in areas retained. Replacements for the loss of tree hollows should be incorporated into areas of retained trees. As replacement for hollow bearing tree removal nest boxes should be incorporated into the retained trees to offset for the loss of hollow bearing trees (at approximately 3 to 1 replacement ratio). The Ecological Site Management Strategy contains full details of the nest box replacement program.

4.2.5 Endangered Ecological Communities

Vegetation mapping of the subject site identified three endangered ecological communities as occurring within the subject site. These are:

- Coastal Saltmarsh
- Swamp Oak Floodplain Forest
- Swamp Sclerophyll Forest on Coastal Floodplains

Coastal Saltmarsh
This community occurs in the NSW North Coast, Sydney Basin and South East Corner bioregions. This ecological community occurs in the intertidal zone on the shores of estuaries and lagoons along the NSW coast.

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Large areas of this community were observed within the subject site associated with supratidal and tidal flats along the western boundary of the Myall River. Two vegetation communities mapped within the subject site are considered to be representative of the endangered ecological community, Coastal Saltmarsh, these were, Rushland (*Baumea juncea*) and Saltmarsh (*Juncus kraussii*).

TABLE 4.7
ENDANGERED ECOLOGICAL COMMUNITY REMOVAL AND OFFSET DETAILS – COASTAL SALTMARSH

Potential Habitat Type	Current Extent of Suitable Habitat within Vegetation Community (Ha)	Amount to be Retained (Ha)	Amount to be Modified (Ha)	Amount to be Removed (Ha)
Saltmarsh (*Juncus krausii*)	17.2	17.182	0.0182	0.05
Mangroves (*Avicennia marina*)	0.3	0.3	0	0
Rushland (*Baumea juncea*)	7.7	7.7	0	0
TOTAL	**25.2**	**25.182**	**0.0182**	**0.05**

The vegetation assessment has determined that the endangered ecological community Coastal Saltmarsh is present within the subject site, corresponding with the mapped Rushland (*Baumea juncea*), Mangrove (*Avicennia marina*) and Saltmarsh (*Juncus kraussii*) vegetation communities. These communities have been mapped as occupying approximately 25.2 hectares within the subject site, predominantly along the low lying areas and intertidal/estuarine flats associated with the Myall River. Within the region, approximately 2,115 ha of vegetation have been mapped as Coastal Saltmarsh (Great Lakes Shire Council 2003).

Approximately 0.018ha of Coastal Saltmarsh will be removed or modified as part of the proposal to widen the channel outlet of the lake. Approximately 25.1 hectares of Coastal Saltmarsh will be retained and protected as part of the site specific ecological management strategies proposed for the site.

Swamp Oak Floodplain Forest

This ecological community is associated with grey-black clay-loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines. The most dominant canopy species of Swamp Oak Floodplain Forest is *Casuarina glauca.*

This community occurs in a small area of the subject adjacent to the Myall River and has been mapped as Casuarina Forest (*Casuarina glauca*). This vegetation community comprises essentially monospecific stands of *Casuarina glauca*, mostly growing on dredge spoil along the river's edge.

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TABLE 4.8 ENDANGERED ECOLOGICAL COMMUNITY REMOVAL AND OFFSET DETAILS – SWAMP OAK FLOODPLAIN FOREST				
Potential Habitat Type	**Current Extent of Suitable Habitat within Vegetation Community (Ha)**	**Amount to be Retained (Ha)**	**Amount to be Modified (Ha)**	**Amount to be Removed (Ha)**
Disturbed Estuarine Vegetation	0.2	0.2	0.0	0.0
Casuarina Forest (*Casuarina glauca*)	1.2	1.2	0.0	0.0
TOTAL	1.4	1.4	0.0	0.0

The endangered ecological community Swamp Oak Floodplain Forest occupies approximately 1.4 hectares within the subject site. The mapped vegetation community Casuarina Forest (*Casuarina glauca*) is a highly disturbed regrowth variant of this EEC. The development does not propose the removal of any of the community. Approximately 1.4 hectares will be retained and restored as part of site specific vegetation management and offset strategies.

Swamp Sclerophyll Forest on Coastal Floodplains

This ecological community is associated with humic clay loams and sandy loams on waterlogged or periodically inundated 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.*

A number of species that characterise this EEC were observed throughout the study area within the Scrub (*Melaleuca ericifolia*), Paparbark Forest (*Melaleuca quinquinervia*) and Woodland/Open Forest *(Eucalyptus robusta*) vegetation communities. However, the majority of the subject sites underlying geomorphology has been identified as an aeolian deposited sandplain (Murphy 1995, 1997) and has also been mapped as containing the Tea Gardens Soil Landscape (Murphy 1995), which is described as an aeolian deposit. Coastal areas of poorly drained sandplains are geomorphologically distinct from the characteristically fertile alluvial floodplain deposits, uniquely associated with these floodplain EEC's.

Keith and Scott (2005) identified a number of distinct coastal Swamp Forest vegetation communities occupying the NSW coastal lowlands, and found Swamp Sclerophyll Forest on Coastal Sandplains to be floristically distinct from the endangered ecological community, Swamp Sclerophyll Forest on Coastal Floodplains.

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TABLE 4.9 ENDANGERED ECOLOGICAL COMMUNITY REMOVAL AND OFFSET DETAILS – SWAMP SCLEROPHYLL FOREST ON COASTAL FLODDPLAINS				
Potential Habitat Type	**Current Extent of Suitable Habitat within Vegetation Community (Ha)**	**Amount to be Retained (Ha)**	**Amount to be Modified (Ha)**	**Amount to be Removed (Ha)**
Scrub (*Melaleuca ericifolia)*	9.5	9.49	0.0	0.01
Paperbark Forest *(Melaleuca quinquenervia)*	1.5	1.5	0.0	0.0
Woodland / Open Forest (*Eucalyptus robusta)*	37.4	16.4	8.9	12.1
TOTAL	**48.4**	**27.39**	**8.9**	**12.11**

The endangered ecological community Swamp Sclerophyll Forest on Coastal Floodplains occupies approximately 48.4 hectares within the subject site. Approximately 8.9 hectares will be modified and 12.1 hectares removed as part of the proposal. Approximately 27.4 hectares of this EEC will be retained, restored and protected as part of site specific vegetation and habitat management offset strategies.

Based on vegetation surveys, habitat and assessment and occurrence of endangered ecological communities within the local area it is considered that the proposal is unlikely to have an adverse impact on the extent of these ecological communities such that its local occurrence is likely to be placed at risk of extinction.

4.2.6 Habitat Connectivity and Enhancement

The subject site is bordered to the west by the Myall Road, disturbed grasslands with scattered trees, industrial and residential development; to the south, by predominately existing residential and commercial development; to the east, by the Myall River; and to the north, by a mixture of open forest vegetation communities, areas of isolated residential development and agricultural lands.

The majority of the vegetation of the site forms a mosaic of highly disturbed pastureland with scattered trees and woodland/open forest communities. However, the eastern portion of the subject site is dominated by remnants of naturally vegetated Swamp Forests, Heaths and Estuarine vegetation communities associated with the low lying areas adjoining the Myall River. This remnant is separated to the south by existing residential development and the Tea Gardens township and to the north by an area of cleared agricultural land.

The land beyond the northern boundary of the subject site is dominated by a mixture of open forest vegetation communities, areas of isolated rural-residential development and cleared agricultural lands. Some marginal connectivity exists between the sites eastern remnant vegetation and the areas of remnant open forest to the north, via a mosaic of disturbed woodland and open forest vegetation communities occupying the north eastern areas of the site. However these vegetation communities provide only limited terrestrial connectivity as the have been significantly impacted by a history of agricultural use and grazing, resulting in a sparse understorey layer.

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The development proposes the retention of the higher quality less disturbed vegetation types within the subject site. These vegetation types are located along the western bank of the Myall River and consist of wetland and swamp forest vegetation communities. The retention of these vegetation types will retain any current north-south connectivity through the site.

The proposal also includes key components of wildlife and drainage corridors within and through the development areas (Figure 4.1). The retention and restoration of these corridors will enhance connectivity of threatened species habitat through the site.

The corridor areas have been provided to retain connectivity within the post development landscape and provide for fauna movement through the area. These consist of a north-west running corridor in the east of the site and an east-west running corridor at the northern boundary of the site. These areas will allow movement through the site to greater areas of habitat to the north, particularly for arboreal and terrestrial fauna species. These areas will also provide a lesser open space/recreational role.

Areas have also been set aside for water/drainage management. These areas will also serve a function in providing landscape linkage and providing habitat for semi-aquatic species within the site, particularly amphibian species. These areas will also provide a lesser open space/recreational role.

The ecological management strategies to be established within the site have been developed to alleviate and ameliorate for any partial fragmentation likely as a result of the proposal.

It is considered that the retained vegetation and habitats are of sufficient size and quality to support the long term viability of threatened species and endangered ecological communities known to occur within the site.

4.2.7 Aquatic Estuarine Fish Habitat

Additional area of aquatic estuarine fish habitat will be created by the extension of the western core of the lake system in a northward direction. This will increase the area of available aquatic estuarine habitat to be approximately 2 hectares. Additionally some aquatic habitat enhancements to create additional fish refuge and foraging habitat will be implemented in accordance with the recommendations of the Fish Community Survey Report by Harris Research (2007). A summary of the Aquatic Estuarine Habitat improve or maintain assessment is provided in Table 4.10.

TABLE 4.10
AQUATIC ESTUARINE FISH HABITAT – IMPROVE OR MAINTAIN

Biodiversity Component	Area of Habitat	Habitat Removed	Habitat Created
Lake Area	9.7ha	Nil	2 ha
Lake Edge	2000m	Nil	500m

The area of the existing lake system (9.7ha) comprises a shoreline of approximately 2000 metres which is comprised of a mixture of sand spits, vegetated edges and shallow water. A

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total of 15 different fish species have been recorded in the lake since fish surveys commenced in 1998. Eleven species of fish were recorded in the 2007 survey (Harris Research 2007).

The proposed extensions to the lake system will increase the overall area by 2 hectares (21% increase) with an additional 500 metres of shoreline habitat created (25% increase). Habitat improvement in the form of additional submerged refuge habitat areas (submerged logs, rocks or artificial reefs).

4.2.8 Mechanisms to Achieve Biodiversity Outcomes

The following mechanisms are proposed to improve and maintain the biodiversity within the retained vegetation and fauna habitats of the site.

- Strategic design so as to confine development to highly disturbed areas with lower habitat and biodiversity values.
- Retention of those less disturbed areas with higher habitat and biodiversity values.
- Strategic design measures to include protection and restoration of local corridor and other movement areas to facilitate continuity of habitat within the site and the local landscape.
- Preparation and implementation of Environmental Site Management Strategy and Vegetation Management Plans for areas of retained vegetation.
- Preparation and Implementation of integrated water management systems.
- Implementation of habitat enhancement measures as identified in the Environmental Site Management Strategy.

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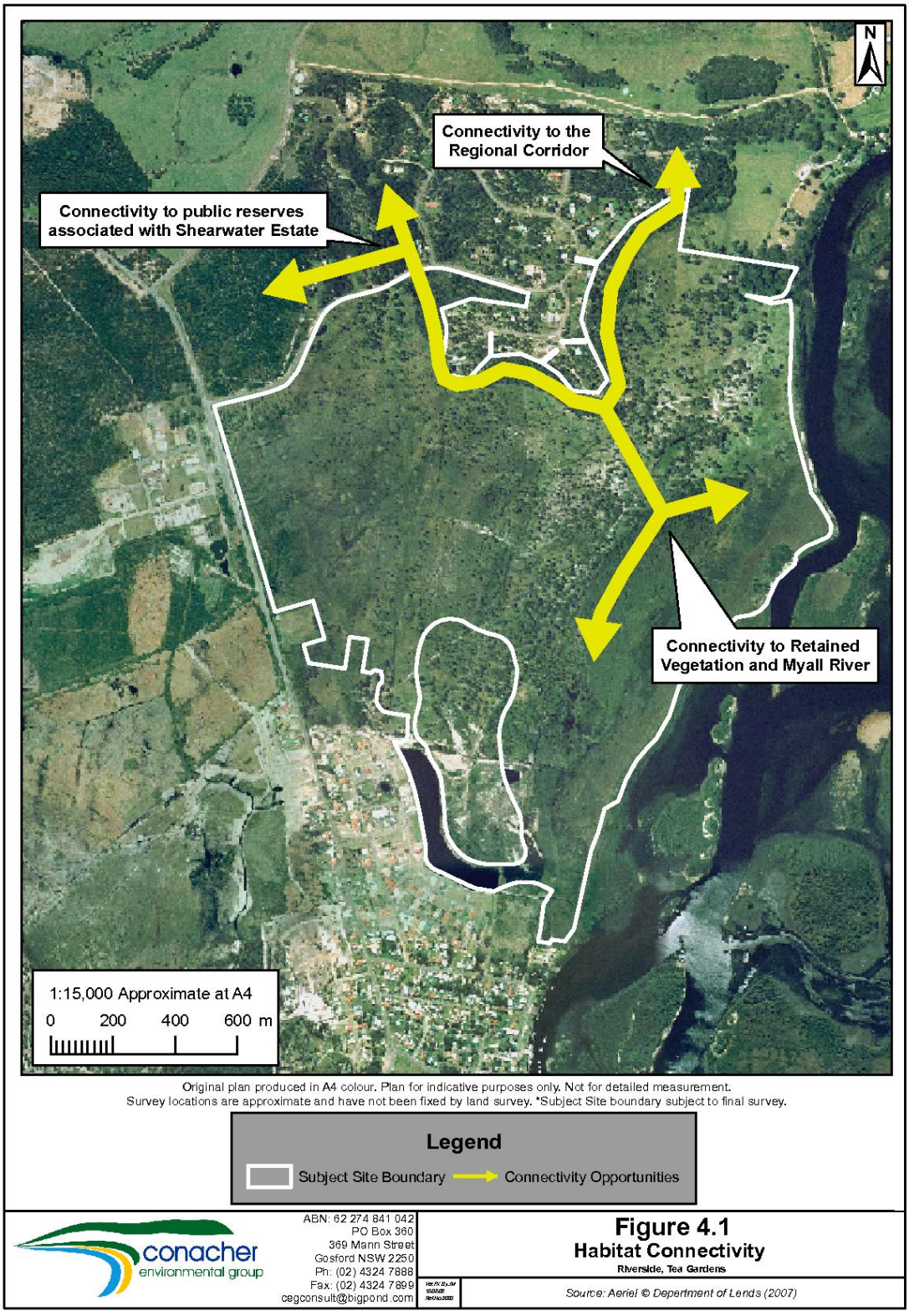
N
Connectivity to the Regional Corridor
Connectivity to public reserves associated with Shearwater Estate
Connectivity to Retained Vegetation and Myall River
1:15,000 Approximate at A4
0 200 400 600 m
Original plan produced in A4 colour. Plan for indicative purposes only. Not for detailed measurement.
Survey locations are approximate and have not been fixed by land survey. *Subject Site boundary subject to final survey.
Legend
Subject Site Boundary
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Figure 4.1
Habitat Connectivity
Riverside, Tea Gardens
Source: Aerial © Department of Lands (2007)

SECTION 5

CONCLUSION

5.1 DOES THE PROPOSAL AFFECT ANY THREATENED SPECIES OR POPULATIONS AT THE LIMIT OF THEIR KNOWN DISTRIBUTION

No threatened species or endangered ecological communities are at the limit of their known distribution in the locality of the subject site. As such the proposal is not likely to affect any threatened species or endangered ecological communities at the limits of their known distribution.

5.2 HOW IS THE PROPOSAL LIKELY TO AFFECT CURRENT DISTURBANCE REGIMES

The site has been historically cleared for grazing and for pine plantations. Large areas of the site have had the understorey and tree cover removed and groundlayer altered as part of grazing use and previous forestry practices. The more highly disturbed areas have been mapped as Open Forest (*Angophora costata/Corymbia gummifera*) (36.9ha), Open Forest (*Corymbia gummifera*) (9.3ha), Open Forest (*Eucalyptus microcorys*) (9.8ha), Open Forest (*Eucalyptus pilularis*) (15.3ha), Woodland (*Eucalyptus resinifera*) (60.9ha), Woodland/Open Forest (*Eucalyptus robusta*) (37.8ha) and Pine Forest (*Pinus ellioti*) (1ha).

The development footprint will be restricted to the currently disturbed vegetation types. While disturbance will ultimately increase as a result of the removal of vegetation for the construction of the development, the disturbance regime will decrease within those areas to be retained. The retained vegetation will have areas restored and managed in the long term as part of the proposal. These areas include SEPP 14 Wetlands, Conservation zoned lands, Asset Protection Zones and buffers, wildlife corridors and drainage corridors. The proposal includes the restoration of currently disturbed corridor areas within the development.

Edge effects are likely to occur at the interface between the development and retained vegetation. Vegetation management strategies and protocols will be established to control and minimise any potential edge effect as detailed in the Ecological Site Management Strategy. Thee establishment of Asset Protection Zones and buffers will aid in buffering the effects of development upon adjacent retained vegetation.

It is not considered that the proposal will alter fire frequencies within the site. The implementation of best practice erosion and sediment controls during construction and occupation will control impacts associated with runoff to lower lying Swamp Forest, Closed Heath and wetland vegetation communities and habitats associated with the Myall River.

5.3 HOW IS THE PROPOSAL LIKELY TO AFFECT HABITAT CONNECTIVITY

The subject site is boarded to the west by the Tea Gardens Road, disturbed grasslands with scattered trees, industrial and residential development; to the south, by predominately existing residential and commercial development; to the east, by the Myall River; and to the north, by a mixture of open forest vegetation communities, areas of isolated residential development and agricultural lands.

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The majority of the vegetation of the site forms a mosaic of highly disturbed grasslands with scattered trees and woodland/open forest communities. However, the eastern portion of the subject site is dominated by a large remnant of naturally vegetated Swamp Forests, Heaths and Estuarine vegetation communities associated with the low lying areas adjoining the Myall River. This remnant is largely isolated to the south by existing residential development and the Tea Gardens township and to the north by an area of cleared agricultural land.

The land beyond the northern boundary of the subject site is largely dominated by a mixture of open forest vegetation communities and areas of isolated residential development. There exists some marginal connectivity between the sites eastern remnant vegetation and the areas of remnant open forest to the north, via a mosaic of disturbed woodland and open forest vegetation communities occupying the north eastern areas of the site. However these vegetation communities provide only limited terrestrial connectivity as the have been significantly impacted by a history of agricultural use and grazing, resulting in a sparse understorey layer.

The development proposes the retention of the higher quality less disturbed vegetation types within the subject site. These vegetation types are located along the western bank of the Myall River and consist of wetland variant vegetation communities. The retention of these vegetation types will retain any current north-south connectivity through the site.

The proposal also includes key components of wildlife and drainage corridors within and through the development areas. The retention and restoration of these corridors will serve the purpose of providing threatened species habitat and movement of fauna through the site.

The Wildlife Corridors areas have been provided to retain connectivity within the post development landscape and provision of any fauna movement through the area. These consist of a north-west running corridor in the east of the site and an east-west running corridor at the northern boundary of the site. These areas will allow movement through the site to greater areas of habitat to the north, particularly for arboreal and terrestrial fauna species. These areas will also provide a lesser open space/recreational role.

Areas have also been set aside for water/drainage management. These areas will also serve a function in providing landscape linkage and providing habitat for semi-aquatic species within the site, particularly amphibian species. These areas will also provide a lesser open space/recreational role.

The ecological management strategies to be established within the site have been developed to alleviate and ameliorate for any partial fragmentation likely as a result of the proposal.

It is considered that the retained vegetation and habitats are of sufficient size and quality to support the long term viability of threatened species and endangered ecological communities known to occur within the site.

5.4 HOW IS THE PROPOSAL LIKELY TO AFFECT CRITICAL HABITATS

No critical habitat relevant to these endangered ecological communities is declared under the *TSC Act 1995* within the subject site.

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5.5 CONCLUDING COMMENTS

Based on the detailed field survey and information provided in this report it is concluded that:

In relation to the *Threatened Species Conservation Act* (1995)

i) No threatened flora species or endangered populations were observed within the subject site.

ii) Eleven threatened fauna species, the Wallum Froglet, Osprey, Barking Owl, Squirrel Glider, Koala, Grey-headed Flying-fox, Common Blossom-bat, Eastern Bentwing-bat, Little Bentwing-bat, Eastern Freetail-bat and Greater Broad-nosed Bat, as listed within the *TSC Act,* were observed within the subject site during surveys. A number of other fauna species including the Black-necked Stork, Powerful Owl, Masked Owl, Eastern Chestnut Mouse, Eastern Pygmy-possum, and Large-footed Myotis have been recorded as part of other studies completed within the Tea Gardens area.

iii) Three endangered ecological communities were observed within the subject site. These are Coastal Saltmarsh, Swamp Sclerophyll Forest on Coastal Floodplains and Swamp Oak Floodplain Forest.

In relation to the Environment Protection and Biodiversity Conservation Act (1999)

i) No threatened flora or fauna species, endangered population or endangered ecological communities were observed within the subject site. It is considered that a referral of this project to the Department of Environment, Water, Heritage and the Arts is not required.

The proposal will require the removal of vegetation and habitats for the construction of residential and commercial facilities and related infrastructure. Based on the concept masterplan the development will require the removal or modification of approximately 125.9 ha of vegetation (including 33.8ha of pasture land). Approximately 98.4ha of vegetation will be retained, protected and restored as part of the site offset and ecological management strategies.

The proposal includes an Ecological Site Management Strategy that details the site specific strategies for minimising and controlling impacts within the site. This includes information on:

- Vegetation and Bushland Management;
- Bushfire Management;
- Fauna and Habitat Management;
- Provision and Establishment of Environmental Corridors;
- Provision of Environmental Buffers;
- Erosion and Sediment Control;
- Stormwater Quality and Management;
- Cultural Values and Management;
- Community Education, Vigilance and Reporting;
- Access, Signage and Fencing;

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- Prohibited Use Identification and Management;
- Feral Pest Species;
- Monitoring and Reporting Regime.

A Koala Management Strategy has also been prepared for the site detailing strategies for the protection and restoration of Koalas and their habitats within the site.

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APPENDIX 1

FLORA AND FAUNA SURVEY REPORT

FLORA AND FAUNA SURVEY REPORT

RIVERSIDE
TEA GARDENS

AUGUST 2008
(REF: 8020)

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FLORA AND FAUNA SURVEY REPORT

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PREFACE

This Flora and Fauna Survey Report has been prepared by *Conacher Environmental Group* to identify the flora and fauna characteristics of the subject site.

This Report provides information regarding existing habitats and the potential for the proposed development to impact on these existing habitats.

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TABLE OF CONTENTS

SECTION 1

BACKGROUND INFORMATION

1.1 INTRODUCTION 1
1.2 THREATENED FLORA SPECIES 1
1.3 THREATENED FAUNA SPECIES 6
1.4 ENDANGERED ECOLOGICAL COMMUNITIES 12
1.5 ENDANGERED POPULATIONS (FLORA) 14
1.6 ENDANGERED POPULATIONS (FAUNA) 14

SECTION 2

SURVEY METHODOLOGY

2.1 THREATENED FLORA AND FAUNA SPECIES 17
2.2 FLORA SURVEY METHODOLOGY 20
2.3 FAUNA SURVEY METHODOLOGY 21

SECTION 3

RESULTS OF FLORA AND FAUNA SURVEY

3.1 FLORA 42
3.2 FAUNA 70

ANNEXURE 1
2008 FLORA SURVEY DATA

SECTION 1

BACKGROUND INFORMATION

1.1 INTRODUCTION

This Flora and Fauna Survey Report has been prepared by *Conacher Environmental Group* to identify the flora and fauna characteristics and to address various ecological matters relating to the proposed development of the property known as Riverside at Tea Gardens..

1.2 THREATENED FLORA SPECIES

A search of the Atlas of NSW Wildlife (NPWS 2008) was undertaken to identify records of threatened flora species located within 10km of the site. In addition to the species listed within the Atlas of NSW Wildlife database, threatened species listed in the botanic gardens records, species identified by NPWS (2008) and local area records have been included for consideration. These species are listed in Table 1.1. This analysis enabled the preparation of a list of threatened flora species that could possibly occur within the habitats found within the subject site, and therefore could be targeted for observation during flora surveys.

TABLE 1.1
RECORDED AND POTENTIAL THREATENED FLORA SPECIES OF THE AREA

BOTANICAL NAME	PREFERRED HABITAT	COMMENTS	TSC ACT	EPBC ACT
Allocasuarina defungens	A straggly shrub to 2m tall. Grows mainly in tall heath on sand, but may also occur on clay and sandstone soils. Occurs in coastal NSW between Nabiac in the south and Byron Bay in the north (NPWS 2002).	No suitable habitat is present. Not observed during floristic survey.	E1	E
Allocasuarina simulans	Dioecious shrub 1-3m. Grows in heath on sand from Nabiac to Forster (Harden 1990).	No suitable habitat is present. Not observed during floristic survey.	V	V
Asperula asthenes	Decumbent perennial herb, trailing to 30cm. Grows in damp sites along river banks from Taree to Bulahdelah.	Sub-optimal habitat is present. Not observed during floristic survey.	V	V
Callistemon linearifolius	Shrub to 4m high. Grows in Sclerophyll Forest in moist gullies on coast and adjacent ranges, Nelson Bay to Georges River.	No suitable habitat is present. Not observed during floristic survey.	V	-
Chamaesyce psammogeton	Prostrate herb. Coastal dunes. Distribution limits N- Tweed Heads S- Jervis Bay.	No suitable habitat is present. Not observed during floristic survey.	E1	-

TABLE 1.1 (Cont.) RECORDED AND POTNTIAL THREATENED FLORA SPECIES OF THE AREA				
BOTANICAL NAME	**PREFERRED HABITAT**	**COMMENTS**	**TSC ACT**	**EPBC ACT**
Cryptostylis hunteriana	Saprophytic terrestrial orchid lacking leaves and with an erect inflorescence to 45cm. Grows in swamp-heath and woodland associated with *Themeda australis* on sandy soils, chiefly in coastal districts from Grafton to Eden. Ku-ring-gai Chase NP (population unknown).	Suitable habitat present. Not observed during floristic survey.	V	V
Cynanchum elegans	Climber or twiner to 1 m. Grows in rainforest gullies, scrub & scree slopes. Distribution limits N – Gloucester S – Wollongong.	No suitable habitat is present. Not observed during floristic survey.	E	E
Dillwynia tenuifolia	Erect shrub 0.6-1 m high. Grows in Woodlands and Open Forest on sandstone shale or laterite. Distribution limits N - Howes Valley S - Cumberland Plain.	No suitable habitat is present. Not observed during floristic survey.	V	V
Diuris arenaria	A tuberous terrestrial orchid with mauve to light purple flowers. Grows in heathy dry sclerophyll forest in association with Themeda australis. From Nelson Bay to Tomago. Flowers Aug – Sept.	No suitable habitat is present. Not observed during floristic survey.	E1	-
Diuris praecox	Terrestrial orchid that grows in open forests of coastal and near coastal districts, from Ourimbah to Nelson Bay. Flowers July to September. Tomaree NP (population unknown), Glenrock SRA (population unknown), Munmorah SRA (population unknown).	No suitable habitat is present. Not observed during floristic survey.	V	V
Eucalyptus glaucina	Tree to 30m growing in grassy woodland on deep, moderately fertile and well-watered soil. Distribution near Casino and from Taree to Broke.	Suitable habitat is present. Not observed during floristic survey.	V	V
Eucalyptus parramattensis ssp. decadens	Tree to 15m, bark smooth grey-pinkish, sheds in large flakes or plates, fruit >7mm dia. Grows in dry sclerophyll woodland on sandy soils in low often wet sites. Tomago to Kurri Kurri.	Suitable habitat is present. Not observed during floristic survey.	V	V

TABLE 1.1 (Cont.) RECORDED AND POTNTIAL THREATENED FLORA SPECIES OF THE AREA				
BOTANICAL NAME	**PREFERRED HABITAT**	**COMMENTS**	**TSC ACT**	**EPBC ACT**
Galium australe	A straggling and inter-twining herb found in moist gullies of tall forest, *Eucalyptus tereticornis* forest, coastal Banksia shrubland and *Allocasuarina nana* heathland. Known from the near Bega, Lake Yarrunga near Kangaroo Valley, Cullendulla Creek Nature Reserve near Batemans Bay, Conjola National Park, Swan Lake near Swanhaven, and the Big Hole in Deua National Park. The species also occurs beside Lake Windemere in the Australian Capital Territory at Jervis Bay. There is also an outlying record to the north from near Byabarra on the north coast.	Suitable habitat is present. Not observed during floristic survey.	E	-
Grevillia guthrieana	Shrub 1.5-2m high. Grows in sandstone-derived loams and granite on creek lines in moist eucalypt forest and cliff lines, restricted to the Booral-Bulahdelah and Carrai Plateau area.	No suitable habitat is present. Not observed during floristic survey.	E	E
Lindernia alsinoides	A small herb. Grows in poorly drained areas and low lying coastal floodplains between Taree and Bulahdelah.	Suitable habitat is present. Not observed during floristic survey.	E	-
Maundia triglochinoides	A perennial rhizomatous herb growing in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Flowers Nov to Jan. Is associated with wetland species. Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct.	Suitable habitat is present. Not observed during floristic survey.	V	-
Melaleuca biconvexa	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.	Suitable habitat is present. Not observed during floristic survey.	V	V

TABLE 1.1 (Cont.) RECORDED AND POTNTIAL THREATENED FLORA SPECIES OF THE AREA				
BOTANICAL NAME	**PREFERRED HABITAT**	**COMMENTS**	**TSC ACT**	**EPBC ACT**
Melaleuca groveana	Shrub or small tree 2-5m tall and rarely 10m tall with fibrous paperbark. Grows in heath often in exposed areas within higher areas and the coastal districts north of Port Stephens.	No suitable habitat is present. Not observed during floristic survey.	V	-
Persicaria elatior	An erect herb to 90cm tall growing in damp places especially beside streams and lakes, and occasionally in swamp forest or associated with disturbance. Found in SE NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests).	Suitable habitat is present. Not observed during floristic survey.	V	V
Pomaderris queenslandica	A medium shrub 2 to 3m high. Grows in moist eucalypt forests and occasionally along creeks. Located from the Upper hunter, Mt Danger, Gloucester, Wingham and Kempsey districts in lower NE NSW.	No suitable habitat is present. Not observed during floristic survey.	E1	-
Prostanthera densa	An erect, often compact shrub 0.5-2m tall. Grows in open forests and shrubland on coastal headlands and near coastal ranges chiefly on sandstone. Found from Nelson Bay to Beecroft Peninsular.	No suitable habitat is present. Not observed during floristic survey.	V	V
Prostanthera marifolia	Low straggling shrub to 1m. Grows in sclerophyll forest and woodland, usually near the coast, in sandy loamy soils, on sandstone; Mangrove Mt. and Sydney districts.	No suitable habitat is present. Not observed during floristic survey.	PE	PE
Rhizanthella slateri	Underground orchid, with flowers maturing below the soil surface or extending 2cm above. Grows in sclerophyll forest in shallow to deep loams. Accurate distribution not known, recorded from the Blue Mts., also Bulahdelah south to Dharug N.P.	Suitable habitat is present. Not observed during floristic survey.	V	

TABLE 1.1 (Cont.) RECORDED AND POTNTIAL THREATENED FLORA SPECIES OF THE AREA				
BOTANICAL NAME	**PREFERRED HABITAT**	**COMMENTS**	**TSC ACT**	**EPBC ACT**
Senna acclinis	A shrub to 3m tall. Grows in or adjacent to subtropical and dry rainforest. Occurs in coastal districts and adjacent tablelands from Bulahdelah in the south to Qld (NPSW 2002).	No suitable habitat is present. Not observed during floristic survey.	E1	-
Syzygium paniculatum	Shrub or small tree to 8m tall with flaky bark. Found in subtropical and littoral rainforests on sandy soils or sheltered gullies, especially near watercourses between Bulahdelah and Jervis Bay. Wamberal Lagoon Nature Reserve (<1,000 plants), Jervis Bay NP (<1,000 plants), Wyrrabalong NP (<1,000 plants).	Suitable habitat is present. Not observed during floristic survey.	V	V
Tetratheca juncea	Prostrate shrub to 1m tall. Stems flattened with reduced leaves. This species has a grass-like appearance. Grows in sandy or swampy soils in heathland, woodlands and open forest from Bulahdelah to Lake Macquarie. Glenrock SRA (>1,000 plants), Awabakal Nature Reserve (<1,000 plants), Munmorah SRA (<1,000 plants), Lake Macquarie SRA Green Point Foreshore Park.	Suitable habitat is present. Not observed during floristic survey.	V	V
Thesium australe	A small herb to 40cm tall. Grows in grassland or grassy eucalypt woodland in association with Themeda australis. Occurs on grassy headlands on the coast, is widespread but uncommon in eastern Australia from Vic. To south-east Qld (NPWS 2002).	Suitable habitat is present. Not observed during floristic survey.	V	V
Tylophora woolsii	Slender twiner, ovate to broad ovate leaves. Grows in wet sclerophyll forest and rainforest in the Clouds Creek area near Nymboida and in sclerophyll forest near Parramatta.	No suitable habitat is present. Not observed during floristic survey.	E	E
Zannichellia palustris	Submerged herb. Fresh or slightly saline stationary or slow-flowing water. Distribution limits N - Tweed Heads S - Newcastle.	No suitable habitat is present. Not observed during floristic survey.	E1	-
Note: No records of *Galium australe*, *Maundia triglochinoides* and *Persicaria elatior* were identified within 10km of the subject site by the DECC Atlas of NSW Wildlife (2008), but have been included in this assessment under the recommendation of the Department of Environment and Climate Change.				

1.3 THREATENED FAUNA SPECIES

A search of the Atlas of NSW Wildlife (NPWS 2008) was undertaken to identify records of threatened fauna located within 10 kilometres of the subject site. This identified a number of threatened species that may be present in the area.

Details on those threatened fauna species recorded as occurring within the local area are provided in Table 1.2. Comments are also provided on the suitability of habitat within the subject site for each of those threatened species, and their presence or absence within the subject site based on the results of recent and past surveys.

TABLE 1.2
RECORDED AND POTENTIAL THREATENED FAUNA OF THE AREA

COMMON NAME *Scientific Name*	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT**	**COMMENTS**
Wallum Froglet *Crinia tinnula*	V	-	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-Tumbi Umbi	Suitable breeding and foraging habitat present. Observed during surveys.
Green Thighed Frog *Litoria brevipalmata*	V	-	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	Suitable breeding and foraging habitat present. Not observed during surveys.
Green and Golden Bell Frog *Litoria aurea*	E	V	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	Suitable breeding and foraging habitat present. Not observed during surveys.
Stephens' Banded Snake *Hoplocephalus stephensii*	V	-	A nocturnal and partly arboreal species that inhabits open and closed forest communities sheltering under bark, in hollows and under exfoliating slabs of granite. Distribution Limit- N-Border Ranges National Park S-Gosford.	Suitable breeding, refuge and foraging habitat present. Not observed during surveys.
Magpie Goose *Anseranas semipalmata*	V	-	A strongly nomadic species found in tropical through to sub-tropical wetlands, flood plains, large swamps, dams and wet grasslands with dense growths of rushes and sedges. Distribution Limit - N-Tweed Heads. S-Mulwala.	Suitable foraging habitat present. Not observed during surveys.
Black Bittern *Ixobrychus flavicollis*	V	-	Freshwater & brackish streams & ponds. Distribution Limit - N-Tweed Heads. S-South of Eden.	No suitable habitat present.
Comb-crested Jacana *Irediparra gallinacea*	V	-	Deep and permanent vegetation-choked tropical and warm temperate wetlands. Distribution Limit - N-Tweed Heads. S - Ku-ring-gai Chase National Park.	No suitable habitat present.

TABLE 1.2 (Cont.) RECORDED AND POTENTIAL THREATENED FAUNA OF THE AREA				
COMMON NAME *Scientific Name*	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT**	**COMMENTS**
Painted Snipe *Rostratula benghalensis*	V	-	Within marshes and freshwater wetlands with swampy vegetation. Distribution Limit- N-Tweed Heads S-South of Eden	Suitable habitat present. Not observed during surveys.
Black-necked Stork *Ephippiorhynchus asiaticus*	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats. Distribution Limit - N-Tweed Heads. S-Nowra.	Suitable foraging habitat present. Not observed during surveys.
Sooty Oystercatcher *Haematopus fuliginosus*	V	-	Exclusively coastal in distribution foraging along rocky coastlines and estuaries. Distribution Limit- N-Tweed Heads S-South of Eden.	Suitable habitat present along Myall River flats. Not observed during surveys.
Pied Oystercatcher *Haematopus longirostris*	V	-	Inhabits coastal beaches and estuarine flats. Distribution Limit N-Tweed Heads S-South of Eden.	Suitable habitat present along Myall River flats. Not observed during surveys.
Little Tern *Sterna albifrons*	E	-	An almost exclusively coastal species inhabiting open beaches, sheltered inlets, estuaries and occasionally lakes. Distribution Limit-N-North of Tweed Heads. S-South of Eden.	Suitable habitat present along Myall River flats. Not observed during surveys.
Osprey Pandion haliaetus	V	-	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	Sub optimal roosting habitat present. Known nesting within local area. Observed during surveys.
Square-tailed Kite *Lophoictinia isura*	V	-	Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. Distribution Limit - N-Goondiwindi. S-South of Eden.	Suitable foraging and roosting habitat present. Not observed during surveys.
Bush Stone-curlew *Burhinus grallarius*	E	-	Utilises open forests, savannah woodlands, dune scrub, savannah and mangrove fringes. Distribution Limit- N-Border Ranges National Park S- Near Nowra	Suitable foraging and roosting habitat present. Not observed during surveys.
Wompoo Fruit Dove *Ptilinopus magnificus*	V	-	Inhabits large undisturbed patches of lowland, adjacent highland rainforest and moist eucalypt forests feeding on fruit. Distribution Limit-N-Tweed Heads. S-Sydney	Suitable habitat present. Not observed during surveys.
Rose-crowned Fruit-dove *Ptilinopus regina*	V	-	Occurs in dense rainforests with a substantial understorey where it feeds entirely on fruit. Distribution Limit - N-Tweed Heads. S-Wollongong.	Suitable habitat present. Not observed during surveys.

TABLE 1.2 (Cont.) RECORDED AND POTENTIAL THREATENED FAUNA OF THE AREA				
COMMON NAME *Scientific Name*	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT**	**COMMENTS**
Superb Fruit-Dove *Ptilinopus superbus*	V	-	Rainforests, adjacent mangroves, eucalypt forests, scrublands with native fruits. Distribution Limit - N-Border Ranges National Park. S-Bateman's Bay	Suitable habitat present. Not observed during surveys.
Glossy Black - Cockatoo *Calyptorhynchus lathami*	V	-	Open forests with *Allocasuarina* species and hollows for nesting. Distribution Limit- N-Tweed Heads. S-South of Eden	Suitable habitat present. Not observed during surveys.
Gang-gang Cockatoo *Callocephalon fimbriatum*	V	-	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	Suitable habitat present. Not observed during surveys.
Swift Parrot Lathamus discolor	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. Distribution Limit - N-Border Ranges National Park. S-South of Eden	Suitable foraging habitat present. Not observed during surveys.
Turquoise Parrot Neophema pulchella	V	-	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	Suitable foraging and roosting habitat present. Not observed during surveys..
Barking Owl *Ninox connivens*	V	-	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	Suitable foraging and roosting habitat present. Observed during surveys.
Powerful Owl *Ninox strenua*	V	-	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. Distribution Limits- N-Border Ranges National Park. S-South of Eden	Suitable foraging and roosting habitat present on site. Observed within adjacent lands at Myall River Downs during surveys. Not observed during surveys.
Masked Owl *Tyto novaehollandiae*	V	-	Open forest and woodlands with cleared areas for hunting. Distribution Limit - N-Border Ranges National Park. S-Eden	Suitable foraging and roosting habitat present. Observed within adjacent lands at Myall River Downs during surveys.

TABLE 1.2 (Cont.) RECORDED AND POTENTIAL THREATENED FAUNA OF THE AREA				
COMMON NAME *Scientific Name*	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT**	**COMMENTS**
Grass Owl *Tyto capensis*	V	-	Inhabits grassland, coastal heath and lignum swamps, sheltering in dense grass tussocks by day. Distribution Limit - N-Tweed Heads. S-Lithgow.	Suitable foraging and sub optimal roosting habitat present. Not observed during surveys.
Sooty Owl Tyto tenebricosa	V	-	Tall, dense, wet forests containing trees with very large hollows. Distribution Limit - N-Border Ranges National Park. S-South of Eden	Suitable foraging and sub optimal roosting habitat present. Not observed during surveys.
Regent Honeyeater Xanthomyza phrygia	E	E	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	Suitable foraging habitat present. Not observed during surveys..
Black-chinned Honeyeater Melithreptus gularis gularis	V	-	Found in woodlands containing box-ironbark associations and River Red Gums, also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence. Distribution Limit. N – Cape York pen. Qld. S – Victor H. Mt Lofty Ra & Flinders Ra. SA	Suitable foraging habitat present. Not observed during surveys..
Brown Treecreeper *Climacteris picumnus victoriae*	V	-	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.	No suitable habitat present. Not observed during surveys.
Barred Cuckoo-shrike *Coracina lineata*	V	-	Inhabits warm temperate to tropical rainforest and their margins, feeding mainly on fruit. Distribution Limit - N-Tweed Heads. S-Manning River.	No suitable habitat present. Not observed during surveys.
Spotted-tailed Quoll *Dasyurus maculatus*	V	V	Dry and moist open forests containing rock caves, hollow logs or trees. Distribution Limit- N-Mt Warning National Park. S-South of Eden.	Suitable habitat present. Not observed during surveys.
Brush-tailed Phascogale *Phascogale tapoatafa*	V	-	A largely arboreal mammal of open forests and woodlands using hollows as nesting in hollow bearing trees. Distribution Limit- N-Border Ranges National Park. S-Eden.	Suitable foraging and shelter habitat present. Not observed during surveys.

TABLE 1.2 (Cont.) RECORDED AND POTENTIAL THREATENED FAUNA OF THE AREA				
COMMON NAME *Scientific Name*	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT**	**COMMENTS**
Common Planigale *Planigale maculata*	V	-	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.	Suitable foraging and shelter habitat present. Not observed during surveys.
Koala *Phascolarctos cinereus*	V	-	Inhabits both wet & dry eucalypt forest on high nutrient soils containing preferred feed trees. Distribution Limit- N-Tweed Heads S-South of Eden.	Suitable foraging and shelter habitat present. Observed during surveys.
Eastern Pygmy-possum *Cercatetus nanus*	V	-	Found in a variety of habitats from rainforest through open forest to heath. Feeds on insects but also gathers pollen from banksias, eucalypts and bottlebrushes. Nests in banksias and myrtaceous shrubs. Distribution Limit – N – Tweed Heads S – Eden.	Suitable foraging and shelter habitat present. Observed within adjacent lands during surveys. Not observed during surveys.
Yellow-bellied Glider *Petaurus australis*	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. Distribution Limit- N-Border Ranges National Park. S-South of Eden.	Suitable foraging and shelter habitat present. Not observed during surveys.
Squirrel Glider *Petaurus norfolcensis*	V	-	Mixed aged stands of eucalypt forest and woodlands including gum barked, high nectar producing species and hollow bearing trees. Distribution Limit - N-Lismore S-Albury	Suitable foraging and den habitat present. Observed during surveys.
Rufous Bettong *Aepyprymnus rufescens*	V	-	Generally found in dry, open woodland dominated by eucalypts preferring a virtual absence of scrub but with dense native grass cover. Distribution Limit - N-Border Ranges National Park. S-Newcastle.	Suitable foraging and shelter habitat present. Not observed during surveys.
Eastern Chestnut Mouse *Pseudomys gracilicaudatus*	V	-	Inhabits heathland including dense wet heath and swampy areas, occasionally in woodland with grassy understorey. Distribution Limit- N-Border Ranges National Park S-Brisbane Water National Park.	Suitable foraging and shelter habitat present. Observed within adjacent lands during surveys. Targeted Survey required.
Long-nosed Potoroo *Potorous tridactylus*	V	V	Coastal heath and dry and wet sclerophyll forests with a dense understorey. Distribution Limit - N-Mt Warning National Park. S-South of Eden.	Suitable habitat present within subject site. Not observed during surveys.

TABLE 1.2 (Cont.) RECORDED AND POTENTIAL THREATENED FAUNA OF THE AREA				
COMMON NAME *Scientific Name*	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT**	**COMMENTS**
Common Blossom-bat *Syconycteris australis*	V	-	Roosts in dense foliage in rainforest and moist hardwood forests and forages for nectar and pollen in coastal forests and heaths. Distribution Limit - N-Tweed Heads. S-Foster	Suitable foraging habitat present within the subject site. Observed during surveys.
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. Distribution Limit – N – Tweed Heads S - Eden	Suitable foraging habitat present. Observed during surveys.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V	-	Rainforests, sclerophyll forests and woodlands. Distribution Limit - N-North of Walgett. S-Sydney	Suitable foraging and roosting habitat present. Not observed during surveys.
Eastern Freetail-bat *Mormopterus norfolkensis*	V	-	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	Suitable foraging and roosting habitat present on site. Observed during surveys.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	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	Suitable foraging and roosting habitat present. Not observed during surveys
Little Bentwing-bat *Miniopterus australis*	V	-	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	Suitable foraging habitat present on site. Observed during surveys.
Eastern Bentwing-bat *Miniopterus schreibersii oceansis*	V	-	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	Suitable foraging habitat present. Observed during surveys..
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V	-	Recorded roosting in caves, old buildings and tree hollows. Distribution Limit- N-Border Ranges National Park S-Pambula	Suitable foraging and roosting habitat present. Not observed during surveys.

TABLE 1.2 (Cont.) RECORDED AND POTENTIAL THREATENED FAUNA OF THE AREA				
COMMON NAME *Scientific Name*	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT**	**COMMENTS**
Large-footed Myotis *Myotis adversus*	V	-	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 Nation Park. S-South of Eden.	Suitable foraging and roosting habitat present. Observed during surveys.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V	-	Inhabits areas containing moist river & creek systems especially tree lined creeks. Distribution Limit- N-Border Ranges National Park. S-Pambula.	Suitable foraging and roosting habitat present. Observed during surveys.
E = Endangered Species V = Vulnerable Species				

1.4 ENDANGERED ECOLOGICAL COMMUNITIES

Descriptions and details on the diagnostic species and habitat requirements of ecological communities known to occur in the Great Lakes Local Government Area are provided below.

TABLE 1.3 ENDANGERED ECOLOGICAL COMMUNITIES WITHIN THE LOCAL AREA		
Name	**Habitat Requirements**	**Comments**
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Geology/soils: Coastal and estuarine sediment. Topography: Intertidal zone on the shores of estuaries and lagoons. Characteristic species: *Baumea juncea*, *Juncus krausii*, *Sarcocornia quinqueflora*, *Sporobolus virginicus*, *Triglochin striata*, *Isolepis nodosa*, *Samolus repens*, *Selliera radicans*, *Suaeda australis* and *Zoysia macrantha*	Present on-site. Characteristic species found. Requires survey and assessment. Corresponds to the following Vegetation Map Units: Winning – 2b and 2c
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Geology/soils: Sand dunes and soils derived from underlying rocks. Topography: Coastal sand dunes, hind dunes and head lands. Characteristic species: Predominantly rainforest species with emergent sclerophyll species such as *Angophora costata*, *Banksia integrifolia*, *Eucalyptus botryoides* and *Eucalyptus tereticornis*.	Not present on-site. Some emergent sclerophyll species present. Rainforest species not present in understorey.

TABLE 1.3 (Cont.) ENDANGERED ECOLOGICAL COMMUNITIES WITHIN THE LOCAL AREA		
Name	**Habitat Requirements**	**Comments**
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	Soils: Fine-grained sedimentary rocks. Topography: Coastal plains and plateaux, footslopes and foothills. Characteristic species: *Ficus* sp., *Argyrodendron trifoliolatum, Castanospermum australe, Dysoxylum muelleri, Archontophoenix cunninghamiana, Livistona australis, Dysoxylum fraserianum, Dendrocnide excels, Doryphora sassafras*, *Daphnandra micranthus, Toona cilliata, Drypetes australasica, Araucaria cunninghamii* and *Flindersia* spp.	Not present on-site. Characteristic species not observed on-site.
Lowland Rainforest on Floodplain in the NSW North Coast Bioregion	Soils: Fertile soils. Topography: Lowland river valleys. Characteristic species: *Ficus macrophylla*, *F. obliqua*, *F. watkinsiana*, *Archontophoenix cunninghamiana*, *Livistona australis*, *Grevillea robusta*, *Castanospermum australe* and *Syzygium australe*.	Not present on-site. Characteristic species not observed on-site.
Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion	Geology/soils: Clay-loams and sandy loams. Topography: Periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Characteristic Species: *Eucalyptus tereticornis, E. siderophloia, Corymbia intermedia, Lophostemon suaveolens, E. robusta, E. resinifera, E acmenoides, Callistemon spp* and *Melaleuca spp.*	Not present on-site. Most characteristic species not observed on-site
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	Geology/soils: Waterlogged or periodically inundated humic clay loams and sandy loams. Topography: Alluvial flats and drainage lines of coastal floodplains. Characteristic Species: *Eucalyptus robusta, Melaleuca quinquenervia* and *eucalyptus botryoides.*	Present on-site. Characteristic species found. Requires survey and assessment. Corresponds to the following Vegetation Map Units: Winning – 3a, 3b, 4a, 4b, 4c and 5a. CEG – 8.
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	Geology/soils: Silts, clay-loams and sandy loams. Topography: Periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Characteristic species: Eucalyptus tereticornis, E. amplifolia, E. botryoides, E. grandis, E. benthamii, Angophora floribunda, A. subvelutina, Melaleuca decora, M. stypheloides, Backhousia myrtifolia, Casuarina cunninghamiana and Casuarina glauca.	Not present on-site. Most characteristic species not observed on-site.

TABLE 1.3 (Cont.) ENDANGERED ECOLOGICAL COMMUNITIES WITHIN THE LOCAL AREA		
Name	**Habitat Requirements**	**Comments**
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions	Geology / Soils: Alluvial soils of fluvial or estuarine origin, with significant salinity. Topography: Flood plains in areas with saline soils and flats adjoining estuaries. Characteristic Species: *Casuarina glauca.*	Present on-site. Characteristic species found. Requires survey and assessment. Corresponds to the following Vegetation Map Units: Winning – 1b
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	Geology / Soils: Silts, muds or humic loams. Topography: in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Characteristic Species: *Carex appressa, Paspalum distichum, Baumea articulata, Phylidrum lanuginosum, Ludwigia peploides ssp. montevidensis and Myriophyllum spp.*	Not present on-site. Characteristic species not observed on-site.

1.5 ENDANGERED POPULATIONS (FLORA)

There are no endangered flora populations within the local government area that require assessment for this proposal.

1.6 ENDANGERED POPULATIONS (FAUNA)

There are two Endangered Populations (Fauna) listed on Schedule 1, Part 2 of the *Threatened Species Conservation Act (1995)* that occur in the local area. These are the Hawks Nest and Tea Gardens Endangered Koala (*Phascolarctos cinereus*) Population and the Emu population in the NSW North Coast Bioregion and Port Stephens Local Government Area.

Emu population in the NSW North Coast Bioregion and Port Stephens Local Government Area
This population is distinct from other populations in the Sydney Basin and New England Tableland Bioregions. The population in the NSW North Coast Bioregion and Port Stephens LGA represents the north-eastern limit of the species in NSW. The majority of recent records are concentrated between Coffs Harbour and Ballina.

There are no records of this species on the Atlas of NSW Wildlife (DECC, 2008) within the local area. It is considered that the subject site contains sub-optimal habitat for the endangered population of Emus. This species was not observed on site or in adjacent areas and has not been observed by any site workers or ecologists. The site is fully fenced by stock exclusion fencing which would exclude emu access to the site.

Hawks Nest and Tea Gardens Population of the Koala

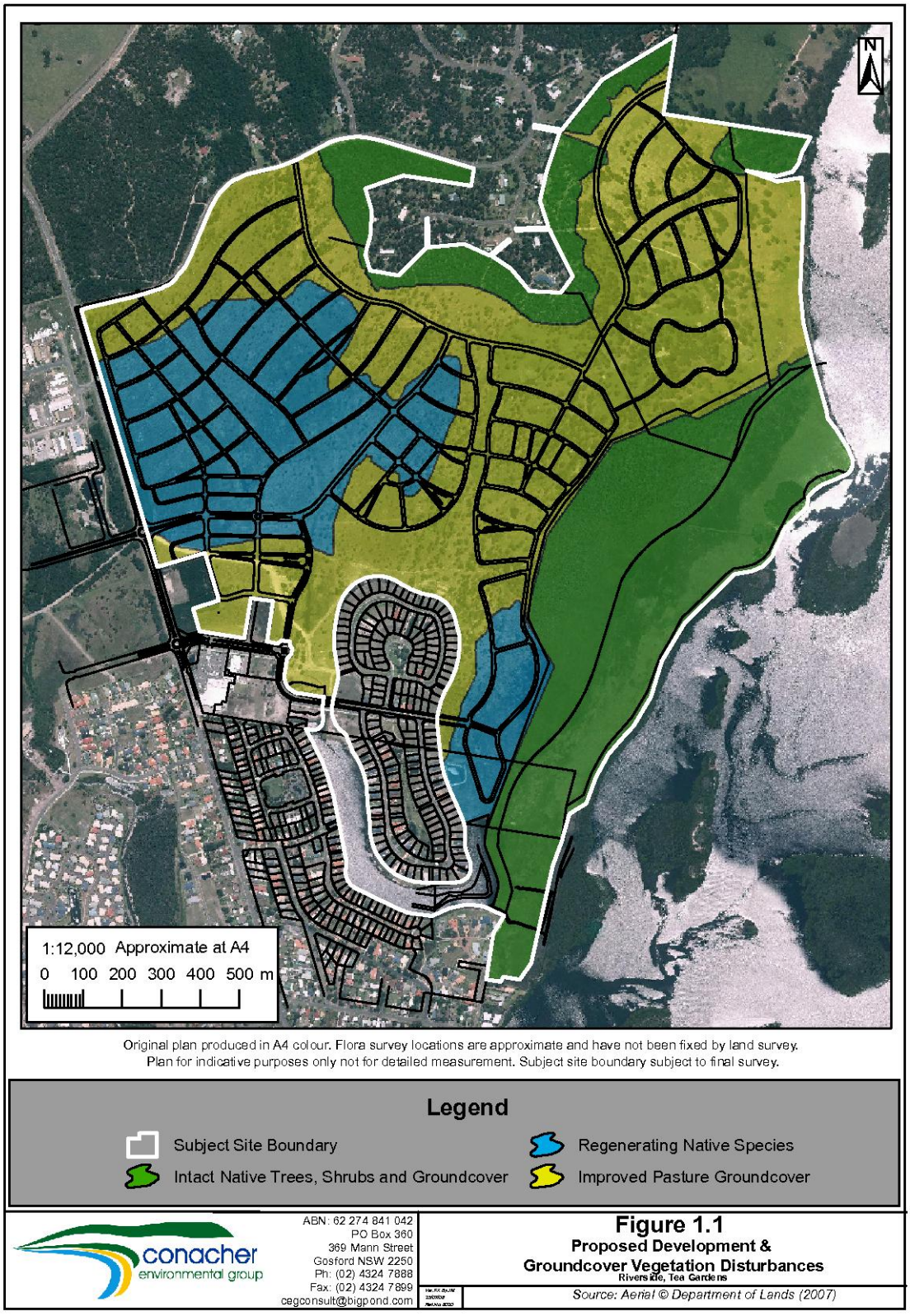
General Description
This population is reliably reported as occurring in Hawks Nest and Tea Gardens and in the immediate vicinity of these towns in the Great Lakes Local Government Area.

Habitat Requirements
Suitable vegetation containing koala Feed Tree species such as *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus punctata* (Grey Gum), *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus microcorys* (Tallowwood), *Eucalyptus haemastoma* (Scribbly Gum), *Eucalyptus signata* (Scribbly Gum), *Eucalyptus viminalis* (Manna Gum), *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus albens* (White Box) and *Eucalyptus populnea* (Bimble Box).

Conservation Status and Distribution
In 1989 the population was thought to contain at least 21 individuals, but by 1998 the population had fallen to about 12 with 2 or 3 in the vicinity of Tea Gardens and the remainder in Hawks Nest and environs (NSW Scientific Committee, Aug 1999). This population of koalas extends in the south-east to the Yaccaba Headland and in the south-west to the peninsula west of Winda Woppa. The population is limited in the west and north-west to the outskirts of the built-up area of Tea Gardens including the Shearwater Estate, where it is bounded by Toonang Drive. The population is limited in the north to an east-west line three kilometres north of the northern boundary of the Hawks Nest Golf Course, although occasional sightings have been made outside these boundaries. The population is bounded in the south and east by the ocean (NSW Scientific Committee, Aug 1999).

Key Threatening Processes
Small population, continuing sub-division and associated clearing of food and habitat trees, road mortality and attacks by dogs.

Occurrence in Subject Site
Habitat requirements and food tree species that characterise habitat for the Hawks Nest and Tea Gardens population of the Koala were located on the subject site and adjacent lands.


N
1:12,000 Approximate at A4
0 100 200 300 400 500 m
Original plan produced in A4 colour. Flora survey locations are approximate and have not been fixed by land survey.
Plan for indicative purposes only not for detailed measurement. Subject site boundary subject to final survey.
Legend
Subject Site Boundary
Intact Native Trees, Shrubs and Groundcover
Regenerating Native Species
Improved Pasture Groundcover
conacher environmental group
ABN: 62 274 841 042
PO Box 360
369 Mann Street
Gosford NSW 2250
Ph: (02) 4324 7888
Fax: (02) 4324 7899
cegconsult@bigpond.com
Figure 1.1
Proposed Development &
Groundcover Vegetation Disturbances
Riverside, Tea Gardens
Source: Aerial © Department of Lands (2007)

SECTION 2

SURVEY METHODOLOGY

2.1 THREATENED FLORA AND FAUNA SPECIES

Following consideration of the threatened biodiversity known to occur locally and the types and suitability of the habitats present on the site a number of threatened flora and fauna species were identified as species requiring targeted survey and assessment, in addition to the general flora and fauna surveys to be completed.

Details of these threatened flora and fauna species and their local occurrences are provided in Table 2.1 and Table 2.2.

TABLE 2.1
THREATENED FLORA SPECIES WITH
SUITABLE HABITAT ON SUBJECT SITE

Species	Local Area Occurrence
Asperula astenes	There are no local records for this species.
Cryptostylis hunteriana	The Atlas of NSW Wildlife (NPWS 2008) has 2 records of this species within 10km of the subject site.
Eucalyptus glaucina	The Atlas of NSW Wildlife (NPWS 2008) has no records of this species within 10km of the subject site.
Eucalyptus parramattensis ssp. Decadens	The Atlas of NSW Wildlife (NPWS 2008) has 5 records of this species within 10km of the subject site.
Galium australe	The Atlas of NSW Wildlife (NPWS 2008) has no records of this species within 10km of the subject site.
Lindernia alsinoides	The Atlas of NSW Wildlife (NPWS 2008) has no records of this species within 10km of the subject site.
Maundia triglochinoides	The Atlas of NSW Wildlife (NPWS 2008) has no records of this species within 10km of the subject site.
Melaleuca biconvexa	The Atlas of NSW Wildlife (NPWS 2008) has no records of this species within 10km of the subject site.
Persicaria elatior	The Atlas of NSW Wildlife (NPWS 2008) has no records of this species within 10km of the subject site.
Rhizanthella slateri	The Atlas of NSW Wildlife (NPWS 2008) has no records of this species within the Port Stephens map sheet.
Syzygium paniculatum	The Atlas of NSW Wildlife (NPWS 2008) has no records of this species within 10km of the subject site. This species is known to occur locally.
Tetratheca juncea	The Atlas of NSW Wildlife (NPWS 2008) has 4 records of this species within 10km of the subject site.
Thesium australe	The Atlas of NSW Wildlife (NPWS 2008) has no records of this species within 10km of the subject site. This species was not observed within the subject site during surveys.

TABLE 2.2 THREATENED FAUNA SPECIES WITH SUITABLE HABITAT ON SUBJECT SITE	
Species	**Local Area Occurrence**
Wallum Froglet *Crinia tinnula*	Observed within subject site during surveys. Observed at other locations within Tea Gardens area. Known from Myall Lakes National Park.
Green Thighed Frog *Litoria brevipalmata*	Not observed during surveys. Not known from local area. Known from Myall Lakes National Park.
Green and Golden Bell Frog *Litoria aurea*	Not observed during surveys. Not known from local area. Known from Myall Lakes National Park.
Stephens' Banded Snake *Hoplocephalus stephensii*	Not observed during surveys. Not known from local area. Known from Myall Lakes National Park.
Magpie Goose *Anseranas semipalmata*	Not observed during surveys. Not known from local area.
Black-necked Stork *Ephippiorhynchus asiaticus*	Not observed during surveys. Small number of local records. Observed at other locations within Tea Gardens area (Myall River Downs). Known from Myall Lakes National Park.
Osprey *Pandion haliaetus*	Observed flying over subject site during surveys. Known local nest site in Tea Gardens. Known from Myall Lakes National Park.
Square-tailed Kite *Lophoictinia isura*	Not observed during surveys. Not known from local area.
Bush Stone-curlew *Burhinus grallarius*	Not observed during surveys. Small number of local records.
Glossy Black - Cockatoo *Calyptorhynchus lathami*	Not observed during surveys. Moderate number of local records. Known from Myall Lakes National Park.
Gang-gang Cockatoo *Callocephalon fimbriatum*	Not observed during surveys. Not known from local area.
Swift Parrot *Lathamus discolor*	Large number of local records. Not observed during surveys. Known from Myall Lakes National Park.
Turquoise Parrot *Neophema pulchella*	Not observed during surveys. Not known from local area. Known from Myall Lakes National Park.
Barking Owl *Ninox connivens*	Observed within subject site during recent surveys. Low number of local records. Known from Myall Lakes National Park.
Powerful Owl *Ninox strenua*	Not observed during surveys. Known from the Tea Gardens area (Myall River Downs). Low number of local records. Known from Myall Lakes National Park.
Masked Owl *Tyto novaehollandiae*	Not observed during surveys. Known from the Tea Gardens area (Myall River Downs). Low number of local records.
Grass Owl Tyto capensis	Not observed during surveys. Not known from local area. Present in Myall Lakes National Park.
Sooty Owl Tyto tenebricosa	Not observed during surveys. Not known from local area. Known from Myall Lakes National Park.
Regent Honeyeater Xanthomyza phrygia	Not observed during surveys. Not known from local area. Known from Myall Lakes National Park.
Black-chinned Honeyeater Melithreptus gularis gularis	Not observed during surveys. Not known from local area.

TABLE 2.2 (Cont.) THREATENED FAUNA SPECIES WITH SUITABLE HABITAT ON SUBJECT SITE	
Species	**Local Area Occurrence**
Brush-tailed Phascogale *Phascogale tapoatafa*	Not observed during surveys. Not known from local area.
Common Planigale *Planigale maculata*	Not observed during surveys. Not known from local area.
Koala *Phascolarctos cinereus*	Observed within the subject site in 1995 (NPWS 2008). Known local population. Present within Myall Lakes National Park.
Eastern Pygmy-possum *Cercatetus nanus*	Not observed during previous surveys. Identified within lands near to subject site (Myall River Downs, Tea Gardens Industrial Estate).
Yellow-bellied Glider *Petaurus australis*	Not observed during previous surveys. Not known from local area.
Squirrel Glider *Petaurus norfolcensis*	Observed within the subject site during surveys. Observed at a number other locations within Tea Gardens. Known from Myall Lakes National Park.
Long-nosed Potoroo Potorous tridactylus	Not observed during surveys. Not known from local area.
Rufous Bettong *Aepyprymnus rufescens*	Not observed during surveys. Not known from local area.
Eastern Chestnut Mouse *Pseudomys gracilicaudatus*	Not observed during surveys. Recorded within local area at Tea Gardens. Known from Myall Lakes National Park.
Common Blossom-bat *Syconycteris australis*	Observed within the subject site during surveys. Low number of local records. Known from Myall Lakes National Park.
Grey-headed Flying-fox *Pteropus poliocephalus*	Observed during surveys. Large number of local records. Known from Myall Lakes National Park.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	Not observed during surveys. Not known from local area.
Eastern Freetail-bat *Mormopterus norfolkensis*	Observed within subject site during surveys. Low number of local records. Known from Tea Gardens area.
Large-eared Pied Bat *Chalinolobus dwyeri*	Not observed during surveys. Low number of local records.
Little Bentwing-bat *Miniopterus australis*	Observed within the subject site during surveys. Large number of local records. Known from Myall Lakes National Park.
Eastern Bentwing-bat *Miniopterus schreibersii oceansis*	Observed within the subject site during surveys. Observed at a number of other locations within Tea Gardens. Known from Myall Lakes National Park.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	Not observed during surveys. Not known from local area.

TABLE 2.2 (Cont.) THREATENED FAUNA SPECIES WITH SUITABLE HABITAT ON SUBJECT SITE	
Species	**Local Area Occurrence**
Large-footed Myotis *Myotis adversus*	Observed within the subject site during surveys. Observed at a number other locations within Tea Gardens. Known from Myall Lakes National Park.
Greater Broad-nosed Bat *Scoteanax rueppellii*	Observed within the subject site during surveys. Low number of local records.

2.2 FLORA SURVEY METHODOLOGY

The methods utilised for the flora survey are detailed below.

Literature Review

- A review of available literature for the area was undertaken to obtain reference material and background information for this study. These documents are listed in the References section of this Report.

- A search of the Atlas of NSW Wildlife (NPWS 2008) was undertaken to identify records of threatened flora species located within 10km of the site. This provided a list of threatened flora species listed on Schedule 1 (Endangered) and Schedule 2 (Vulnerable) of the *Threatened Species Conservation Act* 1995 that occur within the local area.

Aerial Photograph Interpretation

- Aerial photographs at 1:25000 scale were utilised to map the extent of vegetation on the site and in surrounding areas.

Previous Flora Surveys

- The subject site, or portions of it, have previously been surveyed by a number of different consultants over the past 15 years, including, Lembit (1992), Shortland Shortland Wetlands Centre (1988), Hunter Wetlands Research & Management (1997) and *Conacher Travers* (2002, 2007). The cumulative flora species list for these surveys is provided in Table 3.1.

Detailed Field Survey

- Field surveys consisting of foot traverses within vegetated areas were conducted according to Cropper (1993). These surveys were used to identify the occurrence of flora species, identify the extent and location of vegetation communities present across the subject site, and conduct targeted seasonal surveys for threatened species.

- More detailed field surveys were undertaken in accordance with the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004 (DEC 2004). The subject site was initially divided into five stratification units based on vegetation structure and floristic diversity. These units were further separated into vegetation communities based on dominant canopy species. Transects and quadrats were undertaken within these stratification units in accordance with DEC 2004 draft guidelines. Figure 2.1 shows locations of these quadrats and transects. Results of these surveys are shown in the Appendices.

- The boundaries of the vegetation communities (dominant canopy trees) were mapped using a hand held GPS Unit (GeoExplorer 2005 series) to provide specific

mapping lines for vegetation survey. The location of the vegetation survey quadrats were also mapped by this GPS Unit.

- Specimens of plants not readily discernible in the field were collected for identification. Determination of species composition as well as structural descriptions of the vegetation on the site according to Specht *et. al.* (1995) were also carried out.

- The flora survey dates and survey effort details are provided in Table 2.3.

TABLE 2.3
FLORA SURVEY EFFORT

Date	Survey Type
31 August 2005	Cryptic flora searches,
1 September 2005	Cryptic flora searches,
12 January 2007	Cryptic flora searches, Vegetation community mapping
5 February 2007	Cryptic flora searches, Vegetation community mapping
10 March 2007	Cryptic flora searches, Vegetation community mapping
19 March 2007	Cryptic flora searches, Vegetation community mapping, Rapid canopy quadrats
17 July 2007	Cryptic flora searches,
15 August 2007	Cryptic flora searches, Vegetation community mapping
6 September 2007	Cryptic flora searches, Vegetation community mapping
7 September 2007	Cryptic flora searches, Vegetation community mapping
22 January 2008	Cryptic flora searches, Koala habitat, Tree identification surveys
12 February 2008	Cryptic flora searches, Koala habitat, Tree identification surveys
13 February 2008	Cryptic flora searches, Koala habitat, Tree identification surveys
14 February 2008	Cryptic flora searches, Quadrats + transects,
10 March 2008	Flora survey - Quadrats + transects, Habitat searches, Cryptic flora searches
11 March 2008	Flora survey - Quadrats + transects, Habitat searches, Cryptic flora searches
12 March 2008	Flora survey - Quadrats + transects, Habitat searches, Cryptic flora searches
13 March 2008	Flora survey - Quadrats + transects, Habitat searches, Cryptic flora searches
14 March 2008	Flora survey - Quadrats + transects, Habitat searches, Cryptic flora searches
7 May 2008	Flora survey - Quadrats + transects, Habitat searches, Cryptic flora searches

2.3 FAUNA SURVEY METHODOLOGY

2.3.1 Background Details

Literature Review:

A review of local resource documents and previous reports, and a search of the Atlas of NSW Wildlife (NPWS 2008) was undertaken to identify records of threatened fauna species within 10km of the subject site. Additional threatened species were included in this assessment following comments received from the Department of Environment and Climate Change.

Site Specific Survey Assessment:

Fauna survey methods used by *Conacher Environmental Group* follow the methods detailed in the Department of Environment and Conservation (DEC 2004). Where necessary, these have been adapted to satisfy local site conditions. Survey methods may also vary dependant upon environmental conditions (eg. number of vegetation communities, level of disturbance). The following weather data is recorded for all surveys:

- Air temperature;
- Moon (where relevant) (eg none, 1/4 moon, 1/2 moon, 3/4 moon, full moon);
- Rain (eg none, light drizzle, heavy drizzle, heavy rain);
- Recent rain events (where relevant);
- Wind Strength eg calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns).

The subject site was classified into five stratification units for fauna survey based on biophysical characteristics. These units are:

A) Northern slopes open forest;
B) Western lowland woodlands;
C) Northern Central lowland open forest;
D) Eastern Swamp Forest;
E) Saltmarsh, *Juncus* and mangrove areas associated with the Myall River estuary.

These stratification units formed the basis for the location of the fauna survey methods used.

Fauna Survey Dates and Weather Conditions

The methods used to survey each fauna group (eg. birds, mammals, reptiles and amphibians) are detailed below. Fauna survey details showing dates, times and weather conditions are provided in Table 2.4 with survey locations shown in Figure 2.2.

TABLE 2.4 FAUNA SURVEY DATES & WEATHER CONDITIONS					
Date **Time (hrs)**	**Cloud (8th)**	**Temp (°C)**	**Wind**	**Rain**	**Comments**
19/03/07					
0900	4/8	18	calm	nil	
06/09/07					
0900	4/8	22	calm	nil	light overnight rain
1500	6/8	15	calm	nil	
1900	4/8	18	calm	nil	
07/09/07					
0900	3/8	19	light breeze	nil	Showers
1500	6/8	16	light breeze		
1900	8/8	15	calm		
22/01/08					
0900	6/8	19	light	nil	Overnight shower
1500	2/8	22	Moderate		
1900	6/8	20	Calm		Moon - Full
12/02/08					
0900	8/8	18	Nil	light	
1500	8/8	18	Nil	light	
1900	8/8	17	Nil	light	Moon – 1st ¼
13/02/08					
0900	6/8	18	light	nil	
1500	8/8	22	Mod breeze		
1900	8/8	18	light- mod	light	
14/02/08					
0900	8/8	19	light	nil	
1500	8/8	19	light	nil	
1900	8/8 - 2/8	17	light	nil	
10/03/08					
0900	1/8	20	Light		
1500	0/8	24	light	nil	
1900	0/8	17	light	nil	
11/03/08					
0900	0/8	24	light	nil	
1500	0/8	24	light	nil	
1900	0/8	17	light	nil	
12/03/08					
0900	0/8	24	moderate	nil	
1500	0/8	24	moderate	nil	
1900	0/8	17	light	nil	
13/03/08					
0900	0/8	25	nil	nil	
1500	0/8	25	nil	nil	
1900	0/8	20	nil	nil	Moon – 1st ¼

TABLE 2.4 (Cont.) FAUNA SURVEY DATES & WEATHER CONDITIONS					
Date **Time (hrs)**	**Cloud (8th)**	**Temp (°C)**	**Wind**	**Rain**	**Comments**
14/03/08					
0900	4/8	25	light	nil	
1500	-	-	-	-	
1900	-	-	-	-	
31/03/08					
0900	1/8	20	light	nil	
1500	0/8	23	light	nil	
1900	2/8	18	light	nil	Moon – 1st ¼
01/04/08					
0900	0/8	15	light	nil	
1500	0/8	23	strong	nil	
1900	3/8	20	calm	nil	
02/04/08					
0900	2/8	17	light	nil	
1500	1/8	22	light	nil	
1900	4/8	20	calm	nil	
03/04/08					
0900	3/8	22	calm	nil	
1500	2/8	19	calm	nil	
1900	0/8	19	light	nil	
04/04/08					
0900	1/8	18	light	nil	
1500	1/8	20	light	nil	
1900					

2.3.2 Bird Survey Methods

The survey methods for diurnal and nocturnal birds is outlined below while the survey details are provided in Tables 2.5 and 2.6.

Diurnal Bird Survey

Seasonal diurnal bird surveys were conducted to allow detection of migratory and nomadic species, resident species and seasonal forages.

The following survey methodologies were applied:

Bird Census

- The bird census involved traversing the subject site for 1-2 hours and recording all observed birds. The census was undertaken during periods of peak bird activity (6am-9am and 3pm-6pm or later depending on season). Threatened bird species were targeted during each census by ensuring traverses passed through potential habitat for these species. Birds were observed and identified using binoculars. Calls were identified in the field by the observer. Unknown calls were recorded and identified post-survey using references recordings.

Opportunistic Survey

- Opportunistic bird observations were made during all survey work including koala habitat searches, hollow bearing tree assessment and checking of traplines. Signs of birds such as feeding stations are also recorded.

Habitat Searches

- Habitat searches were completed to detect signs of bird activity such as nesting, tree hollow use or feeding (eg. *Allocasuarina* cones with characteristic chew marks, owl pellets, owl whitewash etc).

TABLE 2.5
FAUNA SURVEY DETAILS
DIURNAL BIRDS

Date	Survey Method	Survey Effort/Time
25/02/04	Bird census, Opportunistic observation	2hr 1600- 1800
26/02/04	Bird census, Opportunistic observation	2hr 1600- 1800
02/03/04	Bird census, Opportunistic observation	3hr 1400- 1500
03/03/04	Bird census, Opportunistic observation	2hr 0700- 0900
04/03/04	Bird census, Opportunistic observation	2hr 0700- 0900
05/03/04	Bird census, Opportunistic observation	2hr 0700- 0900
03/08/04	Bird census, Opportunistic observation	4 hrs 1200-1600
04/08/04	Bird census, Opportunistic observation	1 hr 30 mins 0800-0930
04/08/04	Bird census, Opportunistic observation	1 hr 1500-1600
05/08/04	Bird census, Opportunistic observation	1 hr 1500-1600
06/08/04	Bird census, Opportunistic observation	3 hrs 0700-1000
01/09/05	Opportunistic observation x 2 people	6hrs 0730 – 1030
01/09/05	Opportunistic observation	3hrs 1330 - 1630
19/03/07	Opportunistic observation	4hrs 1000 - 1400
17/07/07	Winter bird survey	4hrs 1000 - 1400
15/08/07	Winter bird survey	5hrs 1000 - 1500
06/09/07	Opportunistic observation	2hrs 1200 – 1400
07/09/07	Opportunistic observation	2hrs 0800 – 1000
22/01/08	Opportunistic observation	6hrs 0930-1530
12/02/08	Opportunistic observation	7hrs 1100 – 1800
13/02/08	Opportunistic observation	2.5hrs 0730 – 1000
14/02/08	Opportunistic observation	6.5hrs 0830 – 1500
10/03/08	Opportunistic observation x 3	9hrs 1500-1800
11/03/08	Opportunistic observation	8hrs 0800-1200 + 1400-1800
12/03/08	Opportunistic observation	8hrs 30min 0730-1200 + 1400-1800
13/03/08	Opportunistic observation	6hrs 30min 0730-1100 + 1400-1700
14/03/08	Opportunistic observation x 2	12hrs 0830-1430
07/05/08	Winter Bird Survey	5hrs 1030 – 1530

Nocturnal Birds Survey

Nocturnal bird surveys were conducted over a range of different seasons. Diurnal searches of the subject site did not identify any obvious roosting or nesting sites for threatened owl species. These sites are normally distinguished by whitewash splattered over lower canopy foliage and ground cover, or by the presence of suitable nesting hollows with regurgitated pellets on the ground below.

The following survey methodologies were applied:

Spotlighting

- Spotlight surveys were conducted in the evening after sunset for two hours. Surveys were carried out by one or more persons using a 55 watt spotlight powered by a 12 volt rechargeable battery. Spotlighting was carried out along existing tracks within woodland or forest with open understorey, around individual trees, and trapping transects (if accessible).

Recorded Call Playback

- Prior to the completion of spotlighting, recorded calls of the Powerful, Barking, Masked, Grass and Sooty Owls were broadcast using 13 watt battery operated loudspeaker. Each call type was played for five minutes followed by a two minute listening period. The immediate area was then surveyed with a spotlight to survey for owls.

Stagwatching

- Stagwatch surveys were conducted in the evening for approximately 15 minutes prior to and 45 minutes after sunset. Selected groups of hollow trees identified as habitat potential were observed for use by fauna. Any owls observed leaving hollows are noted and identified.

TABLE 2.6
FAUNA SURVEY DETAILS
NOCTURNAL BIRDS

Date	Survey Method	Survey Effort/Time
25/02/04	Spotlighting + call playback	3hrs 15min 2015-2330
26/02/04	Spotlighting + call playback	2hrs 2015-2215
03/03/04	Spotlighting + call playback	2hrs 15min 1945-2200
04/03/04	Spotlighting + call playback	2hrs 2000-2200
03/08/04	Spotlighting + call playback	2hrs 1800-2000
04/08/04	Spotlighting + call playback	2hrs 1800-2000
05/08/04	Spotlighting + call playback	2hrs 1800-2000
01/09/05	Spotlighting + call playback	2hrs 30mins 1800-2030
06/09/07	Spotlighting + call playback	2hrs 1700-1900
12/02/08	Spotlighting + call playback	1hrs 30mins 2000-2130
14/02/08	Spotlighting + call playback	1hrs 30mins 2000-2030
10/03/08	Spotlighting x 2 + call playback	3 hr 30min 2000-2145
11/03/08	Spotlighting + call playback	1 hr 45min 2000-2145
12/03/08	Spotlighting + call playback	1 hr 45min 1945-2130
13/03/08	Spotlighting x 2 + call playback	3 hr 30min 2000-2145

2.3.3 Mammal Survey Methods

The methods used for mammal surveys are outlined below and detailed in Table 2.7 and Table 2.8.

Arboreal Mammal Survey

The following survey methodologies were applied:

Elliott Trapping

- Arboreal mammal trapping involved the use of Type A and Type B Elliott Traps. Traps were secured with rubber bands onto mounts that were attached to the trunk of large trees (Diameter at Breast Height - DBH > 100mm) at heights of approximately two to three metres.

- Traps were set for a period of three consecutive nights. Traps were baited with a mixture of peanut butter, rolled oats and honey. A 50/50 solution of honey and water was sprayed on the tree trunk, trap and mount to act as an attractant for arboreal mammals. All traps were checked each morning. After their release, captured animals are traced to their den sites if possible.

Spotlighting

- Spotlight surveys were conducted in the evening after sunset for two hours. Surveys were carried out by one or more persons using a 55 watt spotlight powered by a 12 volt rechargeable battery. Spotlighting was carried out along existing tracks and within woodland or forest with open understorey, around individual trees, and trapping transects (if accessible).

Hair Tubes

- Hair tubes comprising of large (90mm diameter) and small (30mm diameter) PVC stormwater pipe fitted with a PVC plug and cap at one end creating a bait chamber were used. Bait was placed in the chamber between the cap and the plug. The chamber had several holes drilled into it to allow the smell of the bait to permeate from the tube without allowing access into the chamber. Strips of Schafco Advance Tape were placed around the inner surface of the tube opening to catch hairs of fauna visiting the hair tubes.

- For arboreal fauna surveying, the hair tube was attached to the trunk of the tree using nails and rubber bands, at a height of approximately 2 metres. Tubes were attached with the open side facing down to prevent rain affecting the adhesiveness of the tape. Tubes were baited with a mixture of rolled oats, peanut butter and honey, and a 50/50 honey water mix sprayed on the trunk of the tree as an attractant. Hair tubes were left in place for 10 days. Hair samples were sent to Barbara Triggs for analysis.

Stagwatch

- Stagwatch surveys were conducted in the evening for approximately 15 minutes prior to and 45 minutes after sunset during spotlight surveys. Hollow trees identified as habitat potential were observed for use by fauna. Any mammals observed leaving hollows were noted and identified.

TABLE 2.7
FAUNA SURVEY DETAILS
ARBOREAL MAMMALS

Date	Survey Method	Survey Effort/Time
25/02/04	Spotlighting	3hrs 15min 2015-2330
25/2/04-5/3/04	Hair Tubes	400 Tube nights
26/02/04	Spotlighting	2hrs 2015- 2215
02/03/04	Small Mammal Trapping	Table 2.9
03/03/04	Small Mammal Trapping	Table 2.9
03/03/04	Koala scat – spot survey	2hrs 30mins
03/03/04	Spotlighting	2hrs 15min 1945- 2200
04/03/04	Koala scat – spot survey – 3 persons	1000-1400 x 3 persons
04/03/04	Spotlighting	2hrs 2000- 2200
04/03/04	Small Mammal Trapping	Table 2.9
03/08/04	Small Mammal Trapping	Table 2.9
03/08/04	Spotlighting + recorded call playback (koala)	2hrs 1800- 2000
04/08/04	Small Mammal Trapping	Table 2.9
04/08/04	Spotlighting + recorded call playback (koala)	2hrs 1800- 2000
05/08/04	Small Mammal Trapping	Table 2.9
05/08/04	Spotlighting	2hrs 1800- 2000
31/08/05	Small Mammal Trapping	Table 2.9
01/09/05	Small Mammal Trapping	Table 2.9
01/09/05	Spotlighting	2hrs 30mins 1800-2030
19/03/07	Koala survey	8 hrs 1000-1400 x 2
15/08/07	Koala survey	5 hrs 1000-1500
06/09/07	Spotlighting	2hrs 1700-1900
22/01/08	Opportunistic searches	6hrs 0930-1530
12/02/08	Small Mammal Trapping	Table 2.9
12/02/08	Spotlighting	1.5hrs 2000-2130
12/02/08	Call playback	1.5hrs 2000-2130
13/02/08	Small Mammal Trapping	Table 2.9
14/02/08	Small Mammal Trapping	Table 2.9
14/02/08	Spotlighting	1.5hrs 2000-2130
14/02/08	Call playback	1.5hrs 2000-2130
10/03/08	Small Mammal Trapping	Table 2.9
10/03/08	Spotlighting x 2	3 hr 30min 2000 - 2145
10/03/08	Call playback	1 hr 45min 2000 - 2145
11/03/08	Small Mammal Trapping	Table 2.9
11/03/08	Spotlighting	1 hr 45min 2000 - 2145
11/03/08	Call playback	1 hr 45min 2000 - 2145
12/03/08	Small Mammal Trapping	Table 2.9
12/03/08	Spotlighting	1hr 45min 2000 - 2145
12/03/08	Call playback	1 hr 45min 1945 - 2130

TABLE 2.7 (Cont.) FAUNA SURVEY DETAILS ARBOREAL MAMMALS		
Date	**Survey Method**	**Survey Effort/Time**
12/03/08 – 21/03/08	10 Hair Tubes x 3 transects	300 Hair Tube Nights
13/03/08	Small Mammal Trapping	Table 2.9
13/03/08	Spotlighting x2 persons	3 hr 30min 2000 - 2145
13/03/08	Call playback	1 hr 45min 2000-2145
31/03/08	Small mammal trapping	Table 2.9
31/03/08	Spotlighting	2hrs 2015-2215
31/03/08	Call playback	45mins 2000-2045
01/04/08	Small mammal trapping	Table 2.9
01/04/08	Spotlighting	2hrs 2000-2200
01/04/08	Call playback	45mins 1945-2030
02/04/08	Small mammal trapping	Table 2.9
02/04/08	Spotlighting	2hrs 2000-2200
02/04/08	Call playback	45mins 1945-2030
03/04/08	Small mammal trapping	Table 2.9
03/04/08	Spotlighting	2hrs 2000-2200
03/04/08	Call playback	45mins 1945-2030

Terrestrial Mammal Survey

The following survey methodologies were applied for terrestrial mammals.

Diurnal Observations

Daytime observations of any mammals were recorded during any site visits. This method is useful for the larger macropod species and feral species such as dogs, foxes and cats.

Elliott Trapping

- Terrestrial mammal trapping involved the combined use of both Type A and Type B Elliott Traps. Elliott Traps are small folding box traps available in two sizes, Type A (330 x 100 x 100 mm) and Type B (450 x 150 x 150 mm) (Elliott Scientific Co., Victoria).

- Traps were placed on the ground along predefined transects. There are 5-10 traps per transect with transect length generally between 100-200 metres.

- Traps were set for a period of three consecutive nights. Traps were baited with a mixture of peanut butter, rolled oats and honey, and strategically positioned next to animal diggings, burrows, fallen logs, tree trunks and animal runways.

Spotlighting

- Spotlight surveys were conducted in the evening after sunset for two hours. Surveys were carried out by one or two persons using a 55 watt spotlight powered by a 12 volt rechargeable battery. Spotlighting was carried out along existing tracks and within woodland or forest with open understorey, around individual trees, and trapping transects (if accessible).

Hair Tubes

- Hair tubes comprising of large (90mm diameter) and small (30mm diameter) PVC stormwater pipe fitted with a PVC plug and cap at one end creating a bait chamber were used. Bait was placed in the chamber between the cap and the plug. The chamber has several holes drilled into it to allow the smell of the bait to permeate from the tube without allowing access into the chamber. Strips of Schafco Advance Tape were placed around the inner surface of the tube opening to catch hairs of fauna visiting the hair tubes.

- Hair tubes were placed along transects in suitable locations and left in place for 10 days. Tubes were baited either with chicken meat or with a mixture of peanut butter, rolled oats and honey. Hair samples were sent to Barbara Triggs for analysis.

Cage Trapping

- Traps were baited with chicken or rolled oats, peanut butter and honey and placed within transect lines, usually in conjunction with Elliott trapping. Traps were set for a period of three or four continuous nights.

Pitfall Trapping

- Pitfall trapping involved lining an excavated pit with a bucket or a PVC pipe. Pit dimensions were 28cm aperture x 40cm pit depth, or 15cm aperture x 60cm pit depth. Each pit (trap) contained at least 5m of plastic drift fencing, 30cm high either side of each pit. The fencing was secured via pegs so that it remains upright forming an impassable barrier for small fauna. The bottom of each pit was covered with leaf litter to provide shelter for entrapped fauna. A floating object was placed in each pit in case of rainfall inundating the pit.

- Pits were checked each morning and late afternoon, and all entrapped fauna identified and released.

TABLE 2.8
FAUNA SURVEY DETAILS
TERRESTRIAL MAMMALS

Date	Survey Method	Survey effort/Time
12/02/08	Small Mammal Trapping	Table 2.9
12/02/08	Spotlighting	1.5hrs 2000-2130
13/02/08	Small Mammal Trapping	Table 2.9
14/02/08	Small Mammal Trapping	Table 2.9
14/02/08	Spotlighting	1.5hrs 2000-2130
10/03/08	Opportunistic Observation	9hrs 1500-1800
10/03/08	Small Mammal Trapping	Table 2.9
10/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
10/03/08	Spotlighting x 2	3hr 30min 2000 - 2145
11/03/08	Small Mammal Trapping	8hrs 0800-1200 + 1400-1800
11/03/08	Small Mammal Trapping	Table 2.9
11/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
11/03/08	Spotlighting	1hr 45min 2000 - 2145
12/03/08	Small Mammal Trapping	8hrs 30mins 0730-1200 + 1400-1800
12/03/08	Small Mammal Trapping	Table 2.9

TABLE 2.8 (Cont.) FAUNA SURVEY DETAILS TERRESTRIAL MAMMALS		
Date	**Survey Method**	**Survey effort/Time**
12/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
12/03/08	Spotlighting	1hr 45min 1945 - 2130
12/03/08 – 21/03/08	Hair Tubes 10 tubes x 3 transects Opportunistic Observation	300 Hair Tube Nights
13/03/08	Small Mammal Trapping	Table 2.9
13/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
13/03/08	Spotlighting x 2	3hr 30min 2000-2145
31/03/08	Small mammal trapping	Table 2.9
31/03/08	Spotlighting	2hrs 2015-2215
31/03/08	Habitat search	3hrs 0700-1000
01/04/08	Small mammal trapping	Table 2.9
01/04/08	Spotlighting	2hrs 2000-2200
01/04/08	Habitat search	3hrs 0700-1000
02/04/08	Small mammal trapping	Table 2.9
02/04/08	Spotlighting	2hrs 2000-2200
02/04/08	Habitat search	3hrs 0700-1000
03/04/08	Small mammal trapping	Table 2.9
03/04/08	Spotlighting	2hrs 2000-2200
03/04/08	Habitat search	3hrs 0700-1000

TABLE 2.9 SMALL MAMMAL TRAPPING – SURVEY DETAILS									
Area	**Transect**	**Survey Period**	**Nights**	**Arboreal Elliot**			**Terrestrial Elliot Traps**		
				A	**B**	**E**	**A**	**B**	**Cage**
A	1	1	3	2	3	-	2	3	2
	2	1	3	2	3	-	2	3	2
	3	1	3	2	3	-	2	3	2
	4	2	3	2	3	-	2	3	2
B	5	2	3	2	3	-	2	3	2
	6	2	3	2	3	-	2	3	2
	7	2	3	2	3	-	2	3	2
	8	2	3	2	3	-	2	3	2
C	9	1	3	2	3	-	2	3	2
	10	1	3	2	3	-	2	3	2
	11	1	3	2	3	-	2	3	2
	12	2	4	2	3	-	2	3	2
	13	1	3	2	3	-	2	3	2
	14	2	4	2	3	-	2	3	2
	15	2	4	2	3	-	2	3	2
D	16	3	4	2	3	5	2	5	3
	17	3	4	2	3	5	2	5	3

TABLE 2.9 (Cont.) SMALL MAMMAL TRAPPING – SURVEY DETAILS									
Area	**Transect**	**Survey Period**	**Nights**	**Arboreal Elliot**			**Terrestrial Elliot Traps**		
				A	**B**	**E**	**A**	**B**	**Cage**
	18	3	4	2	3	5	2	5	3
E				No Trapping					

Survey Periods/Dates

1 12, 13, 14 February 2008 (3 nights)

2 11, 12, 13, 14 March 2008 (4 nights)

3 31 March 2008, 1, 2, 3 April (4 nights)

Bats

The subject site contains suitable foraging habitat for all locally occurring megachiroptera and microchiroptera bat species. Roosting habitat is present only for those species that roost in tree hollows or under bark. Suitable roosting sites are only available for hollow, under bark or tree roosting bat species. The bat survey details are provided in Table 2.10.

The following survey methodologies were utilized:

Sonar Detection

- The ultrasonic calls of Microchiroptera bats were recorded to audio cassette tapes using an Anabat II echolocation call detector. Recordings were made for a continuous two hour period at dusk/early evening with the Anabat II then being left overnight with call activated recording switch.

- An Anabat II ZCA Interface Module and Anabat 5.2b Software package for an IBM Compatible computer was used to analyse the ultrasonic call patterns recorded during the field survey and to identify those species recorded on site.

Harp Traps

- Harp traps were placed across flyways, eg. across tracks, trails or understorey openings within suitable vegetation types for a minimum of three nights. Harp Traps were checked each morning, and any captured bats identified and released.

Stagwatch

- Stagwatch surveys were conducted in the evening for approximately 15 minutes prior to and 45 minutes after sunset. Hollow trees identified as habitat potential were observed for use by microchiroptera bats. Any bats observed leaving hollows were recorded by Anabat II detectors positioned at the base of the tree.

Spotlighting

- Flying-foxes were surveyed for spotlighting potential food trees and identifying their characteristic social calls.

TABLE 2.10 FAUNA SURVEY DETAILS BATS		
Date	**Survey Method**	**Survey Effort/Time**
25/02/04	Anabat II x 2 + spotlighting	4hrs 1945- 2145
26/02/04	Anabat II x 2 + spotlighting	4hrs 1945- 2145
03/03/04	Anabat II x 2 + spotlighting	4hrs 30min 1945- 2200
04/03/04	Anabat II x 2 + spotlighting	4hrs 30min 1945- 2200
04/04/04	Anabat II x 2 + spotlighting	4hrs 30min 1945- 2200
03/08/04	Anabat II x 2 + spotlighting	4hrs 40 mins 1725-1945
04/08/04	Anabat II x 2 + spotlighting	4hrs 30 mins 1730-1945
05/08/04	Anabat II x 2 + spotlighting	1hr 30mins 1745-1830
01/09/05	Anabat II + spotlighting	2hrs 15mins 1800-2015
06/09/07	Anabat II + spotlighting	2hrs 1700 – 1900
12/02/08	Anabat II + spotlighting	1.45hrs 2000-2130
14/02/08	Anabat II + spotlighting	1.45hrs 2000-2130
10/03/08	Anabat II x 3	Overnight
10/03/08	Spotlighting x 2	3.5hrs 2000 - 2145
10/03/08	Harp Trap x 3	3 harp trap nights
11/03/08	Anabat II x 3	Overnight
11/03/08	Spotlighting	1hr 45mins 2000 - 2145
11/03/08	Harp Trap x 3	3 harp trap nights
12/03/08	Anabat II x 2	Overnight
12/03/08	Spotlighting	1hr 45mins 2000 - 2145
12/03/08	Harp Trap x 3	3 harp trap nights
13/03/08	Anabat II x 2	Overnight
13/03/08	Spotlighting x 2	3.5 hrs 2000-2145
31/03/08	Anabat II x 2 + spotlighting	2hrs 2015-2215
01/04/08	Anabat II x 3 + spotlighting	2hrs 2000-2200
02/04/08	Anabat II x 3 + spotlighting	2hrs 2000-2200
03/04/08	Anabat II x 3 + spotlighting	2hrs 2000-2200

2.3.4 Frog Survey Methods

The survey methods used are outlined below and detailed in Table 2.11.

The following survey methodologies were utilized:

Habitat Search

- Habitat searches involve searching likely niches such as dense undergrowth, around trees, under logs and rocks, and aquatic habitats. Amphibian species observed during habitat searches were noted and the calls of species not observed were recorded onto a personal cassette recorder for later comparison with call reference libraries. Captured individuals were identified on site using field reference texts and released.

Pitfall Trapping

- Pitfall trapping involves lining an excavated pit with a bucket or a PVC pipe. Pit dimensions were 28cm aperture x 40cm pit depth, or 15cm aperture x 60cm pit depth. Each pit (trap) contained at least 5m of drift fencing, 30cm high either side of each pit. The fencing was secured via pegs so that it remains upright forming an impassable barrier for frogs. The bottom of each pit was covered with leaf litter to

provide shelter for entrapped fauna. A floating object was placed in each pit in case of rainfall inundating the pit.

- Pits were checked each morning and late afternoon, and all entrapped fauna identified and released.

Nocturnal Habitat Searches

- Nocturnal watercourse searches based on one hour per 100m of water body edge were conducted using a torch and headlamp of less than 30 watts of power.

- Aquatic freshwater habitats present were sampled for the presence of particular fish species to gather information on any predatory fish species such as *Gambusia holbrooki*. A small dip net was passed through the water body a number of times to sample the fish stock of the aquatic habitat.

Opportunistic Survey

- Opportunistic sightings of any amphibians were also made while undertaking other survey work and during spotlight surveys of the site.

Recorded Frog Call Playback

- Recorded frog call playback was undertaken as part of a targeted survey to record the distribution of the Wallum Froglet.

Call Identification

- Any frogs heard calling were identified in the field or recorded onto cassette for later identification.

TABLE 2.11
FAUNA SURVEY DETAILS
AMPHIBIANS

Date	Survey Method	Survey Effort/Time
25/02/04	Call detection, spotlighting	3hrs 15min 2015-2330
26/02/04	Call detection, spotlighting	2hrs 2015- 2215
03/03/04	Call detection, spotlighting	2hrs 15min 1945- 2200
06/04/04	Recorded call playback survey - Wallum Froglet target survey	5hrs 0945-1245 + 1315-1515
04/04/04	Call detection + spotlighting	2hrs 2000- 2200
05/08/04	Call detection + spotlighting	2hrs 1800- 2000
01/09/05	Call detection + spotlighting	2hrs 30min 1800-2030
06/09/07	Call detection + spotlighting	2hrs 1700-1900
22/01/08	Opportunistic diurnal call detection	6hrs 0930-1530
12/02/08	Opportunistic diurnal call detection	7hrs 1100 – 1800
12/02/08	Call detection + spotlighting	1.5hrs 2000-2130
13/02/08	Opportunistic diurnal call detection	2.5hrs 0730 – 1000
14/02/08	Opportunistic diurnal call detection	6.5hrs 0830 – 1500
14/02/08	Call detection + spotlighting	1.5hrs 2000-2130
10/03/08	Diurnal habitat searches and call detection	3hrs 1500-1800
10/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
10/03/08	Call detection + spotlighting x 2	3hrs 30mins 2000 - 2145
10/03/08	Nocturnal water body search x 2	1hr 1945 - 2015
11/03/08	Diurnal habitat searches and call detection	8hrs 0800-1200 + 1400-1800

TABLE 2.11 (Cont.) FAUNA SURVEY DETAILS AMPHIBIANS		
Date	**Survey Method**	**Survey Effort/Time**
11/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
11/03/08	Nocturnal water body search	30min 1930-2000
11/03/08	Call detection + spotlighting	1hr 45mins 2000 - 2145
12/03/08	Habitat search, Opportunistic survey	4hrs 1400-1800
12/03/08	Spotlighting	1hr 45mins 2000 - 2145
12/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
13/03/08	Habitat search, Opportunistic survey	3hrs 1400-1700
13/03/08	Spotlighting x 2	3hrs30mins 2000-2145

2.3.5 Reptile Survey Methods

Details on surveys for reptiles are provided in Table 2.12 and outlined below.

Habitat Searches

- Habitat searches involved searching likely niches such as dense undergrowth, around trees, under logs and rocks, and aquatic edge habitats. Reptile species observed during habitat searches were noted and if individuals are captured in pitfall traps they are identified on site using field reference texts and released.

Pitfall Trapping

- Pitfall trapping involved lining an excavated pit with a bucket or a PVC pipe. Pit dimensions were 28cm aperture x 40cm pit depth, or 15cm aperture x 60cm pit depth. Each pit (trap) contained at least 5m of plastic drift fencing, 30cm high either side of each pit. The fencing was secured via pegs so that it remains upright forming an impassable barrier for small fauna. The bottom of each pit was covered with leaf litter to provide shelter for entrapped fauna. A floating object was placed in each pit in case of rainfall inundating the pit.

Opportunistic Searches

- Opportunistic sightings of any reptiles also made while undertaking other survey work were recorded.

Spotlighting

Spotlight surveys were conducted in the evening for two hours after sunset to target nocturnal reptile species. Both terrestrial and arboreal habitats were searched during nocturnal searches. Surveys were carried out by one or two persons and involve the use of a 55 watt spotlight powered by a 12 volt rechargeable battery. Spotlighting was carried out along existing tracks within woodland or forest with open understorey, individual trees, and where accessible, trapping transects.

TABLE 2.12 FAUNA SURVEY DETAILS REPTILES		
Date	**Survey Method**	**Survey Effort/Time**
25/02/04	Spotlighting	3hrs 15min 2015-2330
26/02/04	Spotlighting	2hrs 2015- 2215
04/03/04	Habitat search, Opportunistic survey	2hrs 0730-0930
03/08/04	Habitat search, Opportunistic survey	4 hrs 1200-1600
04/08/04	Habitat search,	2hrs 0730- 0930
04/08/04	Habitat search, Opportunistic survey	1 hr 1500-1600
05/08/04	Habitat search, Opportunistic survey	1 hr 1500-1600
06/08/04	Habitat search, Opportunistic survey	3 hrs 0700-1000
01/09/05	Opportunistic observation x 2 people	6hrs 0730 – 1030
01/09/05	Opportunistic observation	3hrs 1330 – 1630
22/01/08	Opportunistic observation	6hrs 0930-1530
12/02/08	Habitat search, Opportunistic survey	7hrs 1100 – 1800
12/02/08	Spotlighting	1.5hrs 2000-2130
13/02/08	Habitat search, Opportunistic survey	2.5hrs 0730 – 1000
14/02/08	Habitat search, Opportunistic survey	6.5hrs 0830 – 1500
14/02/08	Spotlighting	1.5hrs 2000-2130
10/03/08	Habitat search, Opportunistic survey x 3	9hrs 30mins 1450-1800
10/03/08	Spotlighting x 2	3hr 30mins 2000 - 2145
10/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
11/03/08	Habitat search, Opportunistic survey	4hrs 1400-1800
11/03/08	Spotlighting	1hr 45mins 2000 - 2145
11/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
12/03/08	Habitat search, Opportunistic survey	4hrs 1400-1800
12/03/08	Spotlighting	1hr 45mins 2000 - 2145
12/03/08	Pitfall Traps 1line x 4pits & 1line x 5 pits	9 pitfall trap nights
13/03/08	Habitat search, Opportunistic survey	3hrs 1400-1700
13/03/08	Spotlighting x 2	7hrs 2000-2145

2.3.6 Koala Habitat Survey

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

i. A search of the Atlas of NSW Wildlife (NPWS 2008) was undertaken to identify records of koalas located within 10km of the site.
ii. Review of previous flora and fauna surveys and SEPP 44 assessments undertaken across the site and within the local area.
iii. The site was surveyed on foot with species Koala food trees being inspected for signs of Koala usage. Trees were inspected and identified for presence of Koalas, scratch and claw marks on the trunk and scats around the base of each tree.
iv. Koalas were targeted during spotlight and call playback surveys.
v. 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.
vi. The ground below trees was searched for signs of Koala usage on the 3 and 4 March 2004, 19 March 2007, and the 15 August 2007 using the Spot Assessment Technique (Phillips and Callaghan 1995).

For each assessment, 20 trees were inspected for signs of Koala usage, eg. scats at the base of trees or scratches on the trunks.

2.3.7 Hollow Bearing Tree Assessment

Hollow bearing trees were identified across the subject site, trees were assessed recording tree species, diameter at breast height, spread and height and percentage health of the tree, notes on fauna usage were also made. Hollows identified within these trees were graded by aperture size ranging from <10cm to >30cm and divided into trunk or branch hollows, broken trunk, areas where fauna can take refuge such as tree splits and bark splits were also recorded. The location of hollow bearing trees was recorded onto a field GPS unit for recording onto a site plan.

A total of 48 hollow bearing trees were identified within the residential zoned area of the subject site while an estimated 42 hollow bearing or potential hollow bearing trees were observed within the Conservation Zoned land to the east. These 42 trees were not surveyed or assessed in detail due to the difficultly of surveying through the dense undergrowth of the vegetation within this area.

2.3.8 Fish Species Survey

A detailed survey for fish species utilizing the aquatic areas of the constructed lake was undertaken by a joint collaboration between The Ecology Lab Pty Ltd and Harris Research Pty Ltd in April 2007. This survey followed up previous fish surveys of the lake in 1998 and 2002 by the Australian Museum Business Services (AMBS 1998, 2002). The methods used for sampling the fish species was a combination of Seine Netting (seven survey points) and Gill Netting (four sample points) over a 2 day period in April 2007. Full details of the survey methods used are provided in the separate report prepared by Harris Research Pty Ltd (2007).

Original plan produced in A3 colour. Flora survey locations are approximate and have not been fixed by land survey. Plan for indicative purposes only. Not for detailed measurement. *Subject Site boundary subject to final survey.

Legend

- Subject Site Boundary
- 20x20m Vegetation Quadrat (numbered)
- 100m Vegetation Transect (numbered)

1. Pasture with Scattered Trees
2. Acacia / Melealuca Regrowth Scrub
3. Open Forest (*Corymbia gummifera*)
4. Open Forest (*Corymbia maculata, Eucalyptus paniculata*)
5. Open Forest (*Eucalyptus microcorys*)
6. Open Forest (*Eucalyptus pilularis*)
7. Woodland (*Eucalyptus resinifera*)
8. Woodland / Open Forest (*Eucalyptus robusta*)
9. Woodland (*Eucalyptus signata*)
10. Woodland/Open Forest (*Eucalyptus umbra*)
11. Pine Forest (*Pinus eliotii*)
12. Disturbed Estuarine Vegetation
13. Casuarina forest (*Casuarina glauca*)
14. Mangroves (*Avicennia marina*)
15. Saltmarsh (*Juncus kraussii*)
16. Rushland (*Baumea juncea*)
17. Scrub (*Melaleuca ericifolia*)
18. Paperbark Forest (*Melaleuca quinquenervia*)

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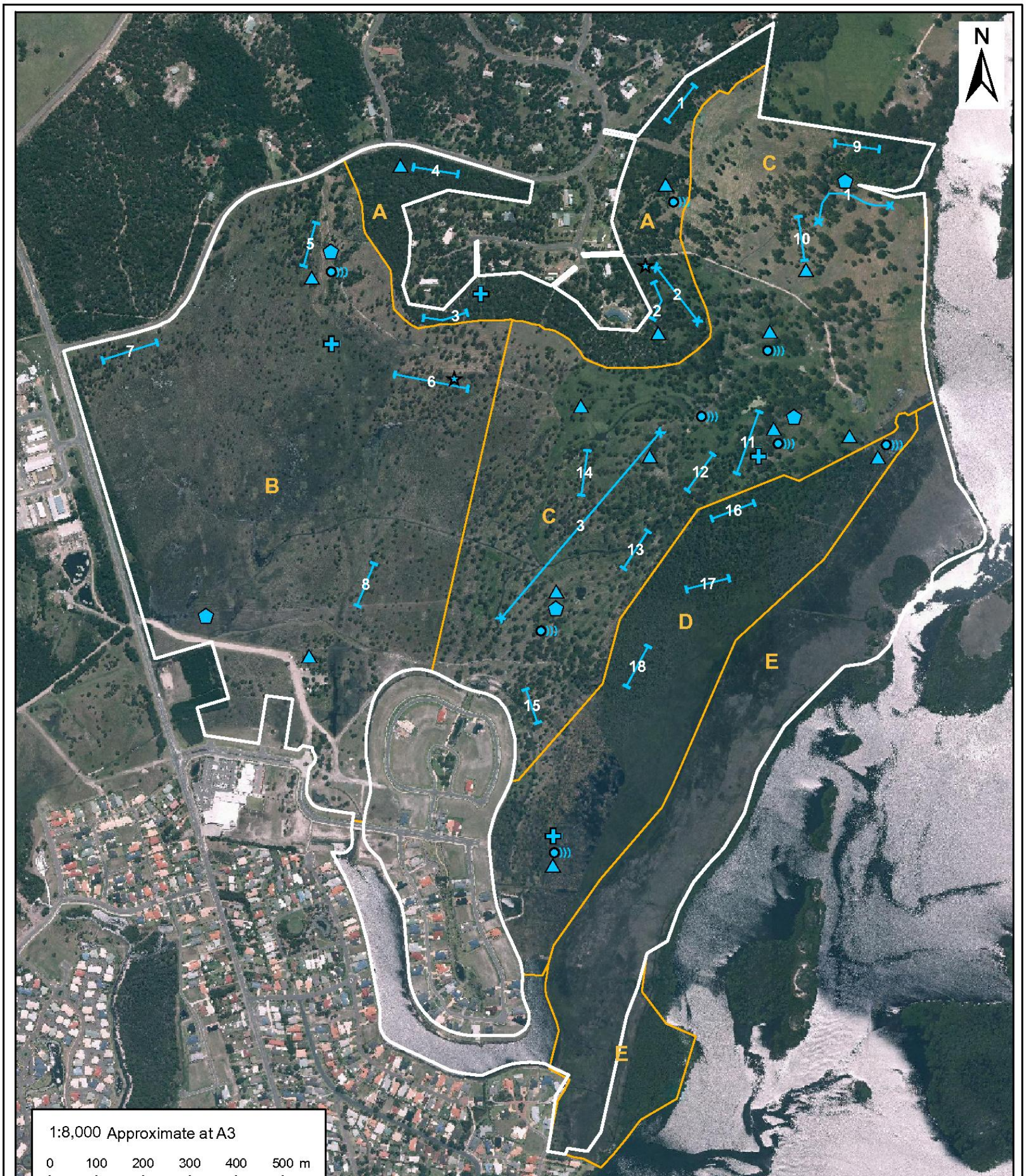
Ver:FX By:JM
25/07/08
Ref.No.8020

Figure 2.1
Vegetation Communities and Flora Survey Locations
Riverside, Tea Gardens

Source: Aerial © Department of Lands (2007)



Original plan produced in A3 colour. Survey locations are approximate and have not been fixed by land survey. Plan for indicative purposes only. Not for detailed measurement. *Subject Site boundary subject to final survey.

Legend

- Subject Site Boundary
- Anabat Station 2008
- Owl Call Playback Station 2008
- Pitfall Trapline 2008
- Harp Trap 2008
- Frog Habitat Search 2008
- Fauna Trapline (1-18) 2008
- Hair Tube Transect (1-3) 2008

Fauna Survey Stratification Areas

- A Northern Slopes Open Forest
- B Western Lowlands Woodland
- C Central-northern Open Forest / Woodland
- D Eastern Swamp Forest
- E Estuarine Wetlands

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Figure 2.2
Fauna Survey Locations 2008
Riverside, Tea Gardens

Ver:FX By:JM 25/07/08 Ref.No.8020

Source: Aerial © Department of Lands (2007)

SECTION 3

RESULTS OF FLORA AND FAUNA SURVEY

3.1 FLORA

3.1.1 Vegetation Communities

The flora species identified on the subject site are listed in Table 3.1. This list is a combination of all flora surveys conducted on the subject site by different botanists over the last 15 years. Because the methods used in the various surveys no specific quadrat based data is available for the pre 2008 surveys. The results of the 2008 transect and quadrat based survey following the DEC Draft Guidelines (DEC 2004) are provided in Annexure 1.

The vegetation communities present on site are:

19. – Pasture with Scattered Trees;
20. – Acacia / Melaleuca Regrowth Scrub;
21. – Open Forest (*Corymbia gummifera*);
22. – Open Forest (*Corymbia maculata, Eucalyptus paniculata*);
23. – Open Forest (*Eucalyptus microcorys*);
24. – Open Forest (*Eucalyptus pilularis*);
25. – Woodland (*Eucalyptus resinifera*);
26. – Woodland / Open Forest (*Eucalyptus robusta*);
27. – Woodland (*Eucalyptus signata*);
28. – Woodland / Open Forest (*Eucalyptus umbra*);
29. – Pine Forest (*Pinus eliottii*);
30. – Disturbed Estuarine Vegetation;
31. – Casuarina Forest (*Casuarina glauca*);
32. – Mangroves (*Avicennia marina*);
33. – Saltmarsh (*Juncus kraussii*);
34. – Rushland (*Baumea juncea*);
35. – Scrub (*Melaleuca ericifolia*);
36. – Paperbark Forest (*Melaleuca quinquenervia*).

Detailed description of each vegetation community is provided below while the distribution of the vegetation communities is provided in Figure 2.1. The vegetation within the site has been classified by community structure and dominant tree species within that community. Due to history of agricultural and plantation pine forestry land uses the natural vegetation of the site has been highly disturbed and modified. The understorey characteristics of the vegetation reflect the past disturbances and current agricultural activities. Areas of grassland/improved pasturelands have been incorporated within the vegetation communities classified after the dominant tree species of that community.

1. Pasture with Scattered Trees

***Structure*:**

Trees: To 20 metres in height, with a highly variable 6-45% Projected Foliage Cover (PFC).

Shrubs: To 3.5 metres in height, with 2-5% PFC.

Groundlayer: To 2 metre in height, with 90% PFC.

Floristics:

(Main Species Present)

Trees: *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Einandra sieberi* (Hard Corkwood), *Eucalyptus microcorys* (Tallowwood) and *Eucalyptus robusta* (Swamp Mahogany).

Shrubs: *Epacris pulchella* (NSW Coral Heath), *Leucopogon lanceolatus*, *Melaleuca nodosa* (Ball Honey Myrtle), *Acacia ulicifolia* (Prickly Moses) and *Leptospermum polygalifolium* (Yellow Tea Tree).

Groundlayer: *Trifolium repens* (White Clover), *Andropogon virginicus* (Whisky Grass), *Pennisetum clandestinum* (Kikuyu), *Pomax umbellata* (Pomax), *Setaria pumila* (Pale Pigeon Grass), *Lomandra longifolia* (Spiky-headed Mat-rush) and *Baloskion tetraphyllum* subsp. *meiostachyum*.

Weeds: *Trifolium repens* (White Clover), *Andropogon virginicus* (Whisky Grass) and *Pennisetum clandestinum* (Kikuyu).

Comments:

This vegetation community occurs scattered throughout the northern and central eastern parts of the site and occupies approximately 36 hectares. It is moderately to highly disturbed by previous activities such as, tree felling, underscrubbing, grazing and incursions of moderate to high levels of exotic weed species. Areas within this vegetation community contain very few trees and one predominantly pasture area

2. Acacia / Melaleuca Regrowth Scrub

***Structure*:**

Trees: To 18 metres in height, with a patchy 10% Projected Foliage Cover (PFC).

Shrubs: To 5 metres in height, with dense 50-70% PFC.

Groundlayer: To 1 metre in height, with 5 to10% PFC.

Floristics:

(Main Species Present)

Trees: *Angophora costata* (Smooth-barked Apple), *Eucalyptus resinifera* (Red Mahogany), *Melaleuca linariifolia* (Snow in Summer) and *Corymbia gummifera* (Red Bloodwood).

Shrubs: *Acacia longifolia* (Sydney Golden Wattle), *Melaleuca sieberi*, *Melaleuca nodosa* (Ball Honey Myrtle) and *Callistemon salignus* (Willow Bottlebrush).

Groundlayer: *Entolasia stricta* (Wiry Panic), *Entolasia marginata* (Bordered Panic), *Epacris pulchella* (NSW Coral Heath), *Hydrocotyle peduncularis, Gahnia sieberiana* (Red-fruited Saw-sedge) and *Gonocarpus teucroides* (Raspwort).

Weeds: *Pennisetum clandestinum* (Kikuyu), *Paspalum spp.*, *Pinus eliottii* (Slash Pine).

Comments:
This vegetation community is located in a small area in the northern part of the site and occupies approximately 2 hectares. This community has been highly disturbed by previous clearing, subsequent regrowth and invasion by exotic species.

3. Open Forest (*Corymbia gummifera*)

***Structure*:**

Trees: To 20 metres in height, with a highly variable 6 - 60% Projected Foliage Cover (PFC).

Shrubs: To 2 metres in height, with 2-6% PFC.

Groundlayer: To 1.6 metres in height, with 95% PFC.

Floristics:
(Main Species Present)

Trees: *Corymbia gummifera* (Red Bloodwood).

Shrubs: *Dodonaea triquetra* (Large-leaved Hop Bush) and *Platysace lanceolata* (Native Parsnip).

Groundlayer: *Andropogon virginicus* (Whisky Grass), *Pteridium esculentum* (Bracken), *Microlaena stipoides* var. *stipoides, Pomax umbellata* (Pomax), *Baloskion tetraphyllum* subsp. *meiostachyum, Selaginella uliginosa* (Swamp Selaginella), *Lepidosperma laterale* (Variable Sword Sedge), *Pratia purpurascens* (Whiteroot) and *Axonopus fissifolius* (Narrow-leaved Carpet Grass).

Weeds: *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush), *Andropogon virginicus* (Whisky Grass) and *Pennisetum clandestinum* (Kikuyu).

Comments:
This vegetation community occurs in the southern parts of the site and occupies approximately 9.28 hectares. It is moderately to highly disturbed by previous activities such as, tree felling, underscrubbing, grazing and incursions of moderate to high levels of exotic weed species, especially in the ground layer.

4. Open Forest (*Corymbia maculata, Eucalyptus paniculata*)

***Structure*:**

Trees: To 25 metres in height, with a 30-60% Projected Foliage Cover (PFC).

Shrubs: To 3.5 metres in height, with 15-50% PFC.

Groundlayer: To 2 metre in height, with 30% PFC.

Floristics:

(Main Species Present)

Trees: *Corymbia maculata* (Spotted Gum), *Eucalyptus paniculata* subsp. *paniculata* (Grey Ironbark), *Eucalyptus propinqua* (Small-fruited Grey Gum), *Eucalyptus resinifera* subsp. *resinifera* (Red Mahogany) and *Eucalyptus umbra* subsp. *umbra* (Broad-leaved White Mahogany).

Shrubs: *Breynia oblongifolia* (Coffee Bush), *Pultenaea blakelyi, Pultenaea paleacea* var. *paleacea, Pultenaea villosa, Acacia ulicifolia* (Prickly Moses), *Leptospermum polygalifolium* (Yellow Tea Tree) and *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush).

Groundlayer: *Entolasia stricta* (Wiry Panic), *Lomandra multiflora* subsp. *multiflora* (Many-flowered Mat-rush), *Pratia purpurascens* (Whiteroot), *Echinopogon ovatus* (Forest Hedgehog Grass), *Imperata cylindrica* (Blady Grass) and *Microlaena stipoides*.

Weeds: *Axonopus fissifolius* (Narrow-leaved Carpet Grass).

Comments:

This vegetation community occurs in the north of the site on the lower to mid slopes and occupies approximately 8 hectares. Disturbances within this community include, selective logging, underscrubbing and low to moderate levels of weed invasion.

5. Open Forest (*Eucalyptus microcorys*)

***Structure*:**

Trees: To 25 metres in height, with a 5-60% Projected Foliage Cover (PFC).

Shrubs: To 3.5 metres in height, with 35-60% PFC.

Groundlayer: To 2 metre in height, with 40% PFC.

Floristics:

(Main Species Present)

Trees: *Eucalyptus microcorys* (Tallowwood), *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus resinifera* subsp. *resinifera* (Red Mahogany).

Shrubs: *Leptospermum polygalifolium* (Yellow Tea Tree), *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle), *Melaleuca sieberi, Dodonaea triquetra* (Hop Bush), *Breynia oblongifolia* (Coffee Bush), *Acacia ulicifolia* (Prickly Moses) and *Callistemon salignus* (Willow Bottlebrush).

Groundlayer: *Entolasia stricta* (Wiry Panic), *Lomandra longifolia* (Spiny-headed Mat-rush) and *Imperata cylindrica* (Blady Grass).

Weeds: *Axonopus fissifolius* (Narrow-leaved Carpet Grass).

Comments:
This community occurs as small patches in the northern parts of the site and occupies approximately 10 hectares. The canopy cover for this community is highly variable. Disturbances include a long history of agricultural use, such as grazing, selective clearing, regular underscrubbing, introduction of pasture improvement species, and construction of drainage works and farm dams. Weed invasion is high within this vegetation community.

6. Open Forest (*Eucalyptus pilularis*)

***Structure*:**

Trees: To 30 metres in height, with a highly variable 10-65% Projected Foliage Cover (PFC).

Shrubs: To 3.5 metres in height, with 45-70% PFC.

Groundlayer: To 2 metre in height, with 70% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus pilularis* (Blackbutt), *Angophora costata* (Smooth-barked Apple), *Banksia serrata* (Old-man Banksia), *Corymbia gummifera* (Red Bloodwood) with occasional *Eucalyptus robusta* (Swamp Mahogany).

Shrubs: *Monotoca elliptica* (Tree Broom-heath), *Pultenaea villosa, Notolaea longifolia* (Large Mock Olive) and *lantana camara* (Lantana).

Groundlayer: *Pomax umbellata* (Pomax), *Imperata cylindrica* (Blady Grass), *Gahnia sieberiana* (Red-fruited Saw-sedge), *Lomandra longifolia* (Spiky-headed Mat-rush) and *Baloskion tetraphyllum* subsp. *meiostachyum*.

Weeds: *Pinus eliottii* (Slash Pine), *Lantana camara* (Lantana), *Bidens pilosa* (Cobblers Pegs), *Setaria pumila* (Pale Pigeon Grass), *Trifolium repens* (White Clover), *Pennisetum clandestinum* (Kikuyu) and *Paspalum dilatatum* (Paspalum).

Comments:
This vegetation community occurs in several patches in the north-eastern parts of the site and occupies approximately 15 hectares. Canopy cover within this community is highly variable. Disturbances include, grazing, selective clearing, regular underscrubbing and introduction of pasture and exotic weed species.

7. Woodland (*Eucalyptus resinifera*)

***Structure*:**

Trees: To 20 metres in height, with a variable 1-25% Projected Foliage Cover (PFC).

Shrubs: To 2 metres in height (mostly less than 0.5m), with a highly variable <2 to 75% PFC.

Groundlayer: To 1.5 metres in height (large areas less than 0.4m), with a 90 - 95% PFC.

Floristics:

(Main Species Present)

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

Shrubs: *Melaleuca sieberi, Leptospermum polygalifolium* (Yellow Tea Tree), *Melaleuca thymifolia, Leptospermum liversidgei*, and *Callistemon pachyphyllus* (Wallum Bottlebrush).

Groundlayer: *Entolasia stricta* (Wiry Panic), *Hemarthria uncinata* (Matgrass), *Lepyrodia scariosa* (Scale Rush), *Xanthorrhoea latifolia* subsp. *latifolia* and *Aristida benthamii.*

Weeds: *Axonopus fissifolius* (Narrow-leaved Carpet Grass) and *Paspalum dilatatum* (Paspalum).

Comments:

This vegetation community occurs within large areas of the western and central parts of the site and occupies approximately 60 hectares. This community has been highly disturbed by activities such as, selective logging and underscrubbing/slashing, grazing and invasion by low to moderate levels of exotic weed species.

Variation:

- There is a low-lying area in the south-western part of this community that remains slightly wetter. This area has a modified ground layer consisting of a slightly higher cover of sedges (35%) within grasses and herbs (65%).
- The western parts of this community (approximately 30ha) are regularly slashed.
- The south-western parts of this community also has several indistinct drainage lines where sedges 60-70% are co-dominant with grasses and herbs 30-40%.
- The tree layer is absent in the slightly wetter south-western corner.

8. Woodland / Open Forest (*Eucalyptus robusta*)

***Structure*:**

Trees: 15 to 20 metres in height, with a variable 5 - 65% Projected Foliage Cover (PFC).

Shrubs: To 2 metres in height (mostly less than 0.5m), with 2 to 5% PFC.

Groundlayer: To 1.6 metres in height, with a variable 95% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus robusta* (Swamp Mahogany), *Melaleuca linariifolia* (Snow in Summer) and *Pinus eliottii* (Slash Pine).

Shrubs: *Melaleuca nodosa* (Ball Honey Myrtle), *Pultenaea villosa, Epacris pulchella* (NSW Coral Heath).

Groundlayer: *Entolasia stricta* (Wiry Panic), *Imperata cylindrica* (Blady Grass), *Blechnum indicum* (Swamp Water Fern), *Leersia hexandra* (Swamp Ricegrass), *Selaginella uliginosa* (Swamp Selaginella), *Baumea teretifolia* (Twigrush), *Lomandra longifolia* (Spiky-headed Mat-rush), *Dianella caerulea* var. *producta* (Blue Flax Lily) and *Baloskion tetraphyllum* subsp. *meiostachyum*.

Weeds: *Pinus eliottii* (Slash Pine), *Axonopus fissifolius* (Narrow-leaved Carpet Grass) and *Paspalum urvillei* (Vasey Grass).

Comments:
This vegetation community corresponds to the Endangered Ecological Community known as Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF). This community occurs on the lowlands within a number of areas scattered throughout the lower elevations within the subject site. This community occupies approximately 36 hectares. The majority of this community is highly disturbed by previous clearing, grazing, slashing and the introduction of exotic species.

9. Woodland (*Eucalyptus signata*)

***Structure*:**

Trees: 15 to 18 metres in height, with a variable 15 - 25% Projected Foliage Cover (PFC).

Shrubs: To 2 metres in height (mostly less than 1m), with a 10 to 15% PFC.

Groundlayer: To 1.5 metres in height, with a 90 - 95% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus signata* (Northern Scribbly Gum) and *Angophora costata* (Smooth-barked Apple).

Shrubs: *Epacris pulchella* (NSW Coral Heath), *Leucopogon lanceolatus* and *Acacia ulicifolia* (Prickly Moses).

Groundlayer: *Trifolium repens* (White Clover), *Pteridium esculentum* (Bracken), *Axonopus fissifolius* (Narrow-leaved Carpet Grass), *Paspalum dilatatum* (Paspalum), *Pratia purpurascens* (Whiteroot), *Cynodon dactylon* (Common Couch), *Imperata cylindrica* (Blady Grass), and *Baloskion tetraphyllum* subsp. *meiostachyum*.

Weeds: *Trifolium repens* (White Clover), *Axonopus fissifolius* (Narrow-leaved Carpet Grass), *Pennisetum clandestina* (Kikuyu), *Andropogon virginicus* (Whisky Grass), *Cynodon dactylon* (Common Couch), *Lotus uliginosus* (Bird's-foot Trefoil), *Conyza sumatrensis* (Tall Fleabane) and *Paspalum dilatatum* (Paspalum).

Comments:
This vegetation community occurs within a single area in the central part of the site and occupies approximately 1 hectare. This community has been highly disturbed by activities such as, clearing of the shrub and ground layers, slashing, grazing and invasion by moderate to high levels of exotic weed species.

10. Open Forest / Woodland (*Eucalyptus umbra*)

***Structure*:**

Trees: 15 to 22 metres in height, with a variable 8 - 40% Projected Foliage Cover (PFC).

Shrubs: To 4 metres in height, with a highly variable <2 to 60% PFC.

Groundlayer: To 1.5 metres in height, with a variable 40 to 95% PFC.

Floristics:
(Main Species Present)

Trees: *Eucalyptus umbra* (Broad-leaved White Mahogany), *Eucalyptus globoidea* (White Stringybark), *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus microcorys* (Tallowwood).

Shrubs: *Callistemon salignus* (Willow Bottlebrush), *Leptospermum polygalifolium* (Yellow Tea Tree), *Persoonia linearis* (Narrow-leaved Geebung) and *Lomatia silaifolia* (Crinkle Bush).

Groundlayer: *Entolasia stricta* (Wiry Panic), *Pratia purpurascens* (Whiteroot), *Imperata cylindrica* (Blady Grass), *Lomandra longifolia* (Spiky-headed Mat-rush), *Microlaena stipoides, Themeda australis* (Kangaroo Grass), *Xanthorrhoea macronema* and *Lomandra filiformis.*

Weeds: *Pinus eliottii* (Slash Pine), *Asparagus aethiopicus* (Asparagus Fern) and Lantana camara (Lantana).

Comments:
This vegetation community occurs within two areas situated on the slopes of the northern parts of the subject site and occupies approximately 4 hectares. The central-northern portion of this community has a highly disturbed structure with scattered trees over pasture, while the northernmost portion has the structure of disturbed Open Forest. Parts of this community have been highly disturbed by activities such as, felling of most of the trees (in the central-

northern patch), clearing of the shrub and ground layers, slashing, grazing and invasion by moderate levels of exotic weed species.

11. Pine Forest (*Pinus eliottii*)

***Structure*:**

Trees: To 20 metres in height, with a patchy 20% Projected Foliage Cover (PFC).

Shrubs: To 2 metres in height, with sparse <5% PFC.

Groundlayer: To 1 metre in height, with 5 to10% PFC.

Floristics:

(Main Species Present)

Trees: *Pinus eliottii* (Slash Pine).

Shrubs: *Acacia longifolia* (Sydney Golden Wattle).

Groundlayer: *Pennisetum clandestinum* (Kikuyu) and Paspalum grasses.

Weeds: *Pennisetum clandestinum* (Kikuyu), *Paspalum spp.*, *Pinus eliottii* (Slash Pine).

Comments:

This vegetation community is located in a small area in the northern part of the site and occupies approximately 1 hectare. This community has been highly disturbed by ongoing agricultural land uses and management activities such as grazing, introduction of weed species and slashing.

12. Disturbed Estuarine Vegetation

***Structure*:**

Variable - sparse grassland to open shrubland

Floristics:

(Main Species Present)

Trees: None.

Shrubs: *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush)

Groundlayer: *Zoysia macrantha* (Coast Couch).

Weeds: *Pennisetum clandestinum* (Kikuyu), *Paspalum spp.*, *Pinus eliottii* (Slash Pine).

Comments:

This unit includes sandy beaches (strand), accumulated stream-borne organic litter (wrack) and areas of dredge spoil. The area covered by this vegetation community is approximately 1 hectare.

13. Casuarina Forest (*Casuarina glauca*)

***Structure*:**
Low closed forest

Floristics:
(Main Species Present)
Trees: *Casuarina glauca* (Swamp Oak).

Comments:
This unit comprises essentially monospecific stands of *Casuarina glauca,* mostly growing on dredge spoil along the river's edge. The area covered by this vegetation community is approximately 1 hectare.

14. Mangroves (*Avicennia marina*)

***Structure*:** Low closed-forest to closed scrub
Trees: To 7 metres in height, with a patchy 20% Projected Foliage Cover (PFC).

Shrubs: None.

Groundlayer: None.

Floristics:
(Main Species Present)
Trees: *Avicennia marina* var. *australasica* (Grey Mangrove) and *Aegiceras corniculatum* (River Mangrove).

Shrubs: *Myoporum acuminatum* (Mangrove Boobialla).

Groundlayer: None.

Weeds: None noted.

Comments:
A variable width fringe of mangroves along the river frontage. This vegetation community occupies approximately 6 hectares in the eastern parts of the subject site.

15. Saltmarsh (*Juncus kraussii*)

***Structure*:** Closed or Open rushland, herbland
Trees: None.

Shrubs: None.

Groundlayer: From 0.1 to 1.3 metres in height, with 80 - 90% PFC.

Floristics:
(Main Species Present)
Trees: None.

Shrubs: None.

Groundlayer: *Juncus krausii* (Sea Rush), *Sarcocornia quinqueflora* (Glasswort), *Sporobolus virginicus* (Sand Couch).

Weeds: None noted.

Comments:
This vegetation community corresponds to the Endangered Ecological Community known as Coastal Saltmarsh. *Juncus kraussii* is the main saltmarsh species on the site, dominating most of the higher intertidal area. This community occupies approximately 20 hectares within the subject site.

16. Rushland (*Baumea juncea*)

***Structure*:** Closed rushland

Trees: None.

Shrubs: None.

Groundlayer: To 1.7 metres in height, with 5 to10% PFC.

Floristics:
(Main Species Present)

Trees: None.

Shrubs: None.

Groundlayer: *Baumea juncea, Juncus kraussii* (Sea Rush), *Sporobolus virginicus* (Sand Couch).

Weeds: None noted.

Comments:
This vegetation community corresponds to the Endangered Ecological Community known as Coastal Saltmarsh. The areas containing *Baumea juncea* rushland are more influenced by freshwater flows from the catchment than from tidal inundation (the latter does occur from time to time). This unit occurs in lower-lying depressions on the landward side of the Saltmarsh and occupies approximately 8 hectares.

17. Scrub (*Melaleuca ericifolia*)

***Structure*:** Closed Scrub / rushland

Trees: None.

Shrubs: To 4 metres in height, with a variable 5 to 70% PFC.

Groundlayer: To 1.5 metres in height, with a variable 5 to 70% PFC.

Floristics:
(Main Species Present)

Trees: None.

Shrubs: *Melaleuca ericifolia* (Swamp Paperbark).

Groundlayer: *Baumea juncea* and *Sporobolus virginicus* (Sand Couch).

Weeds: None noted.

Comments:
This vegetation community corresponds to the Endangered Ecological Community known as Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF). This vegetation unit occurs in lower-lying depressions on the landward side of the saltmarsh, but is further removed from tidal inundation, allowing the dominance of *Melaleuca ericifolia*. Parts of this vegetation unit

contain areas of *Baumea* rushland which has been evidently infrequently slashed. The frequency of slashing has been sufficiently frequent to permit dominance by *Baumea juncea* but there is plenty of stunted *Melaleuca ericifolia.* If slashing was discontinued, these areas would readily re-establish as *Melaleuca ericifolia* scrub. This vegetation type occupies approximately 10 hectares.

18. Paperbark Forest (*Melaleuca quinquenervia*)

***Structure*:** Open Forest to Woodland

Trees: To 20 metres in height, with a patchy 20 to 60% Projected Foliage Cover (PFC).

Shrubs: To 3 metres in height, with a variable 40 to 60% PFC.

Groundlayer: To 1.7 metres in height, with a variable 40 to 70% PFC.

Floristics:

(Main Species Present)

Trees: *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Casuarina glauca* (Swamp Oak) and *Eucalyptus robusta* (Swamp Mahogany).

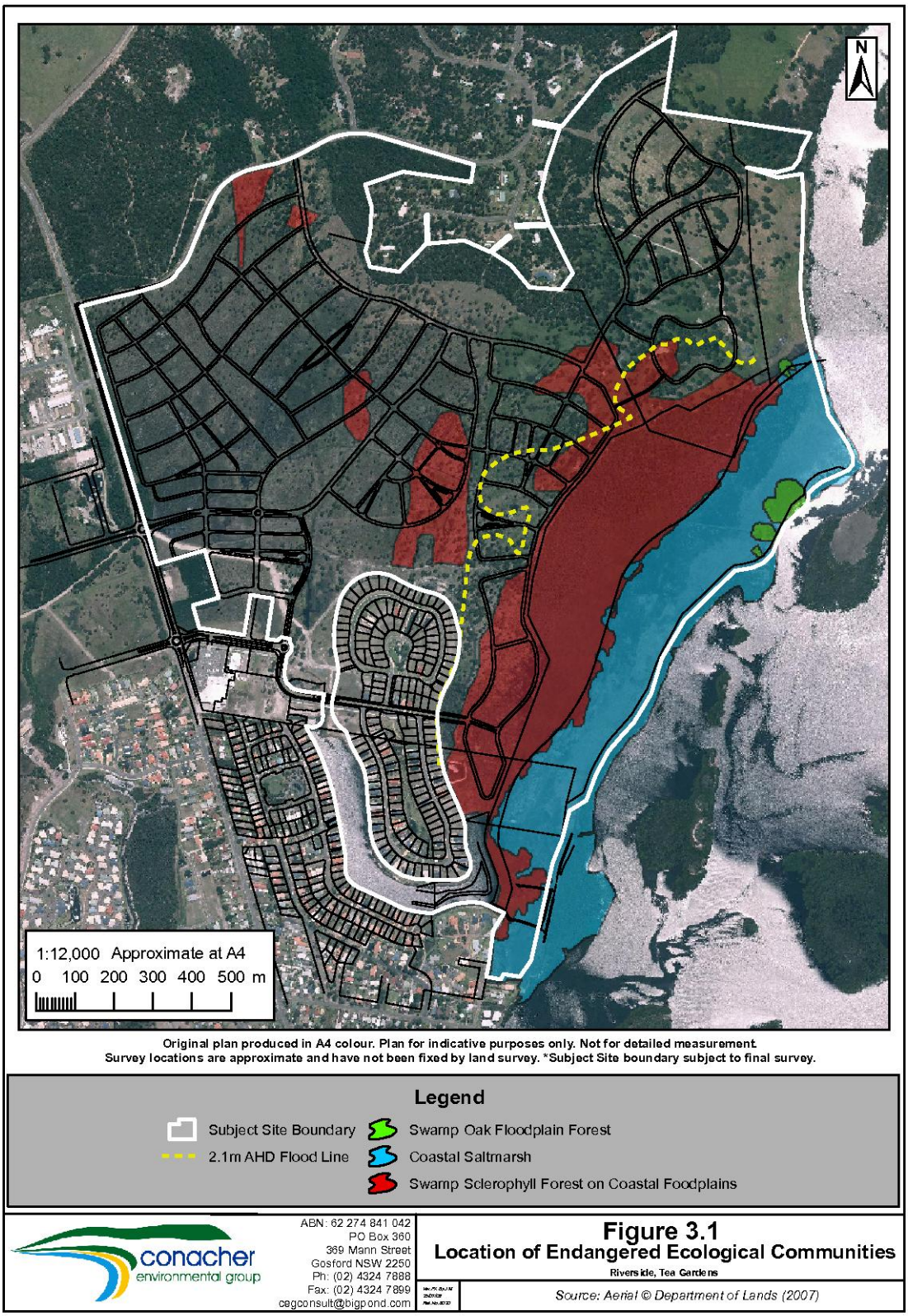
Shrubs: *Acacia longifolia* (Sydney Golden Wattle), *Leptospermum polygalifolium* (Lemon-scented Tea-tree).

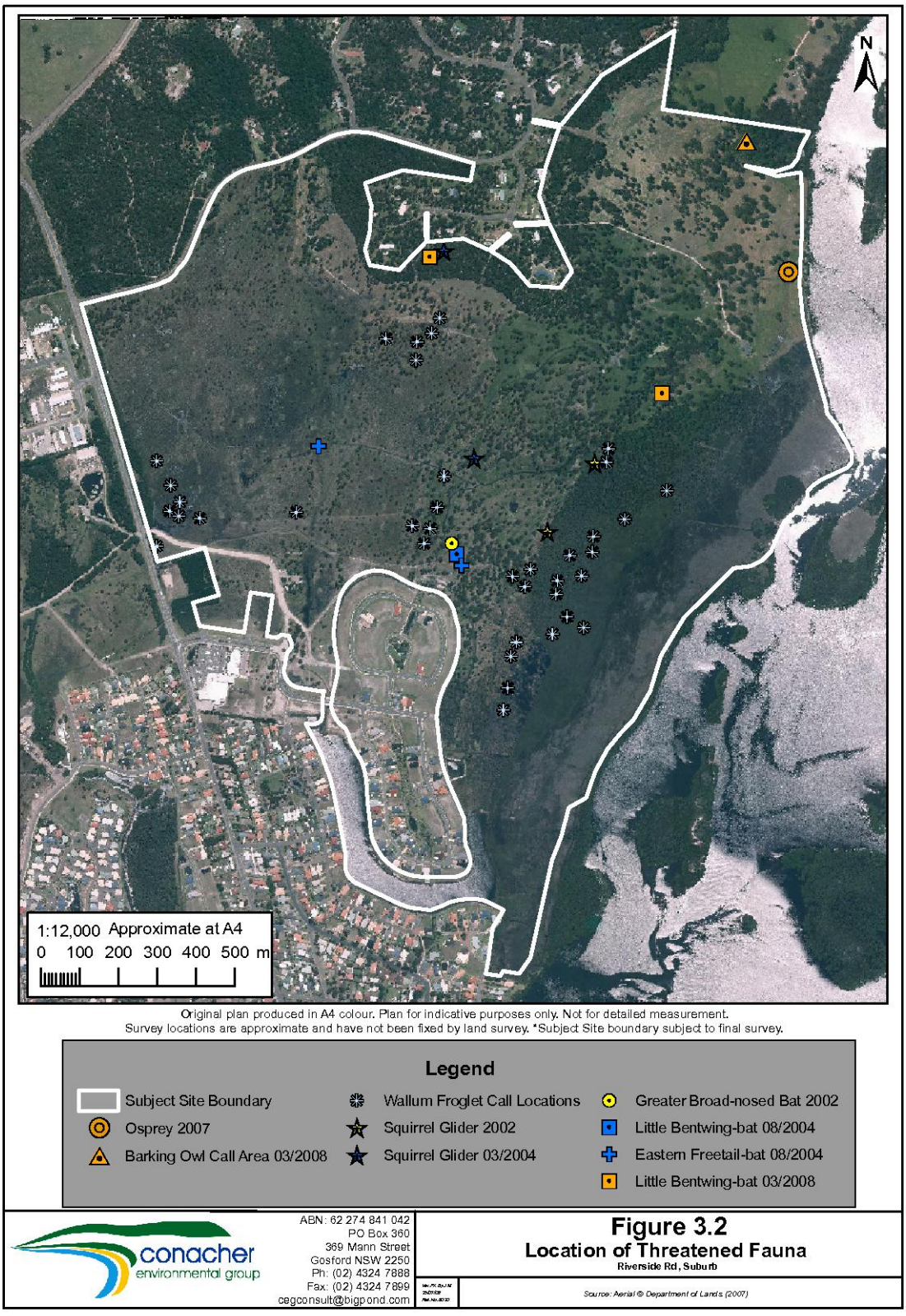
Groundlayer: *Gahnia clarkei* (Tall Saw-sedge).

Weeds: None noted.

Comments:

This vegetation community corresponds to the Endangered Ecological Community known as Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF). Small patches of this mixed forest dominated by *Melaleuca quinquenervia* occur in areas adjacent to the Baumea rushland where it is inferred that catchment surface flows lower the soil salinity sufficiently to give *Melaleuca quinquenervia* a competitive advantage over *Melaleuca ericifolia.* This vegetation community occupies approximately 1 hectare.


N
1:12,000 Approximate at A4
0 100 200 300 400 500 m
Original plan produced in A4 colour. Plan for indicative purposes only. Not for detailed measurement.
Survey locations are approximate and have not been fixed by land survey. *Subject Site boundary subject to final survey.
Legend
Subject Site Boundary
2.1m AHD Flood Line
Swamp Oak Floodplain Forest
Coastal Saltmarsh
Swamp Sclerophyll Forest on Coastal Floodplains
conacher environmental group
ABN: 62 274 841 042
PO Box 360
369 Mann Street
Gosford NSW 2250
Ph: (02) 4324 7888
Fax: (02) 4324 7899
cegconsult@bigpond.com
Figure 3.1
Location of Endangered Ecological Communities
Riverside, Tea Gardens
Source: Aerial © Department of Lands (2007)


N
1:12,000 Approximate at A4
0 100 200 300 400 500 m
Original plan produced in A4 colour. Plan for indicative purposes only. Not for detailed measurement.
Survey locations are approximate and have not been fixed by land survey. *Subject Site boundary subject to final survey.
Legend
Subject Site Boundary
Osprey 2007
Barking Owl Call Area 03/2008
Wallum Froglet Call Locations
Squirrel Glider 2002
Squirrel Glider 03/2004
Greater Broad-nosed Bat 2002
Little Bentwing-bat 08/2004
Eastern Freetail-bat 08/2004
Little Bentwing-bat 03/2008
conacher environmental group
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Gosford NSW 2250
Ph: (02) 4324 7888
Fax: (02) 4324 7899
cegconsult@bigpond.com
Figure 3.2
Location of Threatened Fauna
Riverside Rd, Suburb
Source: Aerial © Department of Lands (2007)

TABLE 3.1 FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
TREES		
Acanthaceae	*Avicennia marina* var. *australasica*	Grey Mangrove
Arecaceae	*Livistona australis*	Cabbage Palm
Casuarinaceae	*Allocasuarina littoralis*	Black Sheoak
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash
Euphorbiaceae	*Glochidion ferdinandii*	Cheese Tree
Fabaceae	*Acacia schinoides*	Green Cedar Wattle
Lauraceae	*Cinnamomum camphora**	Camphor Laurel
Lauraceae	*Endiandra sieberi*	Hard Corkwood
Meliaceae	*Synoum glandulosum subsp. glandulosum*	Scentless Rosewood
Mimosaceae	*Acacia irrorata* subsp. *irrorata*	Green Wattle
Moraceae	*Ficus rubiginosa*	Port Jackson Fig
Moraceae	*Ficus sp. (Seedling)*	A Fig
Myoporaceae	*Myoporum acuminatum*	Mangrove Boobialla
Myrsinaceae	*Aegiceras corniculatum*	River Mangrove
Myrsinaceae	*Aegiceras corniculatum*	River Mangrove
Myrtaceae	*Acmena smithii*	Lillypilly
Myrtaceae	*Angophora costata*	Smooth-barked Apple
Myrtaceae	*Corymbia gummifera*	Red Bloodwood
Myrtaceae	*Corymbia maculata*	Spotted Gum
Myrtaceae	*Eucalyptus canaliculata*	Large-fruited Grey Gum
Myrtaceae	*Eucalyptus capitellata*	Brown Stringybark
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark
Myrtaceae	*Eucalyptus fergusonii*	-
Myrtaceae	*Eucalyptus globoidea*	White Stringybark
Myrtaceae	*Eucalyptus microcorys*	Tallowwood
Myrtaceae	*Eucalyptus paniculata subsp. paniculata*	Grey Ironbark
Myrtaceae	*Eucalyptus pilularis*	Blackbutt
Myrtaceae	*Eucalyptus propinqua* var. *propinqua*	Small Fruited Grey Gum
Myrtaceae	*Eucalyptus punctata*	Grey Gum
Myrtaceae	*Eucalyptus resinifera subsp. resinifera*	Red Mahogany
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
TREES (Cont.)		
Myrtaceae	*Eucalyptus siderophloia*	Northern Grey Ironbark
Myrtaceae	*Eucalyptus signata*	Northern Scribbly Gum
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany
Myrtaceae	*Melaleuca linariifolia*	Snow in Summer
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark
Myrtaceae	*Melaleuca stypheloides*	Prickly-leaved Tea Tree
Oleaceae	*Notelaea venosa*	Veined Mock Olive
Pinaceae	*Pinus elliottii**	Slash Pine
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum
Proteaceae	*Banksia serrata*	Old-man Banksia
Santalaceae	*Exocarpos cupressiformis*	Native Cherry
SHRUBS		
Apiaceae	*Platysace ericoides*	Heathy Platysace
Apiaceae	*Platysace lanceolata*	Native Parsnip
Apiaceae	*Platysace lanceolata*	Lance-leaf Platysace
Apiaceae	*Platysace linearifolia*	Narrow-leafed Platysace
Apocynaceae	*Gomphocarpus fruticosus**	Narrow-leaved Cotton Bush
Araliaceae	*Polyscias sambucifolia subsp. sambucifolia*	Elderberry Panax
Asteraceae	*Chrysanthemoides monilifera* subsp. *monilifera**	Bitou Bush
Asteraceae	*Chrysanthemoides monilifera subsp. rotundata*	Bitou Bush
Asteraceae	*Olearia elliptica*	-
Asteraceae	*Ozothamnus diosmifolius*	Ball Everlasting
Cactaceae	*Opuntia stricta var. stricta**	Common Prickly Pear
Cesalpinioideae	*Senna pendula* var. *glabrata**	-
Dilleniaceae	*Hibbertia linearis*	-
Dilleniaceae	*Hibbertia obtusifolia*	-
Dilleniaceae	*Hibbertia serpyllifolia*	-
Dilleniaceae	*Hibbertia* sp aff. *Riparia*	-
Epacridaceae	*Epacris microphylla*	Coral Heath
Epacridaceae	*Epacris obtusifolia*	-
Epacridaceae	*Leucopogon ericoides*	-
Epacridaceae	*Leucopogon lanceolatus*	Lance-leaf Beard-heath
Epacridaceae	*Monotoca scoparia*	Prickly Broom-heath

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
SHRUBS (Cont.)		
Ericaceae	*Epacris pulchella*	NSW Coral Heath
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath
Ericaceae	*Lissanthe strigosa*	Peach Heath
Ericaceae	*Monotoca elliptica*	Tree Broom-heath
Euphorbiaceae	*Amperea xiphoclada*	Broom Spurge
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Euphorbiaceae	*Micrantheum ericoides*	-
Euphorbiaceae	*Omalanthus populifolius*	Bleeding Heart
Euphorbiaceae	*Phyllanthus hirtellus*	Thyme Spurge
Euphorbiaceae	*Ricinocarpos pinifolius*	Wedding Bush
Fabaceae	*Bossiaea rhombifolia*	-
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea
Fabaceae	*Daviesia ulicifolia* subsp, *stenophylla*	Gorse Bitter Pea
Fabaceae	*Gompholobium latifolium*	Broad-leaf Wedge-pea
Fabaceae	*Mirbelia speciosa*	-
Fabaceae	*Platylobium formosum* subsp. *parviflorum*	Handsome Flat-pea
Fabaceae	*Pultenaea blakelyi*	-
Fabaceae	*Pultenaea daphnoides*	Large-leaf Bush Pea
Fabaceae	*Pultenaea elliptica*	-
Fabaceae	*Pultenaea paleacea* var. *paleacea*	-
Fabaceae	*Pultenaea retusa*	-
Fabaceae	*Pultenaea rosmarinifolia*	-
Fabaceae	*Pultenaea villosa*	-
Fabaceae	*Viminaria juncea*	Native Broom
Fabaceae	*Bossiaea heterophylla*	Variable Bossiaea
Fabaceae	*Dillwynia retorta var. retorta*	Heathy Parrot Pea
Fabaceae	*Platylobium formosum*	Handsome Flat-pea
Faboideae	*Aotus lanigera*	-
Faboideae	*Phyllota phylicoides*	Heath Phyllota
Goodeniaceae	*Goodenia ovata*	Hop Goodenia
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum
Mimosaceae	*Acacia binervia*	Coast Myall
Mimosaceae	*Acacia elongata*	-
Mimosaceae	*Acacia falcata*	Sickle Wattle
Mimosaceae	*Acacia implexa*	Hickory
Mimosaceae	*Acacia longifolia* var. *longifolia*	Sydney Golden Wattle

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
SHRUBS (Cont.)		
Mimosaceae	*Acacia longifolia* var. *sophorae*	-
Mimosaceae	*Acacia myrtifolia*	Red Stem Wattle
Mimosaceae	*Acacia suaveolens*	Sweet Scented Wattle
Mimosaceae	*Acacia terminalis*	Sunshine Wattle
Mimosaceae	*Acacia ulicifolia*	Prickly Moses
Myrsinaceae	*Rapanea variabilis*	Muttonwood
Myrtaceae	*Babingtonia pluriflora*	-
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush
Myrtaceae	*Callistemon pachyphyllus*	Wallum Bottlebrush
Myrtaceae	*Callistemon pinifolius*	Pine-leaved Bottlebrush
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush
Myrtaceae	*Kunzea ambigua*	Tick Bush
Myrtaceae	*Leptospermum juniperinum*	Prickly Tea-tree
Myrtaceae	*Leptospermum laevigatum*	Coast Tea Tree
Myrtaceae	*Leptospermum liversidgei*	-
Myrtaceae	*Leptospermum polygalifolium*	Lemon Scented Tea-tree
Myrtaceae	*Leptospermum trinervium*	Flaky-barked Tea-tree
Myrtaceae	*Melaleuca ericifolia*	Swamp Paperbark
Myrtaceae	*Melaleuca nodosa*	Ball Honeymyrtle
Myrtaceae	*Melaleuca sieberi*	-
Myrtaceae	*Melaleuca thymifolia*	Thyme Honey Myrtle
Oleaceae	*Notelaea longifolia*	Large Mock-olive
Oleaceae	*Notelaea ovata*	-
Phytolaccaceae	*Phytolacca octandra**	Inkweed
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum
Polygalaceae	*Comesperma ericinum*	Matchheads
Proteaceae	*Banksia aemula*	Wallum Banksia
Proteaceae	*Banksia ericifolia* var. *ericifolia*	Heath-leaved Banksia
Proteaceae	*Banksia integrifolia* subsp. *integrifolia*	Coast Banksia
Proteaceae	*Banksia oblongifolia*	Fern-leaved Banksia
Proteaceae	*Banksia robur*	Wallum Banksia
Proteaceae	*Banksia spinulosa* var. *collina*	Hairpin Banksia
Proteaceae	*Banksia spinulosa* var. *spinulosa*	-
Proteaceae	*Hakea dactyloides*	Broad-leaved Hakea
Proteaceae	*Hakea sericea*	Needlebush
Proteaceae	*Hakea teretifolia*	Dagger Hakea
Proteaceae	*Persoonia lanceolata*	Lance Leaf Geebung

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
SHRUBS (Cont.)		
Proteaceae	*Persoonia levis*	Broad-leaved Geebung
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung
Rosaceae	*Rubus moluccanus*	Broad-leaf Bramble
Rubiaceae	*Opercularia aspera*	Common Stinkweed
Rubiaceae	*Opercularia diphylla*	-
Rutaceae	*Boronia pinnata*	Pinnate Boronia
Rutaceae	*Nematolepis squamea subsp. squamea*	Satinwood
Rutaceae	*Zieria smithii*	Sandfly Zieria
Santalaceae	*Leptomeria acida*	Sour Currant Bush
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush
Solanaceae	*Duboisia myoporoides*	Corkwood
Solanaceae	*Solanum mauritianum**	Wild Tobacco Bush
Verbenaceae	*Lantana camara**	Lantana
Zamiaceae	*Macrozamia communis*	Burrawang
Zamiaceae	*Macrozamia pauli-guilielmi*	-
GROUNDCOVERS		
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
Aizoaceae	*Tetragonia tetragonioides*	New Zealand Spinach
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed
Anthericaceae	*Caesia parviflora* var. *parviflora*	Pale Grass Lily
Anthericaceae	*Thysanotus tuberosus*	Common Fringe-lily
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily
Apiaceae	*Centella asiatica*	Pennywort
Apiaceae	*Hydrocotyle bonariensis**	Kurnell Curse / Pennywort
Apiaceae	*Hydrocotyle peduncularis*	Pennywort
Apiaceae	*Xanthosia pilosa*	Woolly Xanthosia
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern
Asteraceae	*Actinotus helianthi*	Flannel Flower
Asteraceae	*Ageratina adenophorum**	Crofton Weed
Asteraceae	*Aster subulatus**	Wild Aster
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Asteraceae	*Centipeda minima*	Spreading Sneezeweed
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane
Asteraceae	*Conyza* sp.*	-

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Asteraceae	*Conyza sumatrensis**	Tall fleabane
Asteraceae	*Cotula coronopifolia**	Waterbuttons
Asteraceae	*Crassocephalum crepidioides**	Thickhead
Asteraceae	*Epaltes australis*	Spreading Nut-heads
Asteraceae	*Erechtites valerianifolia**	Brazilian Fireweed
Asteraceae	*Euchiton involucratus*	Star Cudweed
Asteraceae	*Euchiton sphaericus*	Cudweed
Asteraceae	*Hypochaeris radicata**	Flatweed
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy
Asteraceae	*Senecio diaschides*	-
Asteraceae	*Senecio lautus* ssp. *dissectifolius*	Fireweed
Asteraceae	*Senecio lautus* subsp. *maritimus*	-
Asteraceae	*Senecio madagascariensis**	Fireweed
Asteraceae	*Sigesbeckia orientalis subsp. orientalis*	Indian Weed
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Asteraceae	*Taraxacum officinale**	Dandelion
Asteraceae	*Vernonia cinerea var. cinerea*	-
Baueraceae	*Bauera rubioides*	Dog Rose
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine
Blandfordiaceae	*Blandfordia grandiflora*	Christmas Bell
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern
Blechnaceae	*Blechnum indicum*	Swamp Water Fern
Blechnaceae	*Doodia aspera*	Prickly Rasp Fern
Brassicaceae	*Capsella bursa-pastoris**	Shepherds purse
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell
Campanulaceae	*Wahlenbergia stricta* subsp. *stricta*	Austral Bluebell
Carophyllaceae	*Cerastium glomeratum**	Mouse-ear Chickweed
Caryophyllaceae	*Stellaria media**	Common Chickweed
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Chenopodiaceae	*Einadia polygonoides*	-
Chenopodiaceae	*Sarcocornia quinqueflora*	Glasswort
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort
Clusiaceae	*Hypericum japonicum*	-
Clusiaceae	*Hypericum perforatum**	St Johns Wort
Colchicaceae	*Burchardia umbellata*	Milkmaids
Commelinaceae	*Commelina cyanea*	Native Wandering Jew
Commelinaceae	*Murdannia graminea*	-

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Convolvulaceae	*Dichondra repens*	Kidney Weed
Convolvulaceae	*Polymeria calycina*	Polymeria
Cyperaceae	*Baumea arthrophylla*	White Fruited Twig Rush
Cyperaceae	*Baumea articulata*	Jointed Twig-rush
Cyperaceae	*Baumea juncea*	-
Cyperaceae	*Baumea rubignosa*	Twig Rush
Cyperaceae	*Baumea teretifolia*	A Twigrush
Cyperaceae	*Bolboschoenus fluviatilis*	Marsh Clubrush
Cyperaceae	*Carex appressa*	Tall Sedge
Cyperaceae	*Caustis flexuosa*	Curly Sedge
Cyperaceae	*Chorizandra cymbaria*	Heron Bristle Rush
Cyperaceae	*Chorizandra sphaerocephala*	Round-headed Bristle Rush
Cyperaceae	*Cyperus aggregatus**	-
Cyperaceae	*Cyperus brevifolius**	-
Cyperaceae	*Cyperus difformis*	-
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge
Cyperaceae	*Cyperus polystachyos*	A Sedge
Cyperaceae	*Cyperus sesquiflorus**	-
Cyperaceae	*Eleocharis pusilla*	-
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge
Cyperaceae	*Gahnia aspera*	Rough Saw-sedge
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge
Cyperaceae	*Isolepis inundata*	Swamp Clubrush
Cyperaceae	*Isolepis nodosa*	Knobby Club-rush
Cyperaceae	*Lepidosperma elatius*	Tall Sword-sedge
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge
Cyperaceae	*Ptilothrix deusta*	-
Cyperaceae	*Schoenus apogon*	Fluke Bogrush
Cyperaceae	*Schoenus brevifolius*	A Bog Rush
Cyperaceae	*Schoenus ericetorum*	A Bog Rush
Cyperaceae	*Schoenus melanostachys*	Black Bog Rush
Dennstaedtiaceae	*Histiopteris incisa*	Bat's Wing Fern
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Dicksoniaceae	*Calochlaena dubia*	False Bracken
Dilleniaceae	*Hibbertia acicularis*	Prickly Guinea Flower

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower
Dilleniaceae	*Hibbertia empetrifolia* subsp. *uncinata*	-
Dilleniaceae	*Hibbertia fasciculata*	-
Dilleniaceae	*Hibbertia vestita*	-
Dilleniaceae	*Hibbertia virgata subsp. virgata*	-
Droseraceae	*Drosera peltata*	Pygmy Sundew
Droseraceae	*Drosera pygmaea*	Pygmy Sundew
Droseraceae	*Drosera spatulata*	Common Sundew
Elaeocarpaceae	*Tetratheca thymifolia*	Black-eyed Susan
Eriocaulaceae	*Eriocaulon scariosum*	Salt Pipewort, Button Grass
Euphorbiaceae	*Phyllanthus tenellus**	-
Euphorbiaceae	*Poranthera microphylla*	
Fabaceae	*Acacia brownii*	Heath Wattle
Fabaceae	*Bossiaea prostrata*	-
Fabaceae	*Gompholobium pinnatum*	Pinnate Wedge Pea
Fabaceae	*Lotus uliginosus**	Birds-foot Trefoil
Fabaceae	*Trifolium repens**	White Clover
Gentianaceae	*Centaurium erythraea**	Pink Stars
Geraniaceae	*Geranium homeanum*	Northern Cranesbill
Geraniaceae	*Geranium solanderi*	Cutleaf Cranesbill
Gleicheniaceae	*Gleichenia dicarpa*	Pouched Coral Fern
Goodeniaceae	*Dampiera stricta*	Blue Damperia
Goodeniaceae	*Goodenia bellidifolia subsp. bellidifolia*	Daisy-leaved Goodenia
Goodeniaceae	*Goodenia heterophylla subsp. heterophylla*	Variable-leaved Goodenia
Goodeniaceae	*Goodenia paniculata*	Swamp Goodenia
Goodeniaceae	*Goodenia stelligera*	-
Goodeniaceae	*Scaevola ramosissima*	Purple Fan Flower
Haemodoraceae	*Haemodorum planifolium*	Bloodroot
Haloragaceae	*Gonocarpus micranthus* subsp. *micranthus*	-
Haloragaceae	*Gonocarpus micranthus subsp. ramosissimus*	-
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Haloragaceae	*Gonocarpus teucrioides*	Raspwort
Haloragaceae	*Haloragis heterophylla*	-
Haloragaceae	*Myriophyllum propinquum*	Common Water Milfoil

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Hypoxidaceae	*Hypoxis hygrometrica*	Golden Weather-grass
Iridaceae	*Crocosmia X crocosmiiflora**	Montbretia
Iridaceae	*Patersonia glabrata*	Leafy Purple-flag
Iridaceae	*Patersonia sericea*	Silky Purple-Flag
Juncaceae	*Juncus cognatus**	-
Juncaceae	*Juncus continuus*	A Rush
Juncaceae	*Juncus krausii*	Sea Rush
Juncaceae	*Juncus kraussii*	Sea Rush
Juncaceae	*Juncus planifolius*	Broad Rush
Juncaceae	*Juncus polyanthemus*	-
Juncaceae	*Juncus prismatocarpus*	Branching Rush
Juncaceae	*Juncus usitatus*	Common Rush
Juncaginaceae	*Triglochin striata*	Streaked Arrow-grass
Lamiaceae	*Stachys arvensis**	Stagger Weed
Lentibulariaceae	*Utricularia dichotoma*	Fairy aprons
Lindsaeaceae	*Lindsaea linearis*	Screw Fern
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern
Lobeliaceae	*Lobelia alata*	Angled Lobelia
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Loganiaceae	*Mitrasacme paludosa*	-
Loganiaceae	*Mitrasacme polymorpha*	-
Lomandraceae	*Lomandra confertifolia*	-
Lomandraceae	*Lomandra confertifolia* subsp. *rubiginosa*	-
Lomandraceae	*Lomandra confertifolia var. pallida*	-
Lomandraceae	*Lomandra cylindrica*	-
Lomandraceae	*Lomandra filiformis* var. *filiformis*	Wattle Mat-rush
Lomandraceae	*Lomandra glauca subsp. glauca*	Pale Mat-rush
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush
Lomandraceae	*Lomandra obliqua*	Twisted Mat-rush
Lycopodiaceae	*Lycopodium laterale*	Slender Clubmoss
Lythraceae	*Lythrum hyssopifolia*	Loosestrife
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Menyanthaceae	*Villarsia exaltata*	Yellow Marsh Flower
Orchidaceae	*Acianthus fornicatus*	Pixie Caps

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Orchidaceae	*Caladenia alba*	Finger Orchid
Orchidaceae	*Calochilus campestris*	Copper Beards
Orchidaceae	*Chiloglottis sp.*	-
Orchidaceae	*Cryptostylis erecta*	Bonnet Orchid
Orchidaceae	*Cryptostylis Sp. (Leaf only)*	A Tongue Orchid
Orchidaceae	*Cryptostylis subulata*	Large Tongue Orchid
Orchidaceae	*Pterostylis longifolia*	-
Orchidaceae	*Pterostylis pedunculata*	-
Orchidaceae	*Thelymitra purpurata*	Sun Orchid
Oxalidaceae	*Oxalis corniculata**	Yellow Wood Sorrel
Oxalidaceae	*Oxalis exilis*	Slender xalis
Oxalidaceae	*Oxalis sp.*	-
Phormiaceae	*Dianella caerulea* var. *assera*	Flax Lily
Phormiaceae	*Dianella caerulea var. caerulea*	Blue Flax lily
Phormiaceae	*Dianella caerulea var. producta*	Blue Flax lily
Phylydraceae	*Phylidrum lanuginosum*	Woolly Frogsmouth
Plantaginaceae	*Plantago lanceolata**	Ribwort
Plantaginaceae	*Plantago major**	Large Plantain
Poaceae	*Andropogon virginicus**	Whisky Grass
Poaceae	*Anisopogon avenaceus*	Oat Speargrass
Poaceae	*Aristida benthamii*	Wire Grass
Poaceae	*Aristida sp.*	Three-awn Speargrass
Poaceae	*Aristida vagans*	Threeawn Speargrass
Poaceae	*Austrodanthonia sp.*	Wallaby Grass
Poaceae	*Austrodanthonia tenuior*	-
Poaceae	*Austrostipa scabra subsp. scabra*	A Speargrass
Poaceae	*Axonopus affinis**	Narrow-leaved Carpet Grass
Poaceae	*Axonopus fissifolius**	Narrow-leaved Carpet Grass
Poaceae	*Briza maxima**	Quaking Grass
Poaceae	*Chloris gayana**	Rhodes Grass
Poaceae	*Chloris truncata**	Windmill Grass
Poaceae	*Cortaderia selloana**	Pampas Grass
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass
Poaceae	*Cynodon dactylon*	Common Couch
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass
Poaceae	*Dichelachne rara*	-

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass
Poaceae	*Digitaria sanguinalis**	Crab Grass
Poaceae	*Echinopogon caespitosus var. caespitosus*	Tufted Hedgehog Grass
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Entolasia stricta*	Wiry Panic
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Poaceae	*Eragrostis curvula**	African Lovegrass
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass
Poaceae	*Hemarthria uncinata var. uncinata*	Matgrass
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass
Poaceae	*Isachaemum australe* var. *australe*	-
Poaceae	*Leersia hexandra*	Swamp Ricegrass
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Rice Grass
Poaceae	*Oplismenus aemulus*	Basket Grass
Poaceae	*Oplismenus imbecillis*	-
Poaceae	*Panicum effusum*	Hairy Panic
Poaceae	*Panicum simile*	Two-colour Panic
Poaceae	*Paspalidium distans*	-
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Paspalum distichum*	Water Couch
Poaceae	*Paspalum orbiculare*	Ditch Millet
Poaceae	*Paspalum urvillei**	Vasey Grass
Poaceae	*Paspalum wettsteinii**	Broad-leaved Paspalum
Poaceae	*Pennisetum alopecuroides**	Swamp Foxtail
Poaceae	*Pennisetum clandestinum**	Kikuyu Grass
Poaceae	*Phalaris aquatica**	Phalaris
Poaceae	*Phragmites australis*	Common Reed
Poaceae	*Poa affinis*	-
Poaceae	*Poa poiformis*	Coast Tussock Grass
Poaceae	*Setaria pumila**	Pale Pigeon Grass
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass
Poaceae	*Sporobolus virginicus*	Sand Couch
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Poaceae	*Themeda australis*	Kangaroo Grass
Polygonaceae	*Persicaria decipiens*	Slender Knotweed
Polygonaceae	*Rumex bidens*	Mud Dock
Portulacaceae	*Portulaca oleracea*	Purslane
Primulaceae	*Anagallis arvensis var. arvensis**	Scarlet Pimpernel
Primulaceae	*Anagallis arvensis var. caerulea**	Blue Pimpernel
Proteaceae	*Lomatia silaifolia*	Crinkle Bush
Ranunculaceae	*Ranunculus inundatus*	River Buttercup
Ranunculaceae	*Ranunculus sp.*	-
Restionaceae	*Baloskion pallens*	-
Restionaceae	*Baloskion tetraphyllum subsp. meiostachyum*	-
Restionaceae	*Empodisma minus*	Spreading Rope-rush
Restionaceae	*Leptocarpus tenax*	Slender Twine-rush
Restionaceae	*Lepyrodia muelleri*	Scale Rush
Restionaceae	*Lepyrodia scariosa*	Scale Rush
Rubiaceae	*Galium propinquum*	Maori Bedstraw
Rubiaceae	*Opercularia varia*	Variable Stinkweed
Rubiaceae	*Pomax umbellata*	Pomax
Scrophulariaceae	*Veronica plebia*	Creeping Speedwell
Selaginellaceae	*Selaginella uliginosa*	Swamp Selaginella
Solanaceae	*Solanum nigrum**	Black-berry Nightshade
Stackhousiae	*Stackhousia viminea*	-
Stylidiaceae	*Stylidium graminifolium*	Grass Triggerplant
Theophrastaceae	*Samolus repens*	Creeping Brookweed
Thymelaeaceae	*Pimelea linifolia* subsp. *linifolia*	Slender Rice Flower
Typhaceae	*Typha orientalis*	Cumbungi
Verbenaceae	*Verbena bonariensis**	Purpletop
Verbenaceae	*Verbena rigida**	Veined Verbena
Violaceae	*Hybanthus monopetalus*	Slender Violet-bush
Violaceae	*Viola banksii*	-
Violaceae	*Viola hederacea*	Ivy-leaved Violet
Xanthorrhoaceae	*Xanthorrhoea latifolia* subsp. *latifolia*	-
Xanthorrhoaceae	*Xanthorrhoea minor* subsp. *minor*	-
Xanthorrhoeaceae	*Xanthorrhoea fulva*	Swamp Grasstree
Xanthorrhoeaceae	*Xanthorrhoea macronema*	-
Xyridaceae	*Xyris complanata*	-

TABLE 3.1 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	**Scientific Name**	**Common Name**
GROUNDCOVERS (Cont.)		
Xyridaceae	*Xyris gracilis*	Slender Yellow-eye
Xyridaceae	*Xyris operculata*	Tall Yellow-eye
EPIPHYTES		
Loranthaceae	*Amyema congener*	A mistletoe
Orchidaceae	*Cymbidium suave*	Native Cymbidium
CLIMBERS		
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Asclepiadaceae	*Marsdenia rostrata*	Common Milk Vine
Asclepiadaceae	*Marsdenia suaveolens*	Scented Marsdenia
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower
Fabaceae	*Desmodium brachypodum*	Large Tick-trefoil
Fabaceae	*Desmodium varians*	-
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Hardenbergia violacea*	False Sarsparilla
Fabaceae	*Kennedia rubicunda*	Dusky Coral Pea
Fabaceae	*Desmodium gunnii*	Slender tick trefoil
Fabaceae	*Desmodium rhytidophyllum*	-
Fabaceae	*Glycine microphylla*	-
Fabaceae	*Glycine tabacina*	-
Lauraceae	*Cassytha glabella* forma *glabella*	Slender Devil's Twine
Lauraceae	*Cassytha pubescens*	Common Devil's Twine
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine
Menispermaceae	*Stephania japonica var. discolor*	Snake Vine
Pittosporaceae	*Billardiera scandens*	Appleberry
Ranunculaceae	*Clematis aristata*	Old Man's Beard
Smilacaceae	*Smilax australis*	Lawyer Vine
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla
Vitaceae	*Cayratia clematidea*	Slender Grape
Species name^{TS} = Threatened Species * = Introduced Species		

3.1.2 Flora Species

The flora species identified on the subject site are listed in Table 3.1. This list is a combination of all flora surveys conducted on the subject site by different botanists over the last 15 years. No specific quadrat based data is available for the pre 2008 surveys. The results of the transect and quadrat based survey following the DEC Draft Guidelines (DEC 2004) for the 2008 surveys are also provided in Annexure 1.

3.1.3 Local and Regional Connectivity of Vegetation

The subject site is bordered to the west by the Myall Road, disturbed grasslands with scattered trees, industrial and residential development; to the south, by predominately existing residential and commercial development; to the east, by the Myall River; and to the north, by a mixture of open forest vegetation communities, areas of isolated residential development and agricultural lands.

The majority of the vegetation of the site forms a mosaic of highly disturbed woodland with scattered trees and woodland/open forest communities. However, the eastern portion of the subject site is dominated by a large remnant of naturally vegetated Swamp Forests, Heaths and Estuarine vegetation communities associated with the low lying areas adjoining the Myall River. This remnant is largely isolated from adjoining vegetation to the south by existing residential development and to the north of the site by an area of cleared agricultural land. Connectivity of vegetation within the remnant is generally provided by the isolated canopies of the trees present which form a woodland to open forest canopy.

The northern areas of the subject site are dominated by a mixture of open forest vegetation communities and adjoin areas of isolated rural-residential development. There exists some connectivity between the sites eastern remnant vegetation and the areas of remnant open forest to the north, via a mosaic of disturbed woodland and open forest vegetation communities and scattered trees occupying the north-eastern areas of the site. However these vegetation communities provide only limited terrestrial connectivity as they have been significantly impacted by a history of agricultural use and grazing, resulting in a sparse understorey layer.

3.1.4 Endangered Ecological Communities

Three Endangered Ecological Communities have been identified within the subject site. These are:

- Coastal Saltmarsh;
- Swamp Sclerophyll Forest on Coastal Floodplains;
- Swamp Oak Floodplain Forest.

The Coastal Saltmarsh (29 hectares) and Swamp Oak Floodplain Forest (one hectare) are located in the eastern parts of the site within the areas predominantly proposed to be retained within the Conservation Zones with proposed removal of .027ha for constriction of modification to the existing outlet drain to Myall River from the existing detention dam.

The Swamp Sclerophyll Forest on Coastal Floodplains is predominantly located within the eastern parts of the site with small areas occurring in localised depressions within the central and northern parts of the site.

Figure 3.1 shows distribution of these Endangered Ecological Communities within the subject site.

3.2 FAUNA

3.2.1 Fauna Habitats Present

A range of fauna habitats are present within the subject site reflecting the diversity in the vegetation communities present. The majority of the site is, however, of decreased habitat quality due to the large amount of disturbance through removal and modification of the groundcover and shrublayer through grazing and slashing and previous clearing of much of the site for a pine plantation.

The following fauna habitats are present on the site and on land adjacent to the site:

- Flower, nectar, fruit and seed producing tree and shrub species;
- Occasional hollow-bearing trees;
- Cleared areas;
- Pasture areas;
- Semi-aquatic habitats associated with low lying areas and intermittent ponds and drains;
- Dense understorey areas;
- Leaf litter;
- Aquatic areas associated with the Myall River foreshore and wetland areas.

The flower, nectar, seed and fruit producing tree and shrub species within the site provide a seasonal foraging resource for a range of fauna species, particularly bird and arboreal mammal species. The site contains a relatively low number of hollow-bearing trees with mostly small hollows. These hollows contain potential den, roost and breeding hollows for bird, arboreal mammal, and microchiropteran bat and reptile species.

Much of the site consists predominantly of disturbed vegetation types with a modified shrublayer and areas with groundcover dominated by pasture grasses. As such the habitat values are decreased for small terrestrial mammal, bird and reptile species. The lack of cover however does increase foraging opportunities for raptor and other bird species. The open grassed areas contain suitable habitat for macropod species, particularly the Eastern Grey Kangaroo and Red-necked Wallaby.

Areas of the subject site are prone to ponding after rain providing suitable habitat for a range of amphibian species. The drainage depressions associated with tracks and land depressions contain suitable foraging and breeding habitat for these locally occurring amphibian species.

The denser, less disturbed vegetation types associated with the Myall River wetlands provide higher quality habitat due to the increased density and diversity of the various structural layers. These less disturbed habitats provide increased foraging, refuge and breeding opportunities for mammal, bird, reptile and amphibian species. This is reflected in the species richness of these vegetation types in comparison to the majority of the site containing the disturbed vegetation communities. These higher quality vegetation and habitat types will be retained as part of the proposed development.

3.2.2 Fauna Species on Site

A list of fauna species recorded within the subject site during surveys is provided in Table 3.2.

TABLE 3.2 FAUNA SPECIES OBSERVED ON THE SITE AND ADJOINING AREAS					
Species List		**Species Locations**			
Common name	**Scientific Name**	**Riverside prior to 2007 Surveys**	**Riverside Surveys 2007/2008**	**Myall River Downs**	**Hawks Nest North**
Ampibians					
Common Eastern Froglet	*Crinia signifera*	X	X	X	X
Wallum Froglet [TS]	*Crinia tinnula*	X	X	X	X
Dainty Tree Frog	*Litoria gracilenta*	X	X	X	
Smooth Toadlet	*Uperoleia laevigata*	X	X		
Dusky Toadlet	*Uperoleia fusca*	X	X		
Dwarf Tree Frog	*Litoria fallax*	X	X	X	
Heath Frog	*Litoria jervisiensis*		X	X	
Broad-palmed Frog	*Litoria latopalmata*	X			
Rocket Frog	*Litoria nasuta*	X	X	X	
Laughing Tree Frog	*Litoria tyleri*			X	
Peron's Tree Frog	*Litoria peronii*		X	X	
Haswell's Tree Frog	*Paracrinia haswellii*	X		X	
Striped Marsh Frog	*Limnodynastes peronii*	X	X	X	
Ornate Burrowing Frog	*Limnodynastes ornatus*	X			
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	X	X	X	
Red-backed Toadlet	*Pseudophryne coriacea*	X			
Bibrons Toadlet	*Pseudophryne bibronii*	X	X		
Freycinet's Frog	*Litoria freycineti*	X			
Green Tree Frog	*Litoria caerulea*			X	
Eastern Banjo Frog	*Limnodynastes dumerilii dumerilii*		X	X	
Bleating Tree Frog	*Litoria dentata*	X		X	
Whistling Tree Frog	*Litoria verreauxii*	X		X	
Reptiles					
Jacky Lizard	*Amphibolurus muricatus*	X		X	
Eastern Water Dragon	*Physignathus lesueurii*		X		
Lace Monitor	*Varanus varius*	X		X	
Striped Skink	*Ctenotus robustus*	X			
Copper-tailed Skink	*Ctenotus taeniolatus*				X
Land Mullet	*Egernia major*		X	X	
Eastern Water Skink	*Eulamprus quoyii*	X		X	
Dark-flecked Garden Sunskink	*Lampropholis delicata*	X	X	X	
Pale-flecked Garden Sunskink	*Lampropholis guichenoti*	X	X		
Weasel Skink	*Saproscincus mustelina*	X			
Eastern Blue Tongue	*Tiliqua scincoides*	X		X	
Diamond Python	*Morelia spilota*	X			
Golden-crowned Snake	*Cacophis squamulosus*	X			
Red-bellied Black Snake	*Pseudechis porphyriacus*	X	X	X	
Eastern Brown Snake	*Pseudonaja textilis*	X			
Black-bellied Swamp Snake	*Hemiaspis signata*	X			
Green Tree Snake	*Dendrelaphis punctulata*			X	
Long-necked Tortoise	*Chelodina longicollis*			X	

TABLE 3.2 (Cont.) FAUNA SPECIES OBSERVED ON THE SITE AND ADJOINING AREAS					
Species List		**Species Locations**			
Common name	**Scientific Name**	**Riverside prior to 2007 Surveys**	**Riverside Surveys 2007/2008**	**Myall River Downs**	**Hawks Nest North**
Birds					
Brown Quail	*Coturnix ypsilophora*	X		X	
Black Swan	*Cygnus atratus*	X	X	X	
Chestnut Teal	*Anas castanea*	X	X	X	
Pacific Black Duck	*Anas superciliosa*	X	X	X	X
Hardhead	*Aythya australis*			X	
Australian Wood Duck	*Chenonetta jubata*	X	X	X	
Australasian Gannet	*Morus serrator*			X	
Little Pied Cormorant	*Phalacrocorax melanoleucos*	X		X	
Little Black Cormorant	*Phalacrocorax sulcirostris*	X	X	X	
Great Cormorant	*Phalacrocorax carbo*	X		X	
Pied Cormorant	*Phalacrocorax varius*			X	
Darter	*Anhinga melanogaster*			X	
Australian Pelican	*Pelecanus conspicillatus*	X	X	X	X
Australasian Grebe	*Tachybaptus novaehollandiae*			X	
White-necked Heron	*Ardea pacifica*	X		X	
White-faced Heron	*Egretta novaehollandiae*	X	X	X	
Striated Heron	*Butorides striatus*	X			
Little Egret	*Egretta garzetta*			X	
Intermediate Egret	*Ardea intermedia*	X			
Great Egret	*Ardea alba*	X	X	X	
Cattle Egret	*Ardea ibis*	X	X	X	
Australian White Ibis	*Threskiornis molucca*	X	X	X	X
Straw-necked Ibis	*Threskiornis spinicollis*	X		X	
Royal Spoonbill	*Platalea regia*	X	X	X	
Black Bittern	*Ixobrychus flavicollis*	X			
Black-necked Stork [TS]	*Ephippiorhynchus asiaticus*			X	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	X	X	X	X
Wedge-tailed Eagle	*Aquila audax*	X		X	
Little Eagle	*Hieraaetus morphnoides*			X	
Swamp Harrier	*Circus approximans*	X	X	X	
Whistling Kite	*Haliastur sphenurus*	X	X	X	X
Black-shouldered Kite	*Elanus axillaris*	X			
Grey Goshawk	*Accipiter novaehollandiae*			X	
Osprey [TS]	*Pandion haliaetus*	X	X	X	X
Australian Hobby	*Falco longipennis*		X		
Brown Falcon	*Falco berigora*	X		X	X
Nankeen Kestrel	*Falco cenchroides*			X	
Pied Oystercatcher [TS]	*Haematopus fuliginosus*			X	X
Sooty Oystercatcher [TS]	*Haematopus fluiginosus*			X	
Black-fronted Dotterel	*Elseyornis melanops*	X		X	
Black-winged Stilt	*Himantopus himantopus*	X			
Eastern Curlew	*Numenius madagascariensis*	X			
Whimbrel	*Numenius phaeopus*	X			
Latham's Snipe	*Gallinago hardwickii*	X			

TABLE 3.2 (Cont.) FAUNA SPECIES OBSERVED ON THE SITE AND ADJOINING AREAS					
Species List		**Species Locations**			
Common name	**Scientific Name**	**Riverside prior to 2007 Surveys**	**Riverside Surveys 2007/2008**	**Myall River Downs**	**Hawks Nest North**
Masked Lapwing	*Vanellus miles*	X	X	X	X
Silver Gull	*Larus novaehollandiae*	X		X	
Common Tern	*Sterna hirundo*	X		X	
Crested Tern	*Sterna bergii*	X			
Spotted Turtle-Dove *	*Streptopelia chinensis*	X		X	
Crested Pigeon	*Ocyphaps lophotes*	X	X	X	X
Peaceful Dove	*Geopelia striata*	X		X	
Brown Cuckoo-Dove	*Macropygia amboinensis*	X	X		
Common Bronzewing	*Phaps chalcoptera*	X		X	
Bar-shouldered Dove	*Geopelia humeralis*	X	X	X	
White-headed Pigeon	*Columba leucomela*	X	X	X	
Wonga Pigeon	*Leucosarciamelanoleuca*	X	X	X	
Emerald Dove	*Chalcophaps indica*			X	
Glossy Black-cockatoo TS	*Calyptorhynchus lathami*				X?
Sulphur-crested Cockatoo	*Cacatua galerita*	X	X	X	
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	X	X	X	X
Long-billed Corella	*Cacatua tenuirostris*			X	
Galah	*Cacatua roseicapilla*	X	X	X	
Rainbow Lorikeet	*Trichoglossus haematodus*	X	X		
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*	X	X	X	X
Little Lorikeet	*Glossopsitta pusilla*		X		
Musk Lorikeet	*Glossopsitta porphyrocephala*	X	X	X	
Eastern Rosella	*Platycercus eximius*	X	X	X	
Channel-billed Cuckoo	*Scythrops novaehollandiae*		X	X	
Common Koel	*Eudynamys scolopacea*	X		X	
Pallid Cuckoo	*Cuculus pallidus*	X		X	
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	X		X	
Pheasant Coucal	*Centropus phasianinus*	X	X	X	
Powerful Owl TS	*Ninox strenua*			X	
Barking Owl TS	*Ninox connivens*		X		
Barn Owl	*Tyto alba*			X	
Southern Boobook	*Ninox novaeseelandiae*	X	X	X	
Masked Owl	*Tyto novaehollandiae*				X
Tawny Frogmouth	*Podargus strigoides*	X	X	X	X
Fork-tailed Swift	*Apus pacificus*	X		X	
White-throated Needletail	*Hirundapus caudacutus*	X		X	
Azure Kingfisher	*Alcedo azurea*		X		
Laughing Kookaburra	*Dacelo novaeguineae*	X	X	X	X
Sacred Kingfisher	*Todiramphus sanctus*	X		X	X
Rainbow Bee-eater	*Merops ornatus*	X		X	
Dollarbird	*Eurystomus orientalis*			X	
White-throated Treecreeper	*Climacteric picumnus*	X	X	X	
Superb Fairy-wren	*Malurus cyaneus*	X	X	X	X
Variegated Fairy-wren	*Malurus lamberti*	X	X	X	

TABLE 3.2 (Cont.) FAUNA SPECIES OBSERVED ON THE SITE AND ADJOINING AREAS					
Species List		**Species Locations**			
Common name	**Scientific Name**	**Riverside prior to 2007 Surveys**	**Riverside Surveys 2007/2008**	**Myall River Downs**	**Hawks Nest North**
Southern Emu-wren	*Stipiturus malachurus*	X		X	
Spotted Pardalote	*Pardalotus punctatus*		X	X	
Striated Pardalote	*Pardalotus striatus*	X		X	
Southerrn Emu-wren	*Stipiturus malachurus*			X	
White-browed Scrubwren	*Sericornis frontalis*	X	X	X	
White-throated Gerygone	*Gerygone olivacea*	X	X	X	X
Brown Gerygone	*Gerygone mouki*	X		X	
Brown Thornbill	*Acanthiza pusilla*	X	X	X	
Buff-rumped Thornbill	*Acanthiza reguloides*	X			
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	X		X	
Yellow Thornbill	*Acanthiza lineata*	X		X	
Stirated Thornbill	*Acanthiza chrysorrhoa*	X		X	
Red Wattlebird	*Anthochaera carunculata*	X	X	X	X
Little Wattlebird	*Anthochaera chrysoptera*	X	X	X	X
Little Friarbird	*Philemon citreogularis*				X
Noisy Friarbird	*Philemon corniculatus*	X	X	X	X
Blue-faced Honeyeater	*Entomyzon cyanotis*	X	X	X	
Noisy Miner	*Manorina melanocephala*	X	X	X	X
Lewin's Honeyeater	*Meliphaga lewinii*	X	X	X	X
Yellow-faced Honeyeater	*Lichenostomus chrysops*	X	X	X	
Brown Honeyeater	*Lichmera indistincta*			X	
Brown-headed Honeyeater	*Melithreptus brevirostris*			X	
Fuscous Honeyeater	*Lichenostomus flavescens*			X	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	X		X	X
Scarlet Honeyeater	*Myzomela sanguinolenta*	X	X	X	
White-naped Honeyeater	*Melithreptus lunatus*			X	
White-cheeked Honeyeater	*Phylidonyris nigra*	X	X	X	X
Eastern Spinebill	*Acanthorhynchus tenuirostris*	X	X	X	X
Eastern Yellow Robin	*Eopsaltria australis*	X	X	X	
Eastern Whipbird	*Psophodes olivaceus*	X	X	X	X
Varied Sittella	*Daphoenositta chrysoptera*	X	X	X	
Jacky Winter	*Microeca fascinans*	X		X	
Crested Shrike-tit	*Falcunculus frontatus*			X	
Rufous Whistler	*Pachycephala rufiventris*	X	X	X	
Golden Whister	*Pachycephala pectoralis*	X	X	X	
Grey Shirke-thrush	*Colluricincla harmonica*	X		X	
Mistletoebird	*Dicaeum hirundinaceum*	X		X	
Grey Fantail	*Rhipidura fuliginosa*	X	X	X	
Rufous Fantail	*Rhipidura rufifrons*		X		
Leaden Flycatcher	*Myiagra rubecula*	X	X	X	
Willie Wagtail	*Rhipidura leucophrys*	X	X	X	X
Magpie-lark	*Grallina cyanoleuca*	X	X	X	X
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	X	X	X	X
White-winged Triller	*Lalage sueurii*			X	
Olive-backed Oriole	*Oriolus sagittatus*		X	X	
Figbird	*Sphecotheres viridis*			X	

TABLE 3.2 (Cont.) FAUNA SPECIES OBSERVED ON THE SITE AND ADJOINING AREAS					
Species List		**Species Locations**			
Common name	**Scientific Name**	**Riverside prior to 2007 Surveys**	**Riverside Surveys 2007/2008**	**Myall River Downs**	**Hawks Nest North**
White-breasted Woodswallow	*Artamus leucorynchus*		X	X	
Dusky Woodswallow	*Artamus cyanopterus*	X	X	X	
White-winged Chough	*Corcorax melanorhamphos*	X	X	X	
Satin Bowerbird	*Ptilonorhynchus violaceus*	X		X	
Richards Pipit	*Anthus novaeseelandiae*			X	
Grey Butcherbird	*Cracticus torquatus*	X	X	X	
Pied Butcherbird	*Cracticus nigrogularis*	X	X	X	X
Australian Magpie	*Gymnorhina tibicen*	X	X	X	X
Spangled Drongo	*Dicrurus bracteatus*			X	
Pied Currawong	*Strepera graculina*	X	X	X	X
Torresian Crow	*Corvus orru*	X	X	X	X
Australian Raven	*Corvus coronoides*	X	X	X	X
Red-browed Finch	*Neochmia temporalis*	X	X	X	
Double-barred Finch	*Taeniopygia bichenovii*	X			
Golden-headed Cisticola	*Cisticola exilis*	X		X	
Little Grassbird	*Megalurus gramineus*	X			
Welcome Swallow	*Hirundo neoxena*	X	X	X	X
Fairy Martin	*Hirundo ariel*	X			
Silvereye	*Zosterops lateralis*	X	X	X	X
House Sparrow *	*Passer domesticus*	X		X	
Common Starling *	*Sturnus vulgaris*	X			
Common Myna *	*Acridotheres tristis*	X		X	
Mammals					
Echidna	*Tahyglossus aculeatus*	X			
Eastern Grey Kangaroo	*Macropus giganteus*	X	X	X	
Red-necked Wallaby	*Macropus rufogriseus*	X	X	X	
Swamp Wallaby	*Macropus bicolor*	X		X	
Northern Brown Bandicoot	*Isoodon macrourus*	X		X	
Long-nosed Bandicoot	*Parameles nasuta*	X			
Common Brushtail Possum	*Trichosurus vulpecula*	X	X	X	X
Common Ringtail Possum	*Pseudocheirus peregrinus*	X		X	
Koala [TS]	*Phascolartos cinereus*	X		X	X
Squirrel Glider [TS]	*Petaurus norfolcensis*	X		X	
Sugar Glider	*Petaurus breviceps*	X		X	
Feathertail Glider	*Acrobates pygmaeus*	X		X	
Eastern Pygmy-possum [TS]	*Cercartetus nanus*			X	
Yellow-footed Antechinus	*Antechinus flavipes*				X
Brown Antechinus	*Antechinus stuartii*	X	X	X	X
Common Dunnart	*Sminthopsis murina*	X			
Grassland Melomys	*Melomys burtoni*			X	
Grey-headed Flying-fox [TS]	*Pteropus poliocephalus*	X	X	X	
Little Red Flying-fox	*Pteropus scapulatus*		X		
Common Blossom-bat [TS]	*Syconycteris australis*	X			X
Gould's Wattled Bat	*Chalinolobus gouldii*	X	X	X	

TABLE 3.2 (Cont.) FAUNA SPECIES OBSERVED ON THE SITE AND ADJOINING AREAS					
Species List		**Species Locations**			
Common name	**Scientific Name**	**Riverside prior to 2007 Surveys**	**Riverside Surveys 2007/2008**	**Myall River Downs**	**Hawks Nest North**
Chocolate Wattled Bat	*Chalinolobus morio*	X	X	X	
Eastern Freetail-bat [TS]	*Mormopterus norfolkensis*	X		X	
Freetail-bat	*Mormopterus species 2.*			X	
Eastern Bentwing-bat [TS]	*Miniopterus schreibersii oceanensis*	X			
Little Bentwing-bat [TS]	*Miniopterus australis*	X	X	X	
Large-footed Myotis [TS]	*Myotis adversus*	X			
Gould's Long-eared Bat	*Nyctophilus gouldii*			X	
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	X		X	
Long-eared Bat	*Nyctophilus sp.*		X	X	
White-striped Freetail-bat	*Nyctinomus australis*			X	
Greater Broad-nosed Bat [TS]	*Scoteanax rueppelli*	X		X	X
Eastern Broad-nosed Bat	*Scotorepens orion*			X	
Large Forest Bat	*Vespadelus darlingtoni*	X			
Little Forest Bat	*Vespadelus vulturnus*	X	X	X	
Eastern Forest Bat	*Vespadelus pumilus*	X	X		
Southern Forest Bat	*Vespadelus regulus*	X		X	
Bush Rat	*Rattus fuscipes*	X	X	X	X
Swamp Rat	*Rattus lutreolus*	X		X	
Black Rat *	*Rattus rattus*	X			
House Mouse *	*Mus musculus*	X		X	
New Holland Mouse	*Pseudomys novaehollandiae*				X
Eastern Chestnut Mouse [TS]	*Pseudomys gracilicaudatus*			X	
Dog *	*Canis familiaris*	X		X	
Dingo	*Canis lupus*	X			X
European Red Fox *	*Vulpes vulpes*	X		X	
Cat *	*Felis cattus*	X		X	X
Rabbit *	*Oryctolagus cuniculus*	X	X	X	
Brown Hare *	*Lepus lepus*	X	X	X	
Horse *	*Equus caballus*		X		
Goat *	*Capra hircus*	X			
Cow *	*Bos taurus*	X	X	X	
Fish					
Plague Minnow *	*Gambusia holbrooki*	X	X	X	
Crustean					
Blue-claw Crayfish	*Cherax destructor*	X	X	X	
[TS] Threatened species	* Introduced species		X? unconfirmed record		

Birds

A total of 78 bird species were recorded within the subject site during the surveys conducted in 2007/2008. A full list of bird species recorded within the local area is provided in Table 3.2.

Two threatened bird species, the Barking Owl and Osprey, as listed in Schedule 2 (vulnerable) of the *TSC Act* (1995), were recorded within the subject site during surveys conducted in 2007/2008.

Diurnal Birds

A total of 75 diurnal bird species were recorded within the subject site during surveys conducted in 2007/2008.

Of these, 16 species are considered to be dependant on aquatic habitats for foraging. Some water bird species, such as ducks, herons, egrets, spoonbills and the ibis, occur in greater numbers in coastal regions during high rainfall periods especially when inland areas are in drought. However, within the local area, these species appear to be resident for most of the year, regardless of rainfall, due to the presence of permanent water bodies associated with the Myall River estuary.

Six diurnal raptor species were recorded within the subject site during the surveys conducted 2007/2008. One threatened raptor species, the Osprey, as listed in Schedule 2 (vulnerable) of the *TSC Act* (1995), was recorded flying over the subject site.

Nocturnal Birds

A total of 3 nocturnal species were recorded within the subject site during surveys conducted in 2007/2008 of which one species the Barking Owl *(Ninox connivens)* is listed on Schedule 2 (vulnerable) of the TSC Act 1995. A further 4 nocturnal bird species have been recorded within 10km of the subject site including the Powerful Owl *(Ninox strenua)* and the Masked Owl *(Tyto novaehollandiae)* both listed in Schedule 2 (vulnerable) of the TSC Act 1995 (NPWS 2008).

Mammals

A total of 9 mammal species (excluding bats) were recorded within the subject site during the surveys conducted in 2007/2008. One of these species (Squirrel Glider) is listed in Schedule 2 (vulnerable) of the *TSC Act* (1995).

Five exotic mammal species were recorded within the subject site during surveys conducted in 2007/2008, of which 3 are considered pest species.

Two species the Eastern Pygmy-possum and Eastern Chestnut Mouse, as listed in Schedule 2 (vulnerable) of the *TSC Act* (1995) have been recorded within 5 kilometres of the site.

Arboreal Mammals

Suitable foraging and shelter habitat for arboreal mammals was observed within the subject site. One arboreal mammal species was recorded during the surveys conducted in 2007/2008. A full list of arboreal mammal species recorded within the local area is provided in Table 3.2.

Terrestrial Mammals

Suitable habitat for terrestrial mammals was observed within the subject site. *Macropod* species were common within the cleared areas, and smaller *Rattus* species in the forested areas. A total of 8 terrestrial mammal species were recorded within the subject site during surveys conducted in 2007/2008.

A full list of terrestrial mammal species recorded within the local area is provided in Table 3.2.

Bats

Suitable foraging habitat megachiropteran and microchiroptera bats are present within the subject site. Suitable roosting habitat is present only for those species that roost in tree hollows or under bark.

A total of 8 bat species were recorded within the subject site during surveys conducted in 2007/2008. The following threatened bat species as listed within the *TSC Act* (1995) were identified on the site:

- Grey-headed Flying-fox;
- Little Bentwing-bat;
- Eastern Freetail-bat;
- Greater Broad-nosed Bat.

Frogs

A total of 13 frog species were observed within the subject site during surveys conducted in 2007/2208, including 1 threatened species, the Wallum Froglet, as listed in Schedule 2 (vulnerable) of the *TSC Act* (1995). All other observed species are considered relatively common in the local area.

Targeted Wallum Froglet surveys were carried out to determine its distribution within the subject site. This species was heard calling during both diurnal and nocturnal surveys, and on most visits to the site.

The Plague Minnow (*Gambusia hoolbrooki*), which predates on tadpoles, is abundant in all permanent fresh water bodies across the subject site. Tadpole predation by Plague Minnow is a listed Threatening Process within Schedule 3 of the *TSC Act* (1995).

A full list of frog species recorded within the local area is provided within the Table 3.2.

A total of 20 frog species have been recorded within 10km of the subject site (NPWS 2008).

Reptiles

A total of 5 reptile species were observed within the subject site during surveys conducted in 2007/2008. No threatened reptile species were recorded.

The subject site contains suitable reptile habitat in the form of wet areas, fallen logs and hollow bearing trees within forested areas. Drainage lines provide suitable foraging and shelter habitat for skinks, dragons, pythons and elapid snake species such as the Black-bellied Swamp Snake and the Red-bellied Black Snake.

A full list of reptile species recorded within the local area is provided within the Appendices.

Aquatic Species

Two aquatic species were recorded during the fauna surveys within the subject site. These species are Plague Minnow and the Blue-claw Crayfish.

3.2.3 Threatened Fauna Species

The detailed seasonal surveys undertaken during 2007/08 identified the following threatened fauna species within the subject site.

- Wallum Froglet (*Crinia tinnula*);
- Osprey (*Pandion haliaetus*);
- Barking Owl (*Ninox connivens*);
- Little Bentwing-bat (*Miniopterus australis*);
- Grey-headed Flying-fox (*Pteropus poliocephalus).*

Additionally the following species have previously been recorded on the subject site.

- Squirrel Glider (*Petaurus australis*).
- Koala (*Phascolarctos cinereus*);
- Common Blossom-bat (*Syconycteris australis*).
- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Eastern Bentwing-bat (*Minipterus schreibersii oceanensis*).

Figure 3.2 shows the location of threatened species observed within the subject site during recent surveys undertaken during 2007 and 2008.
The detailed surveys completed for the subject site have identified several threatened fauna species utilising habitats present for foraging purposes. Details of these species and other threatened fauna species with suitable habitat present are provided below.

Wallum Froglet (*Crinia tinnula)*
This species is usually found in association with wetlands and vegetation communities occurring on low nutrient sandy soils, including coastal freshwater swamps and lakes, wet heath and nearby eucalypt/forest woodland. Water bodies this species breeds in are usually nutrient poor and acidic wallum areas (pH<6.0).

This species was observed calling within a number of areas of the subject site during surveys. The higher quality, less disturbed vegetation and habitat types for this species within the subject site will be retained by the proposed development. The Management Plan to be implemented for the site will detail strategies for the control of water quality and maintenance of hydrological conditions.

Green and Golden Bell Frog (*Litoria aurea*)
The Green and Golden Bell Frog is largely aquatic and is found among vegetation within or at the edges of permanent water. It is frequently active during the day and can be found under debris on low, frequently flooded river flats.

The subject site contains some suitable habitat for this species within the wetter vegetation types associated with the farm dams. This species was not detected within the subject site during surveys.

Green-thighed Frog (*Litoria brevipalmata*)
The Green-thighed Frog has been found in mostly terrestrial habitats including along the grassy margins of semi-permanent and permanent ponds in late spring and rainforests, moist open forest (Robinson 1993), drier open forest and woodland (Nattrass & Ingram 1993), coastal swamp forest and along the perimeter of flooded paddocks (Barker & Grigg 1977).

The subject site contains some suitable habitat for this species within the wetter vegetation types associated with the farm dams.

Magpie Goose (*Anseranas semipalmata*)
Magpie Geese inhabit terrestrial wetlands live in shallow swamps and associated grasslands, feeding on seeds or tubers and green grass. They occur across northern Australia and throughout eastern Australia including parts of western NSW (Garnett & Crowley 2000).

The subject contains suitable foraging habitat for this species. This species was not observed within the subject site during surveys.

Osprey (*Pandion haliaetus*)
The Osprey is generally found in association with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, off shore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995). These habitat locations usually have a sufficient supply of fish for food and possible nesting sites (Clancy 1991). Osprey may nest on the ground on sea cliffs or in trees (Olsen 1995). Ospreys generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995). Nests are large and built of sticks, roughly lined with grass and seaweed (Schodde and Tidemann 1986).

The subject site contains suitable roosting habitat for this species adjacent to suitable foraging areas within the Myall River. This species was detected flying over the site but was not detected roosting within the subject site during surveys. This species has previously been recorded utilising a nest site within the Tea Gardens township.

Bush Stone-curlew (*Burhinus grallarius*)
The Bush Stone-curlew has been located in dry open woodland closely associated with grassy areas, occasionally near beaches. It prefers to forage in areas with fallen timber, leaf litter, and little undergrowth and where the grass is short and patchy (Environment Australia 2000). Marchant and Higgins 1993; Johnson and Baker-Gabb 1994). It is occasionally recorded on dune scrubs, in savanna areas, the fringes of mangroves and even on golf courses and open forest farmland (Marchant and Higgins 1993). The Bush Stone-curlew roosts on ground among leaf-litter, often among clumps or thickets of trees in, or adjacent to, more open habitat; within day-shelters, percentage cover of fallen tree debris is higher; there is more bare ground, lower grass and less disturbance (Environment Australia 2000).

The subject site contains some suitable habitat for this species. This species was not detected within the subject site during surveys.

Black-necked Stork (*Ephipiorhynchus asiaticus*)
The Black-necked Stork occurs throughout tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats and occasionally in grassland and wooded lands (Marchant and Higgans 1990). This species utilises a range of waterbodies including extensive sheets of shallow water over grassland and sedgeland, shallow swamps with small emergent vegetation and abundant aquatic life, permanent billabongs and pools on floodplains, freshwater meadows, wet heathland, seepage fern springs, semi-permanent swamps with tall emergent vegetation and occasionally in small artificial waterbodies such as farm dams, irrigation storages and sewage ponds (Marchant and Higgans 1990).

The subject contains suitable foraging habitat for this species. This species was not observed within the subject site during surveys. There is a local recent record for this species to the south-west of the subject site (*Conacher Travers* 2006) at Myall River Downs.

Square-tailed Kite (*Lophoictinia isura*)
The Square-tailed Kite occurs typically in forested and wooded lands of tropical and temperate Australia (Marchant and Higgins 1993). The species may be recorded inland along timbered watercourses, but are often absent from waterless areas (NPWS 1999).

The subject site contains suitable roosting habitat for this species adjacent to suitable foraging areas. This species was not detected within the subject site during surveys.

Glossy Black-Cockatoo (*Calyptorhynchus lathami*)
The Glossy Black-Cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of casuarinas. Foraging within Casuarinas tends to be concentrated on trees with greater crops of cones (Clout 1989). This species nests in large trees with large hollows (dead and alive). The Glossy Black-Cockatoo usually forages close to the nest but is capable of traveling up to 20km away thus requiring a water source (DEH 2000).

The subject contains suitable foraging habitat for this species within the Allocasuarina tree species present. This species was not observed within the subject site during surveys.

Swift Parrot *(Polytelis swainsonii)*
This species feeds mainly on nectar and lerp from eucalypt flowers, particularly Blue Gum (*Eucalyptus globulus*). On the mainland, the Swift Parrot congregates where winter flowering species such as Red Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*), Yellow Gum (*Eucalyptus leucoxylon*) and Swamp Gum (*Eucalyptus ovata*) (Brown, 1989). The Swift Parrot is a migratory species that breeds in Tasmania and its offshore islands in summer (Shepherd, 1994). In late March almost the entire population migrates to mainland Australia (Schodde and Tidemann, 1986).

The subject site contains some suitable foraging habitat for this species within the winter flowering *Eucalyptus robusta* however it was not detected during surveys.

Turquoise Parrot (*Neophema pulchella*)
The Turquoise Parrot is a sedentary species inhabiting the foothills of the Great Divide, including steep rocky ridges and gullies, rolling hills, valleys and river-flats, sometimes nearby plains. This species feeds on the ground among seeding grasses or weeds usually beneath trees. Endemic to eastern Australia, from south east Queensland through eastern New South Wales to north east Victoria (Higgins 1999).

The subject site contains some suitable foraging habitat for this species however it was not detected during surveys.

Powerful Owl (*Ninox strenua*)
The Powerful Owl inhabits mature rainforest and wet and dry eucalypt forest (Schodde and Tidemann 1986). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Schodde et al. 1980; SWC Consultancy 1993). Estimates of the home range of this species vary greatly but territories are thought to be a minimum of 800 hectares (Kavanagh 1988). It is suggested that Powerful Owls forage by concentrating their activities in pockets of their large home range until they reduce their population of preferred prey below limits where it becomes difficult to catch the remaining animals (Kavanagh, 1988).

This species has been recorded within the local area (*PPK* 2000, *Conacher Travers* 2006). However, despite extensive surveys, this species has not been recorded within the subject site. The subject site contains suitable foraging habitat for this species. No hollows of a suitable size for roosting or breeding have been identified within the subject site.

Barking Owl *(Ninox connivens)*
The Barking Owl utilises dry sclerophyll forests and woodlands of tropical, temperate and semi-arid zones, often dominated by eucalypts, and containing many large trees suitable for roosting or breeding. This species is both carnivorous and insectivorous, taking mainly insects outside breeding season and more birds and mammals when breeding (Higgins, 1999).

The subject site contains suitable foraging habitat for this species. No hollows of a suitable size for roosting or breeding have been identified within the subject site. This species was recorded within the subject site during surveys.

Masked Owl (*Tyto novaehollandiae*)
The Masked Owl is widespread though forests and woodlands, utilising caves for shelter in treeless country. The Masked Owl is known to utilise forest margins and isolated stands of trees within agricultural land (Hollands 1991; Hyem 1979). This species is often found in heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained (Kavanagh and Peake 1993). The Masked Owl requires old mature trees with large hollows for breeding and as diurnal roosting sites, being dependent upon hollow bearing trees all year round rather than only during the breeding season (Hyem, 1979).

This species has been recorded within the local area (*ERM Mitchell McCotter* 1998, *Conacher Travers* 2006). However, despite extensive surveys, this species has not been recorded within the subject site. The subject site contains suitable foraging habitat for this species. No hollows of a suitable size for roosting or breeding have been identified within the subject site.

Regent Honeyeater (*Xanthomyza phrygia*)
The Regent Honeyeater inhabits temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. This species is also known to utilise riparian forests of River Oak (*Casuarina cunnighamiana*) (Garnett 1993). The Regent Honeyeater relies on locally abundant nectar sources, especially flowering eucalypts that occur mainly in dry open woodland.

The subject site contains some suitable foraging habitat for this species within the winter flowering *Eucalyptus robusta* however it was not detected during surveys.

Black-chinned Honeyeater *(Melithreptis gularis gularis*)
The Brown Treecreeper can be found in eucalypt woodland over much of eastern Australia. They prefer drier forests/woodlands with fallen branches and its distribution is known to coincide with that of River Red Gums and other eucalypts bordering river courses but it prefers rough-barked trees, especially the boxes and peppermints (Longmore, 1991; Pizzey and Knight, 1997). Hollows in trees are known to be important for Brown Treecreepers. They provide nesting chambers, roosting sites, refuges from predators and sources of food (Longmore, 1991).

The subject site contains some suitable foraging habitat for this species however it was not detected during surveys.

Koala (*Phascolarctos cinereus)*
Koalas inhabit forested areas with acceptable Eucalypt food trees, also utilising non-Eucalypt species as a food source. Koalas inhabit both wet and dry Eucalypt forest that contains a canopy cover of approximately 10 to 70% (Reed *et al.* 1991) growing on high nutrient soils.

The subject site contains some suitable foraging and refuge/shelter habitat for this species within tree species present however it was not detected during surveys. The most recent record for this species within the subject site is from 1995 (NPWS 2008).

Squirrel Glider *(Petaurus norfolcensis)*
The Squirrel Glider is an arboreal, tree dwelling mammal that feeds on nectar, pollen, eucalypt sap, *Acacia* gum, honeydew and arthropods (Quin 1993). The Squirrel Glider feeds on sugary exudates to obtain its energy requirements and arthropods for protein (Smith 2002). The Squirrel Glider feeds on nectar of flowering tree species, honeydew and by gleaning arthropods from vegetation. This species also feeds on sap flows by incising the bark of trees. The Squirrel Glider uses tree hollows for den sites either alone or communally.

The subject site contains suitable foraging and den/refuge habitat for this species. This species was observed within the subject site during surveys in 2002 and 2004.

Eastern Pygmy-possum (*Cercatetus nanus*)
The Eastern Pygmy-possum is found from rainforest through sclerophyll forest to tree heath. Banksia and myrtaceous shrubs and trees are favoured (Turner and Ward, 1995). An important determinant of habitat quality may be the proportion of the year in which pollen is available and the species is usually associated with floristically diverse shrub community, especially those including *Banksia* species. However populations also occur in box-ironbark associations where the understorey is sparse but relatively diverse (Menkhorst, 1996).This species has a preference for hollows with a small entrance (Environment Australia, 1999).

The subject site contains suitable foraging and den/refuge habitat for this species. This species was not observed within the subject site during surveys. The Eastern Pygmy-possum is known from two recent locations within the Tea Gardens area (*Conacher Travers* 2006; M. Bell *pers. comm*. 2006).

Brush-tailed Phascogale (*Phascogale tapoatafa*)
The principle habitat of the Brush-tailed Phascogale are dry open forest and woodlands containing various associations of bloodwood, messmate, box, stringybark and ironbark trees (Cuttle 1982, 1992; Traill 1991; Traill and Coates 1993) with an understorey varying between acacias, grasses and low herbs and dense leaf litter (Cuttle 1982). Tree hollows are used for shelter and nesting which can be shared by several individuals.

The subject site contains some suitable habitat for this species however it was not detected during surveys.

Common Planigale (*Planigale maculata*)
The Common Planigale has been detected in habitats ranging from rainforest to dry hardwood forest, grasslands, marshlands, rocky areas and on the fringes of urban areas (Braithwaite 1988).

The subject site contains some suitable habitat for this species however it was not detected during surveys.

Long-nosed Potoroo (*Potorous tridactylus*)
The Long-nosed Potoroo occupies a wide range of habitats, from heath to dry and moist hardwood forests usually where rainfall exceeds 760mm. It requires thick groundcover and may be commoner on light sandy soils (Newsome and Catling, 1979). Schlager (1981) proposed that warm, temperate rainforest provides the 'backbone' of the distribution of this species with surrounding moist hardwood forests as the supplementary habitat.

The subject site contains some suitable habitat for this species however it was not detected during surveys.

Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*)
The Eastern Chestnut Mouse has been recorded in open woodlands with a grassy understorey but is more often found in heathland and most common in dense wet heath swampy areas (Fox 1988). Nests are constructed from grass and are located either above ground or in a tunnel system (Fox1988). Optimal habitat for this species is provided by regenerating vegetation (Fox 1988). Disturbance by wildfire appears to favour an increase in populations (Fox 1988, 1990; Fox et al. 1985) with substantial increases having been reported in coastal heathland in the second to fourth regeneration years after fire (Fox 1990).

The subject site contains suitable habitat for this species. This species was not observed within the subject site during surveys. The Eastern Chestnut Mouse is known from one recent location within the Tea Gardens area (PPK 2000).

Grey-headed Flying-fox (*Pteropus poliocephalus*)
The Grey-headed Flying-fox is found in a variety of habitats including rainforest, mangroves, paperbark swamps, wet and dry sclerophyll forests and cultivated areas (Churchill, 1998). Grey-headed Flying-foxes congregate in large camps of up to 200,000 individuals, depending on availability of surrounding blossoming plants, from early until late summer (Churchill, 1998). Camps are commonly formed in gullies, typically not far from water and in vegetation with a dense canopy. Roost sites are and important resource where mating, birth and rearing of young occurs as well as providing refuge (Strahan, 1995).

The subject site provides suitable foraging habitat for this species, however no colonies or camp sites were located on the subject site during surveys. The Grey-headed Flying-fox has been detected within the subject site on several occasions.

Common Blossom-bat (*Synconycteris australis*)
The Common Blossom-bat is found in the coastal regions from Cape York Peninsula to Northern NSW. In tropical Australia, the Common Blossom-bat roosts among rainforest foliage and feeds on nectar and pollen from a variety of rainforest trees. (Law & Spencer 1995). At the southern limits of its range, heathland and Melaleuca swamps are critical feeding habitats: *Banksia, Melaleuca, Callistemon* and certain eucalypts are favoured sources of food in these areas (Law & Spencer 1995).

Large-eared Pied Bat (*Chalinolobus dwyeri*)
The Large-eared Pied Bat forages for insects below the forest canopy. During the day these bats may roost in caves, mine tunnels and the abandoned nests of Fairy Martins (Dwyer, 1991). The Large-eared Pied Bat may also utilise tree hollows (Schultz *et. al.* 1994). The Large-eared Pied Bat is mainly found in drier habitat including dry sclerophyll and woodland, east and west of the Great Dividing Ranges. However Hoye and Dwyer (1995) suggest that from records of the species in subalpine woodland, moist eucalypt forest and near rainforest, it may tolerate a greater range of habitats. The distribution of this bat ranges from inland and south-eastern Queensland to central-eastern and north-eastern NSW (Parnaby 1992).

The subject site contains suitable foraging and roosting habitat for this species however it was not detected during surveys.

Large-footed Myotis (*Myotis adversus*)
The Large-footed Myotis inhabits cool temperate, temperate, sub tropical and tropical rainforests and wet and dry sclerophyll forests (Richards 1995b). This species roost in colonies in caves, mines, tunnels, under bridges and buildings, in dense foliage in tropical areas (Richards 1995b) and in tree hollows (Menkhorst 1995). Colonies are always found near water bodies as the species feeds predominantly over water.

Little Bentwing-bat (*Miniopterus australis*)
The Little Bentwing-bat is generally found in forested areas where it forages below the tree canopy (Dwyer 1995). This species roosts in caves, old mines, stormwater channels, tree hollows, buildings and in bunches of bananas, using different roosting sites depending on seasonal needs, age and reproductive status (Dwyer 1995, Hulm 1994).

The subject site contains suitable foraging and roosting habitat for this species. The Little Bentwing-bat was observed within the subject site during recent surveys.

Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
The Eastern Bentwing-bat forages above and below the canopy within open forests and woodlands, feeding on small insects (Dwyer 1995a). The Esatern Bentwing-Bat is known to roost in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and, in particular, caves (Dwyer 1995a).

The subject site contains suitable foraging habitat for this species. The Eastern Bentwing-bat was observed within the subject site during surveys conducted by *Ecotone Ecological Consultants* in 1995 and *Conacher Travers* in 2001, 2002 and 2004.

Greater Broad-nosed Bat (*Scoteanax rueppellii*)
The Greater Broad-nosed Bat inhabits open forests and woodlands, foraging throughout these forest types and also along creeks and small river systems (Hoye & Richards, 1995). This species roosts in tree hollows and occasionally old buildings (Hoye & Richards, 1995).

The subject site contains suitable foraging and roosting habitat for this species. The Greater Broad-nosed Bat was observed within the subject site during surveys conducted by *Ecotone Ecological Consultants* in 1995 and *Conacher Travers* in 2002.

Eastern Freetail-bat (*Mormopterus norfolkensis*)
The Eastern Freetail-bat feeds on insects, flying above the canopy or in clearings along the edge of the forest (Allison, 1988). The Eastern Freetail-bat is generally found in rainforests, open forests and woodland (*AMBS* 1995). Colonies have been found roosting under loose bark, in tree hollows (Allison 1988), within the roofs of houses and in other modified habitats.

The subject site contains suitable foraging and roosting habitat for this species. The Eastern Freetail-bat has been observed during surveys conducted within the subject site by Conacher Travers in 2004.

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
The Eastern False Pipistrelle inhabits warm to cool temperate moist and dry open forests (Strahan 1988). Little is known about the biology of this species although it has been recorded in logged and unlogged areas, preferring open areas for foraging (O'Neill &Taylor 1986). The Eastern False Pipistrelle roosts mainly in tree hollows, occasionally utilising caves and abandoned buildings (Parnaby 1992, Phillips *et al.* 1985).

The subject site contains suitable foraging and roosting habitat for this species however it was not detected during surveys.

Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
The Yellow-bellied Sheathtail Bat inhabits open country, mallee, eucalypt forests, rainforests, heathland and waterbodies. It roosts in tree hollows and has been found inhabiting the abandoned nests of Sugar Gliders (Richards 1988).

The subject site contains suitable foraging and roosting habitat for this species however it was not detected during surveys.

3.2.4 Fish Species

A total of 15 fish species have been identified within the Riverside Lake since fish surveys were commenced in 1998. The latest survey by AMBS and Harris Research Pty Ltd (2007) identified 11 species occurring within the lake. The fish species observed in the lake are listed in Table 3.3.

TABLE 3.3
FISH SPECIES OBERVED WITHIN THE LAKE

Gambusia holbrooki	Eastern gambusia
Psuedomugil signifier	Pacific blue-eye
Mugil cephalus	Striped (or 'sea') mullet
Myxus elongates	Sand mullet
Acanthopagrus australis	Yellow-finned Bream
Gerres subfasciatus	Silver Biddy
Philypnodon grandiceps	Flathead gudgeon
Philypnodon sp.	Dwarf flathead gudgeon
Afurcagobius tamarensis	Blue spot goby
Amoya bifrenatus	Tamar River goby
Favonigobius exquisitus	Exquisite sand goby
Galaxias maculatus	Common jollytail
Gobiopterus semivestitus	Glass goby
Mugilogobius paludis	Mangrove goby

Annexure 1 – 2008 Flora Survey Data

Family	Scienfic Name	Common Name	Q1	T1	Q2	T2	Q3	T3	Q4	T4	Q5	T5	Q6	T6	Q7	T7	Q8	T8	Q9	T9	Q10	T10	Q11	T11	Form	Status	Caps
Anthericaceae	*Caesia parviflora var. parviflora*	-	1	x																					g	u	7183
Anthericaceae	*Thysanotus tuberosus*	Common Fringe-lily																							g	u	3574
Anthericaceae	*Tricoryne elatior*	lily																							g	u	7355
Apiaceae	*Centella asiatica*	Pennywort		x													1	x			2	x			g	u	1106
Apiaceae	*Hydrocotyle bonariensis**	A Pennywort			1	x								x											g	u	1123
Apiaceae	*Hydrocotyle peduncularis*	-	1	x	2	x	2	x	2	x			2	x			2	x	1	x					g	u	1130
Apiaceae	*Platysace ericoides*	-																							g	u	1143
Apiaceae	*Platysace lanceolata*	Native Parsnip																					2	x	s	u	1144
Apiaceae	*Platysace linearifolia*	Narrow-leafed Platysace																							s	u	1145
Apocynaceae	*Gomphocarpus fruticosus**	Narrow-leaved Cotton Bush												x											s	u	1227
Apocynaceae	*Parsonsia straminea*	Common Silkpod																							v	u	1185
Araliaceae	*Polyscias sambucifolia subsp.sambucifolia*	-						x		x	1														s	u	12373
Arecaceae	*Livistona australis*	Cabbage Palm	1				1		1																t	P13	1221
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern							1																g	u	11784
Asteraceae	*Bidens pilosa**	Cobbler's Pegs	1	x	4	x	1	x	1	x	2	x	1	x	2	x									g	u	1283
Asteraceae	*monilifera subsp. rotundata*	Bitou Bush		x																			1		s	u	8686
Asteraceae	*Cirsium vulgare**	Spear Thistle											2	x	1	x									g	u	1400
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane	1	x	2	x			1	x	2	x	1	x	1	x									g	u	1404
Asteraceae	*Conyza sumatrensis**	Tall fleabane			1	x					1	x	2	x	2	x									g	u	10442
Asteraceae	*Crassocephalum crepidioides**	Thickhead			1	x	1	x					1												g	u	1421
Asteraceae	*Epaltes australis*	Spreading Nut-heads															1	x							g	u	7425
Asteraceae	*Hypochaeris radicata**	Catsear	2	x	2	x			2	x	2	x			1	x	1	x	1	x					g	u	8788
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy	1	x													1	x							g	u	1551
Asteraceae	*Senecio diaschides*	-	1	x																					g	u	7914
Asteraceae	*Senecio madagascariensis**	Fireweed	1	x		x						x	1	x	2	x	1	x					1	x	g	u	6465
Asteraceae	*Sigesbeckia orientalis subsp. orientalis*	Indian Weed																							g	u	8789

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Asteraceae	*Taraxacum officinale**	Dandelion							2	x			2	x	1	x							1	x	g	u	1698
Asteraceae	*Vernonia cinerea var. cinerea*	-		x	1	x															1	x			g	u	9254
Baueraceae	*Bauera rubioides*	Dog Rose																							g	u	2268
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine					1	x	1	x															g	u	1740
Blechnaceae	*Blechnum indicum*	Swamp Water Fern											1	x											g	u	8057
Blechnaceae	*Doodia aspera*	Prickly Rasp Fern																							f	u	8064
Cactaceae	*Opuntia stricta var. stricta**	Common Prickly Pear																							s	u	7659
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell			1	x				x				x											g	u	1934
Caryophyllaceae	*Stellaria media**	Common Chickweed	1	x											1										g	u	2006
Casuarinaceae	*Allocasuarina littoralis*	Black Sheoak																							t	u	2012
Clusiaceae	*Hypericum gramineum*	Small St John's Wort																	1	x					g	u	7240
Clusiaceae	*Hypericum japonicum*	-																							g	u	2203
Commelinaceae	*Commelina cyanea*	Native Wandering Jew	2	x	1	x	2	x	1	x				x											g	u	2209
Convolvulaceae	*Dichondra repens*	Kidney Weed		x													2	x							g	u	2222
Convolvulaceae	*Polymeria calycina*	Polymeria															1	x							g	u	2231
Cyperaceae	*Baumea articulata*	Jointed Twig-rush																							g	u	2296
Cyperaceae	*Baumea rubiginosa*	-																			1	x			g	u	2302
Cyperaceae	*Baumea teretifolia*	A Twigrush																							g	u	2303
Cyperaceae	*Carex appressa*	Tall Sedge	1	x				x					1	x											g	u	2310
Cyperaceae	*Chorizandra cymbaria*	Heron Bristle Rush																			1	x			g	u	2344
Cyperaceae	*Cyperus aggregatus**	-							1	x			1	x	1	x									g	u	8845
Cyperaceae	*brevifolius**	-																							g	u	2353
Cyperaceae	*Cyperus difformis*	-																							g	u	7143
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge								x				x										x	g	u	2364
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge							2	x															g	u	2374
Cyperaceae	*Cyperus polystachyos*	A Sedge	2	x	1	x			1	x			1	x	1	x									g	u	8483
Cyperaceae	*Cyperus sesquiflorus**	-	1	x																					g	u	2398
Cyperaceae	*Eleocharis pusilla*	-																									

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Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge	1	x														x	2	x	2	x			g	u	7435
Cyperaceae	*Gahnia aspera*	Rough Saw-sedge	1	x																					g	u	2431
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge																							g	u	2432
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge									1		3	x	1	x	1	x		x			1	x	g	P13	2442
Cyperaceae	*Isolepis inundata*	Swamp Clubrush																							g	u	2454
Cyperaceae	*Isolepis nodosa*	Knobby Club-rush				x															1	x			g	u	2457
Cyperaceae	*Juncus usitatus*	-	1	x		x					1	x	1	x		x							1	x	g	u	3350
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		x													1	x					2	x	g	u	6402
Cyperaceae	*Ptilothrix deusta*	-																							g	u	8956
Cyperaceae	*Schoenus apogon*	Fluke Bogrush																	1	x	2	x			g	u	2491
Cyperaceae	*Schoenus brevifolius*	A Bog Rush																	1		1	x	1	x	g	u	2492
Cyperaceae	*Schoenus ericetorum*	A Bog Rush																							g	u	2495
Dennstaedtiaceae	*Histiopteris incisa*	Bat's Wing Fern																							g	u	7271
Dennstaedtiaceae	*Pteridium esculentum*	Bracken			3	x	4	x	4	x	2	x	4	x	3	x	2	x					3	x	f	P13	6403
Dicksoniaceae	*Calochlaena dubia*	Dicksoniaceae																							f	P13	8341
Dilleniaceae	*Hibbertia acicularis*	Prickly Guinea Flower																							g	u	2526
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower															1			x					g	u	2527
Dilleniaceae	*Hibbertia linearis*	-							1	x													1	x	s	u	2539
Dilleniaceae	*obtusifolia*	-					1																		s	u	2542
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower	1	x	2	x	2	x	1	x	1	x	2	x	1	x								x	v	u	2548
Dilleniaceae	*Hibbertia vestita*	-																					1	x	g	u	2551
Dilleniaceae	*Hibbertia virgata subsp. virgata*	-																							g	u	9398
Droseraceae	*Drosera peltata*	Pygmy Sundew																		x	2	x			g	u	2559
Droseraceae	*Drosera spatulata*	Sundew																	1	x					g	u	2561
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash																					1	x	t	u	2574
Elaeocarpaceae	*Tetratheca thymifolia*	Black-eyed Susan																					1	x	g	u	6214
Ericaceae	*Epacris microphylla*	-																							g	u	2599
Ericaceae	*Epacris pulchella*	NSW Coral Heath													1	x			2	x		x			s	u	2605
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath																						x	s	u	2623

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Ericaceae	*Leucopogon lanceolatus*	-					1	x	1	x			1	x	1	x					1	x	1	x	s	u	2624
Ericaceae	*Lissanthe strigosa*	Peach Heath					1	x													1	x			s	u	2642
Ericaceae	*Monotoca elliptica*	heath					3	x	1	x															s	u	2647
Ericaceae	*Monotoca scoparia*	-																							s	u	2649
Euphorbiaceae	*oblongifolia*	Coffee Bush	1	x			1	x															1	x	s	u	2695
Euphorbiaceae	*Glochidion ferdinandi var. ferdinandi*	Cheese Tree	1	x	1		1	x																	t	u	9360
Euphorbiaceae	*hirtellus*	-					1	x																	g	u	8216
Euphorbiaceae	*Phyllanthus tenellus**	-																							g	u	2751
Euphorbiaceae	*Ricinocarpos pinifolius*	Wedding Bush																							s	u	2759
Fabaceae (Faboideae)	*Bossiaea heterophylla*	Variable Bossiaea																							s	u	2780
Fabaceae (Faboideae)	*Bossiaea prostrata*	-	1	x																					g	u	2786
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender tick trefoil						x																	v	u	6621
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	-			1	x			1	x															v	u	2839
Fabaceae (Faboideae)	*Dillwynia retorta var. retorta*	Heathy Parrot Pea																							s	u	11736
Fabaceae (Faboideae)	*Glycine clandestina*	-	2	x	2	x			2	x							2	x					2	x	v	u	2860
Fabaceae (Faboideae)	*Glycine microphylla*	-	1	x																					v	u	7208
Fabaceae (Faboideae)	*Glycine tabacina*	-															1	x							v	u	2861
Fabaceae (Faboideae)	*Gompholobium pinnatum*	Pinnate Wedge Pea																							g	u	2868
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla	1	x	1	x			1	x	2	x					2	x						x	v	u	2873
Fabaceae (Faboideae)	*Kennedia rubicunda*	Dusky Coral-pea								x	1	x	1	x										x	g	u	2898
Fabaceae (Faboideae)	*Lotus uliginosus**	Birds-foot Trefoil							1	x	1	x	1	x	1	x									g	u	8928
Fabaceae (Faboideae)	*Platylobium formosum*	Handsome Flat-pea																							s	u	2961
Fabaceae (Faboideae)	*Pultenaea blakelyi*	-	1	x																					s	u	2977
Fabaceae (Faboideae)	*Pultenaea daphnoides*	Large-leaf Bush-pea																							s	u	2985
Fabaceae (Faboideae)	*paleacea var. paleacea*	-	1	x															1	x					s	u	7545

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Fabaceae (Faboideae)	*Pultenaea villosa*	-	1	x			2	x		x							1	x			1		1	x	s	u	3023
Fabaceae (Faboideae)	*Trifolium repens**	White Clover	2	x	3	x			2	x	4	x	3	x	4	x									g	u	3085
Fabaceae (Mimosoideae)	*Acacia brownii*	Heath Wattle																							g	u	3723
Fabaceae (Mimosoideae)	*Acacia falcata*	-																							s	u	3771
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle					2	x	1	x															t	u	3792
Fabaceae (Mimosoideae)	*Acacia irrorata subsp. irrorata*	Green Wattle		1			2	x									2	x							t	u	6472
Fabaceae (Mimosoideae)	*Acacia longifolia subsp. longifolia*	Sydney Golden Wattle															1	x	1				1	x	s	u	10790
Fabaceae (Mimosoideae)	*Acacia schinoides*	Green Cedar Wattle																							t	u	3874
Fabaceae (Mimosoideae)	*Acacia suaveolens*	Sweet Wattle																							s	u	3881
Fabaceae (Mimosoideae)	*Acacia terminalis*	Sunshine Wattle																							s	u	3885
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses	1	x							2	x			1			x					1	x	s	u	3893
Geraniaceae	*Geranium homeanum*	-						x						x											g	u	3148
Goodeniaceae	*Dampiera stricta*	Blue Damperia																							g	u	3174
Goodeniaceae	*Goodenia bellidifolia subsp. bellidifolia*	-																	1		1	x			g	u	8711
Goodeniaceae	*Goodenia heterophylla subsp. heterophylla*	Variable-leaved Goodenia					x										1	x	2	x					g	u	10197
Goodeniaceae	*Goodenia ovata*	Hop Goodenia																x							s	u	3192
Goodeniaceae	*Goodenia paniculata*	-																	3	x	3	x			g	u	7057
Haemodoraceae	*Haemodorum planifolium*	Blood Root																							g	u	3236
Haloragaceae	*Gonocarpus micranthus subsp. ramosissimus*	-																			2	x			g	u	8648
Haloragaceae	*Gonocarpus tetragynus*	-																	2	x					g	u	3247
Haloragaceae	*Gonocarpus teucrioides*	Raspwort	1	x													2	x						x	g	u	3248
Hypoxidaceae	*Hypoxis hygrometrica*	Golden Weather-grass	2	x													1								g	u	3553
Iridaceae	*Crocosmia X crocosmiiflora**	Montbretia																							g	u	10271

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Iridaceae	*Patersonia glabrata*	Leafy Purple-flag																							g	u	3301
Iridaceae	*Patersonia sericea*	Silky Purple-Flag																							g	u	3303
Juncaceae	*Juncus cognatus**	-											1	x											g	u	3325
Juncaceae	*Juncus continuus*	A Rush														x									g	u	3326
Juncaceae	*Juncus prismatocarpus*	Branching Rush							1	x															g	u	3342
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum						x																	s	u	6484
Lamiaceae	*Stachys arvensis**	Stagger Weed												x											g	u	3450
Lauraceae	*Cassytha glabella f. glabella*	Slender Devil's Twine																							v	u	3467
Lauraceae	*Cassytha pubescens*	Common Devil's Twine																			1	x	1	x	v	u	3469
Lauraceae	*Cinnamomum camphora**	Camphor Laurel				x																			t	u	3471
Lauraceae	*Endiandra sieberi*	Hard Corkwood			1		2	x	3	x															t	u	3495
Lindsaeaceae	*Lindsaea linearis*	Screw Fern																							f	u	6406
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern																							f	u	6401
Lobeliaceae	*Lobelia alata*	Angled Lobelia																	1	x	2	x			g	u	1916
Lobeliaceae	*purpurascens*	Whiteroot	2	x			1	x	1	x			2	x	2	x	2	x	1	x			2	x	g	u	1925
Loganiaceae	*Mitrasacme polymorpha*	-																							g	u	3595
Lomandraceae	*Lomandra filiformis subsp. filiformis*	-	1	x																					g	u	7931
Lomandraceae	*Lomandra glauca subsp. glauca*	Pale Mat-rush																							g	u	6304
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush			1	x	2	x			2	x	3	x	1	x	3	x		x		x	2	x	g	u	6308
Lomandraceae	*multiflora subsp.*	Many-flowered Mat-rush	3	x			1	x	2	x															g	u	8802
Lomandraceae	*Lomandra obliqua*	Fish Bones																							g	u	6312
Loranthaceae	*Amyema congener*	A mistletoe								x															e	u	3600
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry					1	x	1	x															v	u	6015
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily					1	x																	v	u	6016
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne			2	x			2	x			1	x											g	u	3673
Meliaceae	*glandulosum subsp. glandulosum*	Scentless Rosewood					1	x																	t	u	11178
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine					1	x																	v	u	3688

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Menispermaceae	*Stephania japonica var. discolor*	Snake Vine					1	x																	v	u	8428
Menyanthaceae	*Villarsia exaltata*	Yellow Marsh Flower											1												g	u	3692
Moraceae	*Ficus sp. (Seedling)*	A Fig								x															t	u	-
Myrtaceae	*Angophora costata*	Smooth-barked Apple					3	x	4	x	4	x		x	2	x		x	3	x					t	u	3970
Myrtaceae	*Babingtonia pluriflora*	-															1	x							s	u	10678
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush																		x					s	P13	4004
Myrtaceae	*Callistemon pachyphyllus*	Wallum Bottlebrush																	1	x	2	x			s	P13	4010
Myrtaceae	*Callistemon pinifolius*	Pine-leaved Bottlebrush																	2	x					s	P13	4013
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		x													2	x							s	P13	4015
Myrtaceae	*Corymbia gummifera*	Red Bloodwood				x	2	x		x	2	x											4	x	t	u	9687
Myrtaceae	*Corymbia maculata*	Spotted Gum	4	x																					t	u	9692
Myrtaceae	*Eucalyptus fergusonii subsp. fergusonii*	-																							t	3KC	8355
Myrtaceae	*Eucalyptus globoidea*	White Stringybark	2	x																					t	u	4097
Myrtaceae	*Eucalyptus microcorys*	Tallowwood						x	3	x							5	x							t	u	4128
Myrtaceae	*Eucalyptus paniculata subsp. paniculata*	Grey Ironbark	3	x																					t	u	4149
Myrtaceae	*Eucalyptus pilularis*	Blackbutt			4	x	4	x					4	x											t	u	4155
Myrtaceae	*Eucalyptus canaliculata*	Large-fruited Grey Gum																							t	u	?
Myrtaceae	*Eucalyptus propinqua*	Small-fruited Grey Gum	2	x																					t	u	4162
Myrtaceae	*Eucalyptus resinifera subsp. resinifera*	Red Mahogany	2	x														x	2	x			2	x	t	u	9793
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany								x	4	x	3	x			2	x			3	x	1	x	t	u	4171
Myrtaceae	*Eucalyptus signata*	Northern Scribbly Gum													5	x									t	u	4183
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany	1	x							1														t	u	4196
Myrtaceae	*Leptospermum liversidgei*	-													1	x			1	x	2	x			s	u	4224

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Myrtaceae	*Leptospermum polygalifolium subsp. polygalifolium*	Yellow Tea-tree		x							2	x							1	x	1	x	1	x	s	u	8197
Myrtaceae	*Melaleuca ericifolia*	Swamp Paperbark																			1	x			s	P13	6391
Myrtaceae	*Melaleuca linariifolia*	Snow-in-Summer															1	x							t	u	4257
Myrtaceae	*Melaleuca nodosa*	Ball Honeymyrtle		x						x	2	x			1	x			1	x					s	u	4258
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark									1	x		x						x					t	u	4260
Myrtaceae	*Melaleuca sieberi*	-									1	x							4	x	2	x			s	u	4261
Myrtaceae	*thymifolia*	-															1	x	2	x	2	x			s	u	4266
Oleaceae	*Notelaea longifolia*	Large Mock-olive			1	x	1	x																	s	u	4318
Oleaceae	*Notelaea ovata*	-																							s	u	4321
Orchidaceae	*fornicatus*	Pixie Caps																							g	u	4353
Orchidaceae	*Cryptostylis Sp. (Leaf only)*	A Tongue Orchid	1																						g	-	-
Oxalidaceae	*Oxalis corniculata**	Creeping Oxalis								x				x			1	x							g	u	4613
Oxalidaceae	*Oxalis exilis*	Slender xalis																							g	u	4615
Phormiaceae	*Dianella caerulea var. caerulea*	Blue Flax lily	1	x					1	x															g	P13	6700
Phormiaceae	*Dianella caerulea var. producta*	Blue Flax lily					2	x			2	x	2	x	1	x	1	x	2	x	1	x	2	x	g	P13	7337
Phylydraceae	*Phylidrum lanuginosum*	Woolly Frogsmouth																									
Pinaceae	*Pinus elliottii**	Slash Pine			1	x																	1	x	t	u	11138
Pittosporaceae	*Billardiera scandens*	Appleberry					1	x									1	x					1	x	v	u	4671
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum															1								s	u	4683
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum					1	x	1	x															t	u	4685
Poaceae	*Andropogon virginicus**	Whisky Grass											1	x	1	x			1	x			5	x	g	u	4748
Poaceae	*Aristida benthamii*	-				x													3	x					g	u	4755
Poaceae	*Aristida vagans*	Threeawn Speargrass	1	x													1	x							g	u	4773
Poaceae	*Austrodanthonia tenuior*	-																	2	x					g	u	10633
Poaceae	*Austrostipa scabra subsp. scabra*	A Speargrass																					2	x	g	u	10378
Poaceae	*Axonopus fissifolius**	Narrow-leaved Carpet Grass	2	x	3	x			2	x	2	x	3	x	3	x	3	x	3	x	2	x	2	x	g	u	11194
Poaceae	*Chloris gayana**	Rhodes Grass								x	1	x													g	u	4831

Family	Scienfic Name	Common Name	Q1	T1	Q2	T2	Q3	T3	Q4	T4	Q5	T5	Q6	T6	Q7	T7	Q8	T8	Q9	T9	Q10	T10	Q11	T11	Form	Status	Caps
Poaceae	*Chloris truncata**	Windmill Grass												x											g	u	4833
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass				x			1	x							1		1	x					g	u	4841
Poaceae	*Cynodon dactylon*	Common Couch			1	x			1	x	2	x	2	x	2	x	1	x		x					g	u	6540
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass			1	x						x				x									g	u	4898
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass					2	x	1	x	1	x	1	x									1	x	g	u	4913
Poaceae	*Digitaria sanguinalis**	Crab Grass			2	x			1	x				x											g	u	6937
Poaceae	*Echinopogon caespitosus var. caespitosus*	Tufted Hedgehog Grass															1	x					1	x	g	u	7593
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	2	x									1	x											g	u	4934
Poaceae	*Ehrharta erecta**	Panic Veldtgrass							1	x			2	x											g	u	4937
Poaceae	*Entolasia marginata*	Bordered Panic	1	x			2	x			1	x											2	x	g	u	4946
Poaceae	*Entolasia stricta*	Wiry Panic	3	x													3	x	1	x	3	x	2	x	g	u	4947
Poaceae	*Eragrostis brownii*	Brown's Lovegrass		x	1	x								x				x	1	x		x		x	g	u	7921
Poaceae	*Eragrostis curvula**	Lovegrass				x						x													g	u	4952
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	1	x	1	x			1	x	1	x							2	x	2	x	1	x	g	u	4960
Poaceae	*uncinata*	Matgrass																	3	x	3	x			g	u	5001
Poaceae	*Imperata cylindrica var. major*	Blady Grass	2	x	3	x	3	x	2	x					2	x	3	x	1	x	2	x	2	x	g	u	8511
Poaceae	*Ischaemum australe*	-																			1	x			g	u	9278
Poaceae	*Leersia hexandra*	Swamp Ricegrass																							g	u	5024
Poaceae	*stipoides var. stipoides*	-	2	x	1	x			2	x			1	x			2	x		x			3	x	g	u	7707
Poaceae	*Oplismenus aemulus*	-					1	x	1	x				x			2	x							g	u	5044
Poaceae	*Oplismenus imbecillis*	-					1	x																	g	u	5045
Poaceae	*Panicum simile*	Two-colour Panic		x	1	x											1	x	1	x	1	x	2	x	g	u	5066
Poaceae	*distans*	-	2	x	1	x	2	x							1	x									g	u	7172
Poaceae	*Paspalum dilatatum**	Paspalum	1	x	2	x			2	x	2	x	2	x	3	x	2	x	2	x	2	x			g	u	5086
Poaceae	*distichum*	Water Couch																							g	u	5087
Poaceae	*Paspalum orbiculare*	Ditch Millet							1	x	1	x													g	u	5089
Poaceae	*Paspalum urvillei**	Vasey Grass		x	1	x										x					1	x			g	u	5093
Poaceae	*Paspalum wettsteinii**	Broad-leaved Paspalum							2	x	1	x	1	x				x							g	u	8715

Family	Scienfic Name	Common Name	Q1	T1	Q2	T2	Q3	T3	Q4	T4	Q5	T5	Q6	T6	Q7	T7	Q8	T8	Q9	T9	Q10	T10	Q11	T11	Form	Status	Caps
Poaceae	*Pennisetum alopecuroides**	Swamp Foxtail				x			1	x									1		1	x			g	u	5094
Poaceae	*Pennisetum clandestinum**	Kikuyu Grass			3	x			3	x	3	x	2	x	2	x									g	u	5096
Poaceae	*Setaria pumila**	Pale Pigeon Grass			3	x			3	x	5	x			2	x					1	x			g	u	7842
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass							2	x					1	x									g	u	5179
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass																							g	u	5185
Poaceae	*Themeda australis*	Kangaroo Grass	1	x			1				1	x			1	x	1	x	2	x	2	x			g	u	5219
Polygonaceae	*decipiens*	Knotweed																x							w	u	7568
Polygonaceae	*Rumex bidens*	Mud Dock																									
Portulacaceae	*Portulaca oleracea*	Purslane																									
Proteaceae	*Banksia oblongifolia*	Fern-leaved Banksia																							s	P13	5345
Proteaceae	*Banksia serrata*	Old-man Banksia			2																				t	u	5348
Proteaceae	*Banksia spinulosa var. spinulosa*	-																							s	P13	7488
Proteaceae	*Lomatia silaifolia*	Crinkle Bush																							g	P13	5445
Proteaceae	*Persoonia lanceolata*	Lance Leaf Geebung																							s	P13	5460
Proteaceae	*Persoonia levis*	Broad-leaved Geebung																						x	s	P13	5462
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung																							s	P13	5463
Ranunculaceae	*Clematis aristata*	Old Man's Beard					1	x																	v	u	5493
Restionaceae	*Baloskion tetraphyllum subsp. meiostachyum*	-							2	x	2	x	3	x	2	x							1	x	g	u	10614
Restionaceae	*Empodisma minus*	Spreading Rope-rush															1	x			1	x			g	u	5532
Restionaceae	*Leptocarpus tenax*	-																			2	x			g	u	5534
Restionaceae	*Lepyrodia muelleri*	Scale Rush																	1	x		x			g	u	5540
Restionaceae	*Lepyrodia scariosa*	Scale Rush																	3	x	3	x			g	u	5541
Rubiaceae	*Galium propinquum*	Maori Bedstraw																							g	u	5688
Rubiaceae	*Opercularia diphylla*	-															1	x		x					g	u	5698
Rubiaceae	*Opercularia varia*	Variable Stinkweed																							g	u	5701
Rubiaceae	*Pomax umbellata*	Pomax			2	x	4	x	3	x	2	x	3	x									3	x	g	u	5703
Rutaceae	*Boronia pinnata*	-																							g	P13	5750
Rutaceae	*Nematolepis squamea subsp. squamea*	Satinwood					1																		s	u	10742

Family	Scienfic Name	Common Name	Q1	T1	Q2	T2	Q3	T3	Q4	T4	Q5	T5	Q6	T6	Q7	T7	Q8	T8	Q9	T9	Q10	T10	Q11	T11	Form	Status	Caps
Rutaceae	*Zieria smithii*	Sandfly Zieria															1								s	u	5847
Santalaceae	*Leptomeria acida*	Sour Currant Bush																							s	u	5865
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush					1	x									2	x					2	x	s	u	5911
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell	1	x																					g	u	6009
Selaginellaceae	*Selaginella uliginosa*	Swamp Selaginella																	1	x	2	x			g	u	8187
Smilacaceae	*Smilax australis*	Lawyer Vine						x																	v	u	7592
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla							2	x	1	x											3	x	v	u	6022
Solanaceae	*Solanum mauritianum**	Wild Tobacco Bush																							s	u	6090
Solanaceae	*Solanum nigrum**	Black-berry Nightshade	1										1	x											g	u	6091
Stylidiaceae	*Stylidium graminifolium*	Grass Triggerplant																							g	u	6157
Thymelaeaceae	*Pimelea linifolia subsp. linifolia*	Slender Rice-flower																							g	u	6814
Verbenaceae	*Lantana camara**	Lantana			1	x	1	x	1	x			1												s	u	6248
Verbenaceae	*Verbena bonariensis**	Purpletop									1	x				x									g	u	6256
Violaceae	*Hybanthus monopetalus*	Slender Violet-bush																							g	u	6266
Violaceae	*Viola banksii*	-	1	x				x	1					x											g	u	11863
Vitaceae	*clematidea*	Slender Grape						x																	v	u	6281
Xanthorrhoeaceae	*Xanthorrhoea fulva*	Grasstree									2	x													g	u	8771
Xanthorrhoeaceae	*Xanthorrhoea latifolia subsp. latifolia*	-																			3	x			g	u	9309
Xanthorrhoeaceae	*Xanthorrhoea macronema*	-																							g	P13	6318
Xyridaceae	*Xyris complanata*	-																							g	u	7247
Zamiaceae	*Macrozamia communis*	Burrawang					1	x																	s	P13	6327

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Anthericaceae	*Caesia parviflora var. parviflora*	-																				x	g	u	7183
Anthericaceae	*Thysanotus tuberosus*	Common Fringe-lily		x																			g	u	3574
Anthericaceae	*Tricoryne elatior*	lily	1	x	2	x																	g	u	7355
Apiaceae	*Centella asiatica*	Pennywort					2	x															g	u	1106
Apiaceae	*Hydrocotyle bonariensis**	A Pennywort																					g	u	1123
Apiaceae	*Hydrocotyle peduncularis*	-	2	x			1				2	x											g	u	1130
Apiaceae	*Platysace ericoides*	-							3	x					2	x							g	u	1143
Apiaceae	*Platysace lanceolata*	Native Parsnip													3	x	1	x				x	s	u	1144
Apiaceae	*Platysace linearifolia*	Narrow-leafed Platysace			2	x													x				s	u	1145
Apocynaceae	*Gomphocarpus fruticosus**	Narrow-leaved Cotton Bush																					s	u	1227
Apocynaceae	*Parsonsia straminea*	Common Silkpod																					v	u	1185
Araliaceae	*sambucifolia subsp. sambucifolia*	-			1	x	1				1	x	1	x									s	u	12373
Arecaceae	*Livistona australis*	Cabbage Palm									1							x					t	P13	1221
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern									1												g	u	11784
Asteraceae	*Bidens pilosa**	Cobbler's Pegs					1	x			1		1	x									g	u	1283
Asteraceae	*monilifera subsp. rotundata*	Bitou Bush									1												s	u	8686
Asteraceae	*Cirsium vulgare**	Spear Thistle																	x				g	u	1400
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane											1	x					x			x	g	u	1404
Asteraceae	*Conyza sumatrensis**	Tall fleabane						x						x									g	u	10442
Asteraceae	*Crassocephalum crepidioides**	Thickhead																					g	u	1421
Asteraceae	*Epaltes australis*	Spreading Nut-heads																					g	u	7425
Asteraceae	*Hypochaeris radicata**	Catsear			1	x	1	x					2	x					2	x	2	x	g	u	8788
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy		x	1	x	1	x			1	x											g	u	1551
Asteraceae	*Senecio diaschides*	-																					g	u	7914

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Asteraceae	*Senecio madagascariensis**	Fireweed							1		1		2	x								x	g	u	6465
Asteraceae	*Sigesbeckia orientalis subsp. orientalis*	Indian Weed															1	x					g	u	8789
Asteraceae	*Taraxacum officinale**	Dandelion					2	x		x							1	x	x				g	u	1698
Asteraceae	*Vernonia cinerea var. cinerea*	-										x											g	u	9254
Baueraceae	*Bauera rubioides*	Dog Rose								x													g	u	2268
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine									2	x											g	u	1740
Blechnaceae	*Blechnum indicum*	Swamp Water Fern															3	x					g	u	8057
Blechnaceae	*Doodia aspera*	Prickly Rasp Fern									1	x											f	u	8064
Cactaceae	*Opuntia stricta var. stricta**	Common Prickly Pear																					s	u	7659
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell		x		x																	g	u	1934
Caryophyllaceae	*Stellaria media**	Common Chickweed																	x			x	g	u	2006
Casuarinaceae	*Allocasuarina littoralis*	Black Sheoak									1	x	1	x									t	u	2012
Clusiaceae	*Hypericum gramineum*	Small St John's Wort																	2	x			g	u	7240
Clusiaceae	*Hypericum japonicum*	-					1																g	u	2203
Commelinaceae	*Commelina cyanea*	Native Wandering Jew																					g	u	2209
Convolvulaceae	*Dichondra repens*	Kidney Weed		x			2	x											1	x			g	u	2222
Convolvulaceae	*Polymeria calycina*	Polymeria					1	x															g	u	2231
Cyperaceae	*Baumea articulata*	Jointed Twig-rush																					g	u	2296
Cyperaceae	*Baumea rubiginosa*	-	1	x											1	x		x					g	u	2302
Cyperaceae	*Baumea teretifolia*	A Twigrush		x													2	x					g	u	2303
Cyperaceae	*Carex appressa*	Tall Sedge					1	x							1	x	1	x					g	u	2310
Cyperaceae	*Chorizandra cymbaria*	Heron Bristle Rush	2	x			1	x															g	u	2344
Cyperaceae	*Cyperus aggregatus**	-																					g	u	8845
Cyperaceae	*brevifolius**	-																					g	u	2353
Cyperaceae	*Cyperus difformis*	-																					g	u	7143
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge																	x				g	u	2364
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge																					g	u	2374
Cyperaceae	*Cyperus polystachyos*	A Sedge						x															g	u	8483
Cyperaceae	*Cyperus sesquiflorus**	-																					g	u	2398

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Cyperaceae	*Eleocharis pusilla*	-																	2	x	1	x			
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge					1	x											2	x	1	x	g	u	7435
Cyperaceae	*Gahnia aspera*	Rough Saw-sedge																					g	u	2431
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge						x			1		2				2	x					g	u	2432
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge	2	x					2	x						x							g	P13	2442
Cyperaceae	*Isolepis inundata*	Swamp Clubrush						x															g	u	2454
Cyperaceae	*Isolepis nodosa*	Knobby Club-rush																	3	x	2	x	g	u	2457
Cyperaceae	*Juncus usitatus*	-																					g	u	3350
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge			1	x					2	x											g	u	6402
Cyperaceae	*Ptilothrix deusta*	-													1	x							g	u	8956
Cyperaceae	*Schoenus apogon*	Fluke Bogrush	1	x												x	1	x			3	x	g	u	2491
Cyperaceae	*Schoenus brevifolius*	A Bog Rush	2	x													2	x	2	x			g	u	2492
Cyperaceae	*Schoenus ericetorum*	A Bog Rush													1	x	1						g	u	2495
Dennstaedtiaceae	*Histiopteris incisa*	Bat's Wing Fern																					g	u	7271
Dennstaedtiaceae	*Pteridium esculentum*	Bracken					1	x	3	x	2	x	3	x		x						x	f	P13	6403
Dicksoniaceae	*Calochlaena dubia*	Dicksoniaceae																					f	P13	8341
Dilleniaceae	*Hibbertia acicularis*	Prickly Guinea Flower													1	x							g	u	2526
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower	2	x	2	x					1	x											g	u	2527
Dilleniaceae	*Hibbertia linearis*	-																					s	u	2539
Dilleniaceae	*obtusifolia*	-																					s	u	2542
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower									1	x	1										v	u	2548
Dilleniaceae	*Hibbertia vestita*	-	2	x			1	x	1			x	2	x									g	u	2551
Dilleniaceae	*Hibbertia virgata subsp. virgata*	-													3	x							g	u	9398
Droseraceae	*Drosera peltata*	Pygmy Sundew														x			2	x			g	u	2559
Droseraceae	*Drosera spatulata*	Sundew							1	x	2	x			1	x					2	x	g	u	2561
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash																					t	u	2574
Elaeocarpaceae	*Tetratheca thymifolia*	Black-eyed Susan									1										3	x	g	u	6214
Ericaceae	*Epacris microphylla*	-	1	x											1								g	u	2599
Ericaceae	*Epacris pulchella*	NSW Coral Heath	2	x	2	x		x	2	x	1	x	1	x	2	x	2	x					s	u	2605

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath						x														x	s	u	2623
Ericaceae	*Leucopogon lanceolatus*	-			1	x	1		2	x			1	x	1	x		x					s	u	2624
Ericaceae	*Lissanthe strigosa*	Peach Heath																					s	u	2642
Ericaceae	*Monotoca elliptica*	heath													1	x	1						s	u	2647
Ericaceae	*Monotoca scoparia*	-													2	x							s	u	2649
Euphorbiaceae	*oblongifolia*	Coffee Bush									1		2	x									s	u	2695
Euphorbiaceae	*Glochidion ferdinandi var. ferdinandi*	Cheese Tree		x			2	x				x	2	x									t	u	9360
Euphorbiaceae	*hirtellus*	-			2	x	2	x			2	x	2	x								x	g	u	8216
Euphorbiaceae	*Phyllanthus tenellus**	-													1	x							g	u	2751
Euphorbiaceae	*Ricinocarpos pinifolius*	Wedding Bush													1	x							s	u	2759
Fabaceae (Faboideae)	*Bossiaea heterophylla*	Variable Bossiaea													1	x							s	u	2780
Fabaceae (Faboideae)	*Bossiaea prostrata*	-									1												g	u	2786
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender tick trefoil																					v	u	6621
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	-																					v	u	2839
Fabaceae (Faboideae)	*Dillwynia retorta var. retorta*	Heathy Parrot Pea							1	x					2	x							s	u	11736
Fabaceae (Faboideae)	*Glycine clandestina*	-		x	2	x	1	x			2	x											v	u	2860
Fabaceae (Faboideae)	*Glycine microphylla*	-									1	x											v	u	7208
Fabaceae (Faboideae)	*Glycine tabacina*	-			1	x	1	x			1												v	u	2861
Fabaceae (Faboideae)	*Gompholobium pinnatum*	Pinnate Wedge Pea															1	x					g	u	2868
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla					1	x			2	x	1	x									v	u	2873
Fabaceae (Faboideae)	*Kennedia rubicunda*	Dusky Coral-pea															1	x					g	u	2898
Fabaceae (Faboideae)	*Lotus uliginosus**	Birds-foot Trefoil																	x				g	u	8928
Fabaceae (Faboideae)	*Platylobium formosum*	Handsome Flat-pea									1	x											s	u	2961
Fabaceae (Faboideae)	*Pultenaea blakelyi*	-																					s	u	2977
Fabaceae (Faboideae)	*Pultenaea daphnoides*	Large-leaf Bush-pea									1	x											s	u	2985
Fabaceae (Faboideae)	*Pultenaea paleacea var. paleacea*	-	1	x	2	x	1	x			1	x											s	u	7545

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Fabaceae (Faboideae)	*Pultenaea villosa*	-		x			1	x		x	1						2	x					s	u	3023
Fabaceae (Faboideae)	*Trifolium repens**	White Clover						x					1	x									g	u	3085
Fabaceae (Mimosoideae)	*Acacia brownii*	Heath Wattle									1	x											g	u	3723
Fabaceae (Mimosoideae)	*Acacia falcata*	-										x											s	u	3771
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle																					t	u	3792
Fabaceae (Mimosoideae)	*Acacia irrorata subsp. irrorata*	Green Wattle		x							1	x	1	x									t	u	6472
Fabaceae (Mimosoideae)	*Acacia longifolia subsp. longifolia*	Sydney Golden Wattle	3	x			1		1	x	1	x	1	x			1	x					s	u	10790
Fabaceae (Mimosoideae)	*Acacia schinoides*	Green Cedar Wattle																					t	u	3874
Fabaceae (Mimosoideae)	*Acacia suaveolens*	Sweet Wattle							1				1	x									s	u	3881
Fabaceae (Mimosoideae)	*Acacia terminalis*	Sunshine Wattle							1	x						x							s	u	3885
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses			2	x					1	x	2	x	1	x	1	x					s	u	3893
Geraniaceae	*Geranium homeanum*	-																					g	u	3148
Goodeniaceae	*Dampiera stricta*	Blue Damperia														x	2	x					g	u	3174
Goodeniaceae	*Goodenia bellidifolia subsp. bellidifolia*	-	1	x															2	x	2	x	g	u	8711
Goodeniaceae	*Goodenia heterophylla subsp. heterophylla*	Variable-leaved Goodenia						x			1	x											g	u	10197
Goodeniaceae	*Goodenia ovata*	Hop Goodenia																					s	u	3192
Goodeniaceae	*Goodenia paniculata*	-	1	x			1	x	1	x							2	x	2	x	2	x	g	u	7057
Haemodoraceae	*Haemodorum planifolium*	Blood Root															1	x					g	u	3236
Haloragaceae	*Gonocarpus micranthus subsp. ramosissimus*	-							2	x			1	x	2	x	2	x					g	u	8648
Haloragaceae	*Gonocarpus tetragynus*	-																					g	u	3247
Haloragaceae	*Gonocarpus teucrioides*	Raspwort	2	x			3	x		x			2	x							2	x	g	u	3248
Hypoxidaceae	*Hypoxis hygrometrica*	Golden Weather-grass	1	x			1	x															g	u	3553
Iridaceae	*Crocosmia X crocosmiiflora**	Montbretia																					g	u	10271

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Iridaceae	*Patersonia glabrata*	Leafy Purple-flag			1	x																	g	u	3301
Iridaceae	*Patersonia sericea*	Silky Purple-Flag													2	x		x					g	u	3303
Juncaceae	*Juncus cognatus**	-																					g	u	3325
Juncaceae	*Juncus continuus*	A Rush																					g	u	3326
Juncaceae	*Juncus prismatocarpus*	Branching Rush																					g	u	3342
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum																					s	u	6484
Lamiaceae	*Stachys arvensis**	Stagger Weed																					g	u	3450
Lauraceae	*Cassytha glabella f. glabella*	Slender Devil's Twine															2	x					v	u	3467
Lauraceae	*Cassytha pubescens*	Common Devil's Twine																					v	u	3469
Lauraceae	*Cinnamomum camphora**	Camphor Laurel																					t	u	3471
Lauraceae	*Endiandra sieberi*	Hard Corkwood																					t	u	3495
Lindsaeaceae	*Lindsaea linearis*	Screw Fern		x			1			x													f	u	6406
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern									1	x											f	u	6401
Lobeliaceae	*Lobelia alata*	Angled Lobelia						x								x		x					g	u	1916
Lobeliaceae	*Pratia purpurascens*	Whiteroot	2	x	2	x	2	x		x	3	x							2	x	2	x	g	u	1925
Loganiaceae	*Mitrasacme polymorpha*	-															1	x					g	u	3595
Lomandraceae	*Lomandra filiformis subsp. filiformis*	-			3	x			1	x	3	x											g	u	7931
Lomandraceae	*Lomandra glauca subsp. glauca*	Pale Mat-rush							2	x					2	x							g	u	6304
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		x	2	x	2	x	3	x	2	x	3	x	1	x	2	x			2	x	g	u	6308
Lomandraceae	*multiflora subsp.*	Many-flowered Mat-rush			1	x	1	x															g	u	8802
Lomandraceae	*Lomandra obliqua*	Fish Bones					1				1	x	1	x									g	u	6312
Loranthaceae	*Amyema congener*	A mistletoe																					e	u	3600
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry		x			1				2	x	1										v	u	6015
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily					1						1										v	u	6016
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne																					g	u	3673
Meliaceae	*Synoum glandulosum subsp. glandulosum*	Scentless Rosewood																					t	u	11178

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine																					v	u	3688
Menispermaceae	*Stephania japonica var. discolor*	Snake Vine																					v	u	8428
Menyanthaceae	*Villarsia exaltata*	Yellow Marsh Flower															2	x		x			g	u	3692
Moraceae	*Ficus sp. (Seedling)*	A Fig																					t	u	-
Myrtaceae	*Angophora costata*	Smooth-barked Apple	4	x				x	4	x	2	x		x									t	u	3970
Myrtaceae	*Babingtonia pluriflora*	-									1	x	2										s	u	10678
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush																					s	P13	4004
Myrtaceae	*Callistemon pachyphyllus*	Wallum Bottlebrush						x								x			2	x			s	P13	4010
Myrtaceae	*Callistemon pinifolius*	Pine-leaved Bottlebrush											2	x					1	x	1	x	s	P13	4013
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush	2	x	1	x					2	x	2	x									s	P13	4015
Myrtaceae	*Corymbia gummifera*	Red Bloodwood	3	x					3	x	2	x			3	x		x					t	u	9687
Myrtaceae	*Corymbia maculata*	Spotted Gum			5	x																	t	u	9692
Myrtaceae	*Eucalyptus fergusonii subsp. fergusonii*	-			2	x							2										t	3KC	8355
Myrtaceae	*Eucalyptus globoidea*	White Stringybark									3	x											t	u	4097
Myrtaceae	*Eucalyptus microcorys*	Tallowwood					3	x			2	x	5	x									t	u	4128
Myrtaceae	*Eucalyptus paniculata subsp. paniculata*	Grey Ironbark																					t	u	4149
Myrtaceae	*Eucalyptus pilularis*	Blackbutt																					t	u	4155
Myrtaceae	*Eucalyptus canaliculata*	Large-fruited Grey Gum											1										t	u	?
Myrtaceae	*Eucalyptus propinqua*	Small-fruited Grey Gum			2	x																	t	u	4162
Myrtaceae	*Eucalyptus resinifera subsp. resinifera*	Red Mahogany	4	x			4	x										x			4	x	t	u	9793
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany															4	x					t	u	4171
Myrtaceae	*Eucalyptus signata*	Northern Scribbly Gum																					t	u	4183
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany			2	x					3	x											t	u	4196

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Myrtaceae	*Leptospermum liversidgei*	-													2	x			3	x	2	x	s	u	4224
Myrtaceae	*Leptospermum polygalifolium subsp. polygalifolium*	Yellow Tea-tree					2	x	1	x	2	x	3	x					4	x	2	x	s	u	8197
Myrtaceae	*Melaleuca ericifolia*	Swamp Paperbark																					s	P13	6391
Myrtaceae	*Melaleuca linariifolia*	Snow-in-Summer	2	x													1	x			2	x	t	u	4257
Myrtaceae	*Melaleuca nodosa*	Ball Honeymyrtle	2	x	1	x			2	x			1		1	x	2	x					s	u	4258
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark		x									2									x	t	u	4260
Myrtaceae	*Melaleuca sieberi*	-	3	x			2	x	1	x					1	x	1	x		x	2	x	s	u	4261
Myrtaceae	*thymifolia*	-					1	x		x					2	x		x	3	x			s	u	4266
Oleaceae	*Notelaea longifolia*	Large Mock-olive																					s	u	4318
Oleaceae	*Notelaea ovata*	-									1	x											s	u	4321
Orchidaceae	*Acianthus fornicatus*	Pixie Caps									2	x											g	u	4353
Orchidaceae	*Cryptostylis Sp. (Leaf only)*	A Tongue Orchid																					g	-	-
Oxalidaceae	*Oxalis corniculata**	Creeping Oxalis					1																g	u	4613
Oxalidaceae	*Oxalis exilis*	Slender xalis									1	x											g	u	4615
Phormiaceae	*Dianella caerulea var. caerulea*	Blue Flax lily			2	x																	g	P13	6700
Phormiaceae	*Dianella caerulea var. producta*	Blue Flax lily	1	x			2	x	1	x	2	x	1	x			2	x			2	x	g	P13	7337
Phylydraceae	*Phylidrum lanuginosum*	Woolly Frogsmouth																	1	x					
Pinaceae	*Pinus elliottii**	Slash Pine					2	x	1	x	1		1	x		x	1						t	u	11138
Pittosporaceae	*Billardiera scandens*	Appleberry			1	x	2	x			2	x	1	x									v	u	4671
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum					1				1	x											s	u	4683
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum									1	x	1										t	u	4685
Poaceae	*Andropogon virginicus**	Whisky Grass	1	x			2	x	4	x					3	x	2	x	2	x	3	x	g	u	4748
Poaceae	*Aristida benthamii*	-																					g	u	4755
Poaceae	*Aristida vagans*	Threeawn Speargrass		x	1	x	2	x															g	u	4773
Poaceae	*Austrodanthonia tenuior*	-																			3	x	g	u	10633
Poaceae	*Austrostipa scabra subsp. scabra*	A Speargrass																					g	u	10378

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Poaceae	*Axonopus fissifolius**	Narrow-leaved Carpet Grass		x			2	x		x			2	x	2	x			2	x	2	x	g	u	11194
Poaceae	*Chloris gayana**	Rhodes Grass																		x		x	g	u	4831
Poaceae	*Chloris truncata**	Windmill Grass																					g	u	4833
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass					2	x															g	u	4841
Poaceae	*Cynodon dactylon*	Common Couch					1	x					2	x					2	x		x	g	u	6540
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass																					g	u	4898
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass	1	x																x	1	x	g	u	4913
Poaceae	*Digitaria sanguinalis**	Crab Grass																					g	u	6937
Poaceae	*Echinopogon caespitosus var. caespitosus*	Tufted Hedgehog Grass					3	x															g	u	7593
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass																					g	u	4934
Poaceae	*Ehrharta erecta**	Panic Veldtgrass																					g	u	4937
Poaceae	*marginata*	Bordered Panic	3	x			2	x	1	x	2	x	2	x			1	x					g	u	4946
Poaceae	*Entolasia stricta*	Wiry Panic	4	x	2	x	2	x	2	x	2	x	2		2	x	2	x	4	x	4	x	g	u	4947
Poaceae	*Eragrostis brownii*	Brown's Lovegrass		x	1	x				x		x									1	x	g	u	7921
Poaceae	*Eragrostis curvula**	Lovegrass																			1	x	g	u	4952
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass					2	x	1	x			1	x	2	x	2	x	2	x	1	x	g	u	4960
Poaceae	*uncinata*	Matgrass													1		1	x	3	x	2	x	g	u	5001
Poaceae	*Imperata cylindrica var. major*	Blady Grass	2	x	2	x	3	x	2	x	3	x	2	x			3	x			2	x	g	u	8511
Poaceae	*Ischaemum australe var.*	-																					g	u	9278
Poaceae	*Leersia hexandra*	Swamp Ricegrass						x		x							3	x					g	u	5024
Poaceae	*Microlaena stipoides*	-	2	x	3	x	2	x			2	x	1	x	2	x	1	x					g	u	7707
Poaceae	*Oplismenus aemulus*	-																					g	u	5044
Poaceae	*Oplismenus imbecillis*	-																					g	u	5045
Poaceae	*Panicum simile*	Two-colour Panic					1	x	2	x	1	x	1	x	2	x					1	x	g	u	5066

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Poaceae	*distans*	-					1	x					1	x		x		x					g	u	7172
Poaceae	*Paspalum dilatatum**	Paspalum					2	x					2	x			1	x	1	x	2	x	g	u	5086
Poaceae	*distichum*	Water Couch																					g	u	5087
Poaceae	*Paspalum orbiculare*	Ditch Millet																					g	u	5089
Poaceae	*Paspalum urvillei**	Vasey Grass						x						x			2	x	2	x	2	x	g	u	5093
Poaceae	*Paspalum wettsteinii**	Broad-leaved Paspalum												x									g	u	8715
Poaceae	*Pennisetum alopecuroides**	Swamp Foxtail																					g	u	5094
Poaceae	*Pennisetum clandestinum**	Kikuyu Grass												x									g	u	5096
Poaceae	*Setaria pumila**	Pale Pigeon Grass					1	x		x			2	x					1	x			g	u	7842
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass																					g	u	5179
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass												x									g	u	5185
Poaceae	*Themeda australis*	Kangaroo Grass	1	x	2	x	2	x	1		2	x	2	x				x			1	x	g	u	5219
Polygonaceae	*decipiens*	Knotweed																					w	u	7568
Polygonaceae	*Rumex bidens*	Mud Dock																	1	x					
Portulacaceae	*Portulaca oleracea*	Purslane																	2	x					
Proteaceae	*Banksia oblongifolia*	Fern-leaved Banksia																					s	P13	5345
Proteaceae	*Banksia serrata*	Old-man Banksia																					t	u	5348
Proteaceae	*Banksia spinulosa var. spinulosa*	-	1	x			1																s	P13	7488
Proteaceae	*Lomatia silaifolia*	Crinkle Bush									2	x											g	P13	5445
Proteaceae	*Persoonia lanceolata*	Lance Leaf Geebung															1	x					s	P13	5460
Proteaceae	*Persoonia levis*	Broad-leaved Geebung									1	x				x		x					s	P13	5462
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung			1	x					2	x											s	P13	5463
Ranunculaceae	*Clematis aristata*	Old Man's Beard																					v	u	5493
Restionaceae	*Baloskion tetraphyllum subsp. meiostachyum*	-							3	x					3	x	2	x					g	u	10614
Restionaceae	*Empodisma minus*	Spreading Rope-rush	2	x			1	x	1	x					2	x							g	u	5532
Restionaceae	*Leptocarpus tenax*	-								x							2	x					g	u	5534

Family	Scienfic Name	Common Name	Q12	T12	Q13	T13	Q14	T14	Q15	T15	Q16	T16	Q17	T17	Q18	T18	Q19	T19	Q20	T20	Q21	T21	Form	Status	Caps
Restionaceae	*Lepyrodia muelleri*	Scale Rush																					g	u	5540
Restionaceae	*Lepyrodia scariosa*	Scale Rush																	3	x	4	x	g	u	5541
Rubiaceae	*propinquum*	Maori Bedstraw									1	x											g	u	5688
Rubiaceae	*diphylla*	-		x			1	x			2	x											g	u	5698
Rubiaceae	*Opercularia varia*	Variable Stinkweed													2	x	2	x					g	u	5701
Rubiaceae	*Pomax umbellata*	Pomax							2	x				x	2	x							g	u	5703
Rutaceae	*Boronia pinnata*	-													1	x							g	P13	5750
Rutaceae	*squamea subsp. squamea*	Satinwood																					s	u	10742
Rutaceae	*Zieria smithii*	Sandfly Zieria																					s	u	5847
Santalaceae	*Leptomeria acida*	Sour Currant Bush			1	x									1	x							s	u	5865
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush																					s	u	5911
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell																					g	u	6009
Selaginellaceae	*Selaginella uliginosa*	Swamp Selaginella							3	x					3	x	3	x				x	g	u	8187
Smilacaceae	*Smilax australis*	Lawyer Vine																					v	u	7592
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla								x	2	x	1				1	x					v	u	6022
Solanaceae	*Solanum mauritianum**	Wild Tobacco Bush																					s	u	6090
Solanaceae	*Solanum nigrum**	Black-berry Nightshade																					g	u	6091
Stylidiaceae	*Stylidium graminifolium*	Grass Triggerplant														x							g	u	6157
Thymelaeaceae	*Pimelea linifolia subsp. linifolia*	Slender Rice-flower			1	x	1	x													3	x	g	u	6814
Verbenaceae	*Lantana camara**	Lantana									1												s	u	6248
Verbenaceae	*Verbena bonariensis**	Purpletop																					g	u	6256
Violaceae	*Hybanthus monopetalus*	Slender Violet-bush				x					1	x											g	u	6266
Violaceae	*Viola banksii*	-																					g	u	11863
Vitaceae	*clematidea*	Slender Grape																					v	u	6281
Xanthorrhoeaceae	*Xanthorrhoea fulva*	Swamp Grasstree							1	x			1		1	x							g	u	8771
Xanthorrhoeaceae	*Xanthorrhoea latifolia subsp. latifolia*	-																	3	x			g	u	9309
Xanthorrhoeaceae	*Xanthorrhoea macronema*	-									2	x											g	P13	6318
Xyridaceae	*Xyris complanata*	-							1						1	x	2	x					g	u	7247
Zamiaceae	*Macrozamia communis*	Burrawang																					s	P13	6327

APPENDIX 2

HOLLOW BEARING TREE SURVEY

HOLLOW BEARING TREE SURVEY

CLIENT. Crightons Property Group.....REF NO.8020.....SURVEY DATE.2008.....

SHEET NO.....1.....of.....4.....TREE LOCATIONS SHOWN ON FIGURE 1 SITE SURVEY SHEET COMPLETED Y/N ASSESSOR P.S……..

Tree Tag Number		HT 01	HT 02	HT 03	HT 04	HT 05	HT 06	HT 07	HT 08	HT 09	HT 10	HT 11	HT 12	HT 13
Species		*E. pilularis*	*E. robusta*	*E. robusta*	*E. pilularis*	*E. pilularis*	*C.*	*E.*	*E. fibrosa*	*E. fibrosa*	*E.*	*E.*	*E. robusta*	*E. robusta*
DBH (cm)		50, 90,	40, 60	120	200	45	60, 30	40	35	35	40, 25	35	35, 30	50, 90,
Spread (m)		30	12	12	30	20	15	15	9	7	8	10	6	6
Height (m)		22	15	18	25	30	20	18	12	12	12	15	15	15
Position														
% Health		90	70	60	75	50	80	75	40	30	30	75	40	40
Fauna Use								feral bees				Trunk-		
HOLLOWS														
	S													
I Broken Trunk	M			1					1	1		1	1	
	L													
	S													
II Branch	M	1					1				1			1
	L				1									
	S		1		1	2								
III Trunk	M					1								
	L					2								
	S													
IV Splits	M							1						
	L													
	S													
V Cracked Bark	M													
	L													
Targeted fauna survey														

SIZE OF HOLLOWS: S = < 10cm, M = 10 to 30cm, L = > 30cm
HEALTH: Record % of healthy growth compared to dead limbs.

POSITIONS: Topographical location - ridge, slope, gully etc.
FAUNA USE: Record scats, scratches, feed scars, nests etc.

HOLLOW BEARING TREE ASSESSMENT

CLIENT. Crightons Property Group.....REF NO.8020..... SURVEY DATE.2008.....

SHEET NO.....2.....of.....4.....TREE LOCATIONS SHOWN ON FIGURE 1 SITE SURVEY SHEET COMPLETED Y/N ASSESSOR P.S……..

Tree Tag Number		HT 14	HT 15	HT 16	HT 17	HT 18	HT 19	HT 20	HT 21	HT 22	HT 23	HT 24	HT 25	HT 26
Species		*E. robusta*	*E. pilularis*	*A. costata*	*stag*	*stag*	*E. robusta*	*E. robusta*	*E. robusta*	*E. robusta*	*A. costata*	*E. robusta*	*A. costata*	*E. robusta*
DBH (cm)		50	20, 25	30, 20	40	30		40	40,30, 30	50	30 , 20	45	30, 50	50
Spread (m)		13	2	6	4	2	4	5	6	10	8	4	15	12
Height (m)		15	8	10	1	12	15	15	12	17	18	15	12	15
Position														
% Health		70	10	40			60	65	60	75	75	60	60	75
Fauna Use														
HOLLOWS														
	S	1												
I Broken Trunk	M			1								1	1	1
	L									1	1			
	S													
II Branch	M		1				1	1						
	L													
	S			1	2	1	2		1					
III Trunk	M				1		1							
	L													
	S				2	1								
IV Splits	M							1	1					
	L													
	S													
V Cracked Bark	M			1	2	2								
	L													
Targeted fauna survey														

SIZE OF HOLLOWS: S = < 10cm, M = 10 to 30cm, L = > 30cm
HEALTH: Record % of healthy growth compared to dead limbs.

POSITIONS: Topographical location - ridge, slope, gully etc.
FAUNA USE: Record scats, scratches, feed scars, nests etc.

HOLLOW BEARING TREE ASSESSMENT

CLIENT. Crightons Property Group.....REF NO.8020..... SURVEY DATE.2008.....

SHEET NO.....3.....of.....4.....TREE LOCATIONS SHOWN IN FIGURE 1 SITE SURVEY SHEET COMPLETED Y/N ASSESSOR. P.S……..

Tree Tag Number		HT 27	HT 28	HT 29	HT 30	HT 31	HT 32	HT 33	HT 34	HT 35	HT 36	HT 37	HT 38	HT 39
Species		*A. costata*	*A. costata*	*A. costata*	*E. robusta*	*A. costata*	*C.*	*E.*	*E.*	*E. robusta*	*E. robusta*	*E. robusta*	*E. robusta*	*E. robusta*
DBH (cm)		30	40, 40	45, 20	50,40, 30,	40, 40	30, 25	50	40	50	50	50	40 , 10	35, 10, 5
Spread (m)		5	14	12	9	14	6	14	6	5	9	7	4	3
Height (m)		12	14	14	14	17	12	16	14	15	12	12	10	10
Position														
% Health		5	75	80	60	80	50	60	60	70	80	50	50	30
Fauna Use			scratches										scratches	
HOLLOWS														
	S													
I Broken Trunk	M							1			1			
	L									1			1	1
	S		1	1	2									
II Branch	M	1				1			1					
	L													
	S													
III Trunk	M													
	L													
	S													
IV Splits	M													
	L						1					1		
	S													
V Cracked Bark	M													
	L													
Targeted fauna survey														

SIZE OF HOLLOWS: S = < 10cm, M = 10 to 30cm, L = > 30cm
HEALTH: Record % of healthy growth compared to dead limbs.

POSITIONS: Topographical location - ridge, slope, gully etc.
FAUNA USE: Record scats, scratches, feed scars, nests etc.

HOLLOW BEARING TREE ASSESSMENT

CLIENT. Crightons Property Group.....REF NO.8020..... SURVEY DATE.2008.....

SHEET NO.....4.....of.....4.....TREE LOCATIONS SHOWN ON FIGURE 1 SITE SURVEY SHEET COMPLETED Y/N ASSESSOR P.S……..

Tree Tag Number		HT 40	HT 41	HT 42	HT 43	HT 44	HT 45	HT 46	HT 47	HT 48				
Species		*E. robusta*	*E. robusta*	*E. robusta*	*E. robusta*	*E. robusta*	*E. robusta*	*E. pilularis*	*E. robusta*	*E.*				
DBH (cm)		25	50	25, 10	30	25, 10,40	35	60, 25	50	60				
Spread (m)		2	5	2	5	6	2	8	7	7				
Height (m)		5	8	8	7	12	8	12	12	8				
Position		20	60	60	50	50	10	20	60	60				
% Health														
Fauna Use														
HOLLOWS														
	S							1						
I Broken Trunk	M	1		1			1	1		1				
	L		1											
	S													
II Branch	M				1	1								
	L									1				
	S								1					
III Trunk	M													
	L													
	S													
IV Splits	M													
	L						1		1					
	S													
V Cracked Bark	M													
	L													
Targeted fauna survey														

SIZE OF HOLLOWS: S = < 10cm, M = 10 to 30cm, L = > 30cm
HEALTH: Record % of healthy growth compared to dead limbs.

POSITIONS: Topographical location - ridge, slope, gully etc.
FAUNA USE: Record scats, scratches, feed scars, nests etc.

Original plan produced in A3 colour.

*Subject Site boundary subject to final survey. Plan for indicative purposes only. Not for detailed measurement. Survey locations are approximate and have not been fixed by land survey.

Legend

- Subject Site Boundary
- Surveyed Hollow Bearing Tree Location
- Approximate Identified Hollow Bearing Tree Location

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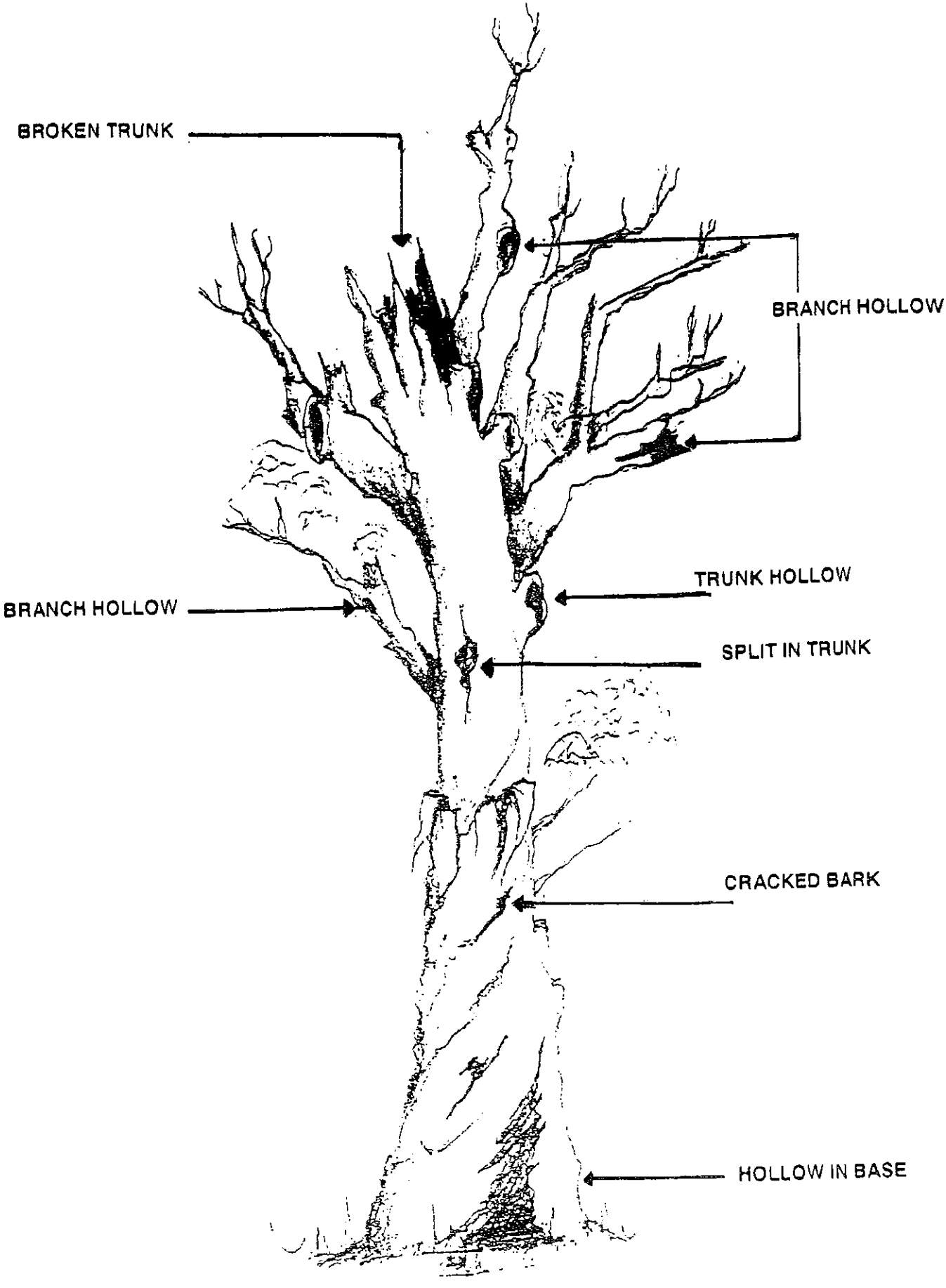
Figure A2.1
Hollow Bearing Tree Locations
Riverside, Tea Gardens

Ver.FX By JM 12/08/08 Ref.No.8020

Source: Surveyed hollow bearing tree location details supplied by Tattersals surveyors 2008.
Aerial © Department of Lands (2007)

TYPES OF TREE HOLLOWS TO BE RECORDED ON HABITAT TREE SURVEY



APPENDIX 3

KOALA MANAGEMENT STRATEGY

KOALA MANAGEMENT STRATEGY

RIVERSIDE
TEA GARDENS

AUGUST 2008
(REF: 8020)

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KOALA MANAGEMENT STRATEGY

RIVERSIDE
TEA GARDENS

AUGUST 2008

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PREFACE

This Koala Management Strategy has been prepared to identify and address issues and actions relevant to the protection of Koalas and their habitat within land known herein as Riverside at Tea Gardens. This report has been prepared to accompany an Environmental Assessment to be submitted as part of a development application for the subject site. The Environmental Assessment has been prepared in accordance with the Director Generals Environmental Assessment Requirements (DGEAR's). These DGEARs have been provided in accordance with Part 3A Major Infrastructure and Other Projects of the *Environmental Planning and Assessment Act* (1979).

This report details the assessment of the site in relation to the occurrence of Koala habitat within the site and the Koala within the local area. This report also considers those recovery objectives of the Recovery Plan for the Hawks Nest and Tea Gardens Endangered Koala (*Phascolarctos cinereus*) Population and Draft Recovery Plan for the Koala (*Phascolarctos cinereus*).

As the Koala or evidence of its use of the site was not observed during surveys a Koala Plan of Management in accordance with State Environmental Planning Policy (SEPP) No. 44 Koala Habitat Protection is not required. Additionally, the preparation of a Koala Plan of Management in accordance with SEPP 44 is not part of the planning framework required to be considered within Part 3A Major Projects applications and within the Director Generals Environmental Assessment Requirements for the Concept Plan. However, this Koala Management Strategy has been prepared as a proactive measure in response to the occurrence of potential habitat within the site and known presence of the Koala within the Tea Gardens and Hawks Nest area and also to make contingency for the future potential use of the site and long term protection of this species.

TABLE OF CONTENTS

KOALA MANAGEMENT STRATEGY

SECTION 1	**INTRODUCTION**	1
	1.1 Background	1
	1.2 Koala Habitat Assessment	2
	1.3 Legislative Framework	3
	1.4 Proposed Development	3
	1.5 Site Description	3
	1.6 Objectives of this Plan of Management	4
	1.7 Format of this Plan of Management	5
SECTION 2	**KOALAS WITHIN THE SITE AND LOCAL AREA**	6
SECTION 3	**KOALA HABITAT WITHIN THE SUBJECT SITE AND LOCALITY**	7
SECTION 4	**THREATENING PROCESSES**	8
SECTION 5	**PROPOSED MANAGEMENT ACTIONS**	10
	5.1 Habitat Protection	10
	5.2 Habitat Restoration	11
	5.3 Traffic Management	11
	5.4 Dog Management Requirements	12
	5.5 Bushfire Management	12
	5.6 Koala Welfare and Public Education	13
	5.7 Monitoring and Reporting	13
SECTION 6	**TIMING OF WORKS**	14
SECTION 7	**FUNDING OF WORKS**	16
SECTION 8	**CONCLUSION**	17
	REFERENCES	18

SECTION 1

INTRODUCTION

This Koala Management Strategy has been prepared to identify and address issues and actions relevant to the protection of Koalas and their habitat within land known herein as Riverside at Tea Gardens. This report has been prepared to accompany an Environmental Assessment to be submitted as part of a development application for the subject site. The Environmental Assessment has been prepared in accordance with the Director Generals Environmental Assessment Requirements (DGEAR's). These DGEARs have been provided in accordance with Part 3A Major Infrastructure and Other Projects of the *Environmental Planning and Assessment Act* (1979).

For the purposes of this Koala Management Strategy the subject site refers to the area proposed for development within Lots 10 and 34 DP 270100 known herein as Riverside. This includes those areas to be developed for commercial and residential mixed use and those areas to be retained as part of reserve and corridor areas. These areas include land within SEPP 14 wetlands, conservation zoned land, Asset Protection Zone and buffer areas, drainage corridors and wildlife corridors.

1.1 Background

The subject site is within the area bound by the Hawks Nest and Tea Gardens Endangered Koala (*Phascolarctos cinereus*) Population. The area containing the endangered population extends in the south-east to Yacaaba Headland and in the south-west to the peninsula west of Winda Woppa. The population area extends in the west and north-west to the outskirts of the builtup area of Tea Gardens, including the Shearwater Estate, where it is bound by Toonang Drive at the northern boundary of the subject site. The population area extends in the north to an east-west line three kilometres north of the boundary of the Hawks Nest Golf Course. Occasional sightings have been made outside these boundaries. The population is bound in the south and east by the Pacific Ocean (NSW Scientific Committee 2000).

The Koala or signs of its presence were not observed within the subject site during surveys. Extensive fauna surveys and Spot Assessments Techniques were employed within the site however no signs of the presence of the Koala within the site were observed during these surveys. Full details of the surveys for the Koala are contained within Section 1.2.

As the Koala or evidence of its use of the site was not observed during surveys a Koala Plan of Management in accordance with State Environmental Planning Policy No. 44 Koala Habitat Protection is not required. However, this Koala Management Strategy has been prepared due to the known presence of the Koala within the Tea Gardens and Hawks Nest area and to provide environmental management strategies for the future potential use of the site and long term protection of this species. The Hawks Nest and Tea Gardens population of the Koala has been listed as endangered within the *Threatened Species Conservation Act* (1995).

The works and measures detailed within this report in relation to Koala Habitat Management are to be carried out in conjunction with those strategies developed for the Ecological Site Management Strategy (CEG 2008) and Bushfire Protection Assessment (CEG 2008).

1.2 Koala Habitat Assessment

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

vii. A search of the Atlas of NSW Wildlife (DECC 2008, Bionet 2008) was undertaken to identify records of koalas located within 10km of the site.

viii. Review of previous flora and fauna surveys and SEPP 44 assessments undertaken across the site and within the local area.

ix. The site was surveyed on foot with all Koala food trees being inspected for signs of Koala usage. Trees were inspected and identified for presence of Koalas, 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 for each transect. Additionally the location and density of droppings if found was documented.

x. Koalas were also targeted during spotlight surveys.

xi. 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.

xii. Trees were searched for signs of Koala usage on March 2007 using methodology outlined in the Spot Assessment Technique (Phillips and Callaghan, 1995). No Koala usage of the subject site was observed.

xiii. Spotlighting for the Koala was carried out during 25-26 February, 15 August and 6 & 7 September 2007 and February, March & April 2008.

Parts of the subject site were found to contain *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus signata* (Scribbly Gum), *Eucalyptus microcorys* (Tallowwood) and *Eucalyptus punctata* (Grey Gum) all identified Koala food tree species listed on Schedule 2 of the State Environmental Planning Policy No. 44 - Koala Habitat Protection. The balance of the trees on the subject site are predominantly *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus umbra* (Broad-leafed White Mahogany), *Endiandra sieberi* (Corkwood) and *Melaleuca quinquenervia* (Broad-leaved Paperbark). Areas of the subject site contain preferred Koala food trees in densities greater than 15% thus there are occurrences of Potential Koala Habitat within the site.

No Koala or signs of evidence were observed during surveys and Spot Assessments. Further Spot Assessments were completed in 2007. Fourteen census points were sampled. At each of these points 20 trees were inspected for signs of Koala usage, that is, scats at the base or tell tale scratches on the trunk. No evidence of any use of the site by the Koala was observed during these surveys. Locations of Spot Assessments undertaken in 2007 are shown in Figure A3.1.

Records of the Koala within the site consist of a single observation from 1995 (DECC 2008). There are no recent records for this species on the subject site within the Atlas of NSW Wildlife (DECC 2008). There are records for the Koala from recent surveys within land to the north-west of the site that have apparently yielded significant activity levels (*M. Bell pers. comm*.)

The absence of Koalas on the site either as regularly occurring individuals or a breeding colony would indicate that the site provides Potential Koala Habitat but does not form Core Koala Habitat as per the guidelines and definitions set out within SEPP 44.

1.3 Legislative Framework

This Koala Management Strategy has been prepared to identify and address issues and actions relevant to the protection of Koalas and their habitat within Riverside at Tea Gardens. This report has been prepared to accompany an Environmental Assessment to be submitted as part of a development application for the subject site. The Environmental Assessment has been prepared in accordance with the Director Generals Environmental Assessment Requirements (DGEAR's). These DGEARs have been provided in accordance with Part 3A Major Infrastructure and Other Projects of the *Environmental Planning and Assessment Act* (1979).

State Environmental Planning Policy No. 44 Koala Habitat Protection provides a legislative framework for the identification of Koala habitat and implementation of management strategies to protect Koala habitat. Where Core Koala Habitat is identified within an area, SEPP 44 requires a Koala Plan of Management to control and minimise impacts upon Koala habitat. No Core Koala Habitat was identified within the site however as detailed within Section 1.2. As such a Koala Plan of Management in accordance with SEPP 44 is not required.

A Recovery Plan for the Hawks Nest Tea Gardens Endangered Koala Population has been prepared by the NSW *National Parks and Wildlife Service* (2003). The Recovery Plan contains broad objectives and actions to be implemented by the *Department of Environment and Climate Change* and *Great Lakes Council* with the objective of returning the endangered population to a position of viability in nature. The Recovery Plan establishes a framework for ongoing protection and rehabilitation through on-ground works and further planning.

This Koala Management Strategy has been developed due to the known presence of the Koala within the Tea Gardens and Hawks Nest area and to make contingency for the future potential use of the site by this species. Where appropriate this Koala Management Strategy includes details to be consistent with the broader objectives and actions of the Recovery Plan for the Hawks Nest Tea Gardens Endangered Koala Population.

1.4 Proposed Development

The proposed development is for a mixed use commercial and residential development according to the Concept Masterplan provided as separate documentation.

1.5 Site Description

The subject site is bound to the north by bushland, rural residential land and Toonang Drive, to the east by the Mile River, to the south by residential land within the Shearwater Estate and to the west by fragmented bushland and industrial estate development west of Myall Street.

1.6 Objectives of this Koala Management Strategy

The following objectives are listed within the Recovery Plan for the Hawks Nest and Tea Gardens Endangered Koala Population (NPWS 2003):

- To co-ordinate the recovery of the Hawks Nest and Tea Gardens Koala Population;
- To identify and map the distribution of koala habitat in the Hawks Nest and Tea Gardens area;
- To conserve the Hawks Nest and Tea Gardens Population in its existing habitat;
- To incorporate Koala conservation into planning processes;
- To rehabilitate and restore Koala habitat in the Hawks Nest and Tea Gardens area;
- To ensure the broader community has access to information about the distribution, conservation and management of Koalas;
- To manage sick, injured or orphaned Koalas with a consistent and high standard of care.

The majority of these objectives and actions provided in the Recovery Plan refer to implementation by NPWS, Great Lakes Council and the formation of the Koala Working Group. The following objectives have been developed for this Koala Management Strategy for the management of Koalas and their habitats within the subject site. Where appropriate these objectives have been developed to be consistent with the relevant objectives and management actions of the NSW *Department of Environment and Climate Change* and *Great Lakes Council* as part of the Recovery Plan for the Hawks Nest and Tea Gardens Endangered Koala Population referred to above.

- Maintenance of areas of potential Koala habitat;
- Rehabilitation of potential Koala habitat;
- Provision of safe movement areas for Koalas through the site;
- Protection of potential Koala habitat areas;
- Maintenance/improvement of current Koala population size;
- Community education in relation to the Koala
- Monitoring for effectiveness of Koala management measures and decisions.

1.7 Format of this Plan of Management

No Koalas have been recorded within the site since 1995 (unconfirmed NPWS). While the site does not constitute Core Koala Habitat (as discussed in Section 1.2), this Koala Management Strategy has been developed in accordance with guidelines within State Environmental Planning Policy (SEPP) 44 Koala Habitat Protection to provide contingency for the occurrence of the Koala within the local area and potential for future use of the site by this species. The following considerations form the basis of management strategies and decisions to be implemented within this plan:

- Estimation of Koala population size;
- Identification of preferred feed tree species for the locality and the extent of the resource available;
- Assessment of the regional distribution of Koalas and the extent of alternative habitat available to compensate for that to be affected by the actions;
- Identification of linkages of potential Koala habitat to adjacent areas and movement of Koalas between habitat areas. Provision of strategies to enhance and maintain these corridors;
- Identification of major threatening processes and provision of methods to alleviate impacts;

- Provision of detailed proposals for amelioration of impacts on Koala populations from any anticipated development within zones of potential Koala habitat;
- Identification of any opportunities to increase size or improve condition of existing core habitat;
- Provisions for long term monitoring, review and regular reporting.

The area to which this plan applies is the area bound by Lots 10 and 34 DP 270100 known as Riverside at Tea Gardens.

SECTION 2

KOALAS WITHIN THE SITE AND LOCAL AREA

Given the lack of evidence of use of the site by the Koala during recent (2007, 2008) surveys an estimate of population size cannot be made. The most recent sighting of the Koala within the site is from1995 (DECC 2008). There are records for the Koala from recent surveys within land to the north-west of the site that have apparently yielded significant activity levels (*M. Bell pers. comm*. 2007).

The endangered population of the Koala in the Hawks Nest Tea Gardens area has been listed as 12 individuals. This consists of 2-3 in the Tea Gardens area and the remainder in the Hawks Nest area (NSW Scientific Committee 2000).

In terms of this species occurrence within the locality the Koala has been recorded within land north of Hawks Nest on the eastern side of Mungo Brush Road and at Limestone. There are also records for the Koala as part of the endangered population within land north of Hawks Nest on the eastern side of Mungo Brush Road, the sewage treatment works, reserve at Kingfisher Avenue, Yacaaba Head, Hawks Nest, Tea Gardens, Jimmys Beach and land south of Lime Kilns Road (DECC 2008).

The *Friends of the Koala* (Great Lakes) were contacted previously to source local area information and observations of the Koala within the Tea Gardens and Hawks Nest area (*Myall Koala and Environmental Support Group* 2006). The following is a summary of the information supplied to *Conacher Travers* under agreement from the Friends of the Koala on Koala observations between 1996 and 2006: Tea Gardens 102 observations, Winda Woppa 66 observations, Swan Bay 431 observations, Central Hawks Nest 492 observations, Hawks Nest Beach 1266 observations. There are only occasional recent sightings (6) for the Koala within the Tea Gardens area from Jan 2004 to Feb 2006.

The above are observation records only and not indicative of the number of individuals or population size. It is considered that these repeated observations of several individuals are part of that population estimated by the NSW Department of Environment and Climate Change as 12 individuals and as recorded periodically throughout the Tea Gardens / Hawks Nest area by the Friends of the Koala. The larger number of records in the Hawks Nest area compared to the Tea Gardens area reflects the larger population size estimated by the NSW Department of Environment and Climate Change in Hawks Nest in comparison to Tea Gardens.

At this stage it is considered that the absence of recent records or signs of recent use of the site by the Koala indicates the Koala may be a rare visitor to the site and may be present periodically, probably from vegetation to the north-west of the site. According to the Spot Assessment Technique (Phillips and Callaghan 1995), the absence of any scats indicates that the current level of use of the site by the Koala is unlikely to be significant.

SECTION 3

KOALA HABITAT WITHIN THE SUBJECT SITE AND LOCALITY

The subject site contains suitable foraging and refuge habitat for the Koala. Four Koala food tree species listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection was observed within the subject site. These species are:

- *Eucalyptus robusta* (Swamp Mahogany);
- *Eucalyptus microcorys* (Tallowwood);
- *Eucalytptus punctata* (Grey Gum);
- *Eucalyptus signata* (Scribbly Gum).

The Recovery Plan for the endangered population of the Koala lists Swamp Mahogany (*Eucalyptus robusta*) as being of primary importance locally. Other species including Broad-leaved Paperbark (*Melaleuca quinquinervia*), Blackbutt (*E. pilularis*), red Bloodwood (*Corymbia gummifera*) and Smooth-barked Apple (*Angophora costata*) are also utilised by the local population but to a lesser extent (NPWS 2003).

These tree species occur in varying proportions and densities within the following vegetation communities mapped on the site:

- Pasture with Scattered Trees;
- Acacia / Melaleuca Regrowth Scrub;
- Open Forest (*Corymbia gummifera*);
- Open Forest (*Eucalyptus microcorys*);
- Open Forest (*Eucalyptus pilularis*);
- Woodland / Open Forest (*Eucalyptus robusta*);
- Paperbark Forest (*Melaleuca quinquenervia*).

The vegetation communities within the site show moderate to high disturbance levels and as such are of decreased quality for the Koala in comparison to vegetation to the north and north-west. The subject site has been extensively grazed and the understorey and groundcover has been regularly maintained (slashed/pasture improved). The highest quality, less disturbed vegetation for the Koala is within the wetland fringing communities including the *Eucalyptus robusta* dominant communities.

The vegetation within the subject site is part of a fragmented local landscape that provides some potential connectivity to other vegetated areas to the north, north-east, north-west and west. The area to the north of the site consists of bushland of higher habitat quality due to decreased levels of disturbance. Vegetation to the east of the site is isolated by the Myall River. While some scattered urban trees are present within the Tea Gardens township to the south it is considered that this urban landscape is generally of low quality for the Koala. The site shows some connectivity to similar, larger areas of vegetation and habitat to the west, including lands within Myall River Downs. This area shows connectivity to large areas of vegetation to the north-west of the subject site.

No mapping of Koala habitats within the Tea Gardens/Hawks Nest area has been completed by Great Lakes Council.

SECTION 4

THREATENING PROCESSES

A number of Key Threatening Processes are listed within the *Threatened Species Conservation Act* (1995) for the Koala. The Koala is listed within the TSC Act (1995) as Vulnerable and is also listed as an Endangered Population for the Hawks Nest Tea Gardens Endangered Koala Population.

A Draft Recovery Plan for the Koala within NSW (NPWS 2003) has been released for public comment. The Draft Recovery Plan for the Koala (NPWS 2003) lists the following as threatening processes:

- Habitat loss and fragmentation;
- Habitat degradation;
- Road kills;
- Dog attacks;
- Fire;
- Logging;
- Disease;
- Severe weather conditions;
- Swimming pools;
- Overbrowsing.

The Department of Environment and Climate Change (DECC 2008) have listed the following as threats to the Koala in NSW:

- Loss, modification and fragmentation of habitat;
- Predation by feral and domestic dogs;
- Intense fires that scorch or kill the tree canopy;
- Road kills.

Of these threats it is considered that habitat loss, habitat degradation, road kills and dog attacks are potential threats posed by the development.

The *TSC Act* (1995) identifies “Clearing of native vegetation”, “high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition” and “invasion of native plant communities by *Chrysanthemoides monilifera* (Bitou Bush)” as Key Threatening Processes for the Hawks Nest Tea Gardens Endangered Koala Population. The proposed development is not likely to affect this species conservation status at a local level. The occurrence of this species and suitable habitat for this species within local reserves and lands zoned for environmental protection indicates that this species local conservation status is not likely to be negatively affected by any potential impacts of development within the subject site.

The Recovery Plan for the Hawks Nest Tea Gardens Endangered Koala Population (NPWS 2003) lists the following as threatening processes for:

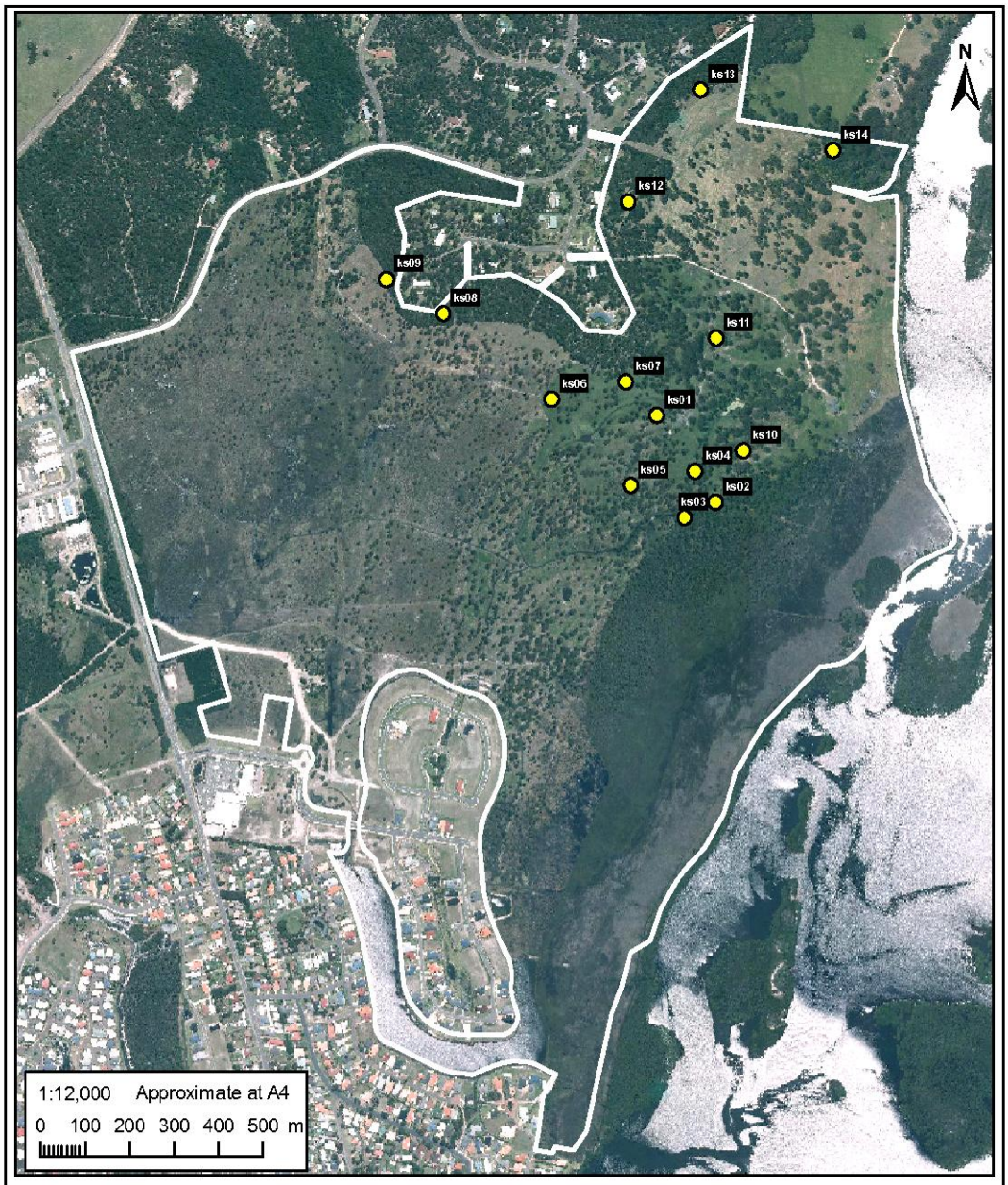
- Habitat loss and fragmentation;
- Habitat degradation;
- Dog attacks;
- Road kills;
- Fire.

The Department of Environment and Climate Change (DECC 2008) have listed the following as threats to the Hawks Nest Tea Gardens Endangered Koala Population:

- Habitat destruction and fragmentation;
- Mortalities from vehicle collisions;
- Attacks by domestic dogs and wild dogs.

Disease and swimming pools are also listed as potential threats (NPWS 2003).

Of these threats it is considered that habitat loss, habitat degradation, road kills, dog attacks and construction of swimming pools are potential threats posed by the development.



Original plan produced in A4 colour. Plan for indicative purposes only. Not for detailed measurement.
Survey locations are approximate and have not been fixed by land survey. *Subject Site boundary subject to final survey.

Legend

ks 04

Property Boundary — Koala Scat Search Location 2007 (numbered)

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Figure A3.1
Koala Survey Locations
Myall Rd, Tea Gardens

Source: DLWC 1:25,000 Aerial Photograph,

SECTION 5

PROPOSED MANAGEMENT ACTIONS

The following Koala habitat management strategies will be implemented for the long term management of the Koala within the subject site. These broad management strategies have been identified and developed based on maximising opportunities for the protection of Koala habitat within the site and minimising the potential impacts of the proposed development and occupation.

These are:

- Habitat protection requirements;
- Habitat restoration requirements;
- Traffic management requirements;
- Dog management requirements;
- Bushfire management;
- Koala welfare public education;
- Monitoring and reporting requirements.

5.1 Habitat Protection

Objectives:

- Provide for retention of preferred feed trees within the subject site;
- Provide for retention area of potential shelter and refuge trees within the subject site within drainage corridors;
- Maximise the retained vegetation within the proposed wildlife corridor as a movement area for the Koala.

Actions:

The development will require the removal of trees as part of preparation for construction of residential areas. As part of the development a number of areas will be retained to provide continued access to potential foraging and refuge resources and movement areas through the post development landscape. These will consist of reserve and corridor areas and provide for the interconnectivity of currently connected vegetation and habitats within the local landscape. The location of these reserve areas are shown in the Concept Masterplan information.

During construction temporary fencing will be used to protect all those areas to be retained. All site contractors will be notified of their responsibilities in regards to tree protection during construction.

Signs will be placed at suitable locations along the length of the reserve areas notifying residents of restrictions to access and occurrence of potential Koala habitat.

Other protective measures that will be implemented as part of the proposal include:

- Protective covenants on trees;
- Long term tree protection measures;
- Monitoring of tree health/condition and use.

5.2 Habitat Restoration

Objectives:

- Restore habitat within corridors and reserve areas;
- Restrict access to reserve areas to aid restoration/revegetation process;
- Monitor and maintain restored/revegetated areas;
- Increase local awareness of importance of corridors and regeneration areas.

Actions:

Areas of the site will be retained and restored as part of corridor and reserve areas. The higher quality, less disturbed vegetation types in the north and east of the site will be retained as part of the proposal. Corridor or "greenway" areas containing preferred feed tree species will also transect development areas to allow for provision of habitat and movement through the site.

These reserve and corridor areas will be managed to allow for natural regeneration of the tree species within those areas, particularly those Koala feed tree species. Where Koala feed tree densities or numbers are sparse, contingency will be made for replanting areas with preferred feed tree species including Swamp Mahogany, Tallowood and Grey Gum.

An Ecological Site Management Strategy has been prepared for the site that details the rehabilitation and vegetation protection strategies for those retained bushland areas. This includes details on tree protection and ongoing weed removal in maximising the vegetation and potential habitat quality for the Koala.

All vegetation and habitat restoration measures completed within retained vegetation will be carried out by a licensed Bushland Regenerator, engaged by the Community Association.

All retained vegetation will be signposted at regular intervals to indicate the sites access restrictions and function.

The results of detailed local area vegetation community mapping have been provided to Great Lakes Council to aid in the local area koala habitat mapping as per the Recovery Plan for the endangered population.

5.3 Traffic Management

Objectives:

- Minimise the risk of injury to Koalas posed by local traffic;
- Increase driver/resident awareness of the risk vehicles pose to Koalas.

Actions:

Traffic speed will be limited to 50km/h along boundary and internal roads of the proposed development. This will be indicated by speed limiting signs. The decrease in speed will minimise the chances of vehicle strike upon Koalas and decrease chance or severity of injuries.

The road construction will also include the provision of Koala warning signs to raise awareness of potential of Koalas to cross roads.

The roadside edges will be regularly maintained to increase driver visibility of Koalas potentially crossing roads associated with the proposed development.

5.4 Dog Management Requirements

Objectives:

- Decrease risk of injury/mortality posed by domestic dogs to Koalas;
- Increase resident awareness of the risk unrestrained dogs pose to Koalas and local wildlife.

Actions:

Any dogs kept within the proposed development will be restricted to fenced yards around dwellings. Yards will be fenced to contain dogs and restrict access to the other areas, particularly reserve areas within the site.

All dogs must be kept restrained on a leash if outside of designated yards.

Council contact details will be supplied to residences to provide information to Council on incidence of dog attacks on Koalas or dogs roaming unrestrained.

The control of dogs is in accordance with the *Companion Animals Act* (1998) and relevant objectives of the Recovery Plan endangered population of the Koala.

5.5 Bushfire Management

Objectives:

- To design/maintain areas within the site so as not to pose a bushfire hazard to adjacent development;
- To design/maintain areas within the site so as to integrate bushfire protection zones while maximising Koala habitat areas.

Actions:

Areas of the site will be periodically maintained for bushfire hazard protection. APZ Management and Bushfire Protection Zones are proposed to be integrated within the site design. As part of bushfire protection measures the understorey will be periodically maintained however no tree removal will be required.

All slashing of the bushfire protection areas will be carried out using a rear mounted slasher on a rubber tyred tractor in a manner that does not damage recruitment seedlings or retained trees.

No hazard reduction burning will be undertaken as part of bushfire management.

5.6 Koala Welfare and Public Education

Objectives:

- To provide ongoing protection to Koalas within the local area
- To increase local awareness of Koalas and Koala welfare in the local area
- Promote positive attitude toward protection of the Koala within the local area
- Increase community awareness of Koala interest groups such as the Koala Preservation Society of NSW and Friends of the Koala
- Increase provision of information from residents to Council regarding Koala observations within the area

Actions:

In accordance with increasing community awareness the distribution of pamphlets to residents providing information relating to the Koala within the local area will be implemented. This pamphlet is to include as a minimum:

- general information on the Koala
- information on the local population
- information on risks to Koalas
- information on local community interest groups (Friends of the Koala)
- Emergency contact details such as Council, FAWNA and Koalas in Care Inc.

Signage will provided within the site identifying Koala habitat areas and Koalas within the area.

Other initiatives will also include the provision of signage within the site and local area that contain information on the importance and vulnerability of the local Koala population with the objective of raising local awareness and promoting a positive local attitude toward the protection of the Koala locally.

The care of Koalas and community education programs are in accordance with the relevant objectives of the Recovery Plan endangered population of the Koala.

5.7 Monitoring and Reporting

Objectives:

- To implement an ongoing survey and monitoring program that will determine use of the area by Koalas;
- To record and report on results of the Koala monitoring program;
- To report on all other actions implemented as part of the Management Plan.

Actions:

A report detailing the ongoing management and restoration activities being carried out within the site is to be submitted to the relevant consent authority detailing the results of vegetation and habitat restoration and protection. This report is to be provided by a qualified ecologist and is to cover:

- Results of tree regeneration within the regeneration areas;

- Details of vegetation management actions;
- Records of observations of Koalas on the site;
- Any other relevant information in regards to Koalas and the proposed development.

A bi-annual Koala survey for ten years following the approval of the various stages of the proposal will be undertaken. Surveys will consist of spotlighting and call playback for two nights during each bi-annual survey period. The Spot Assessment Technique will also be carried out at standard survey locations within those areas to be reserved. A report will be supplied to Council at the completion of each bi-annual monitoring period.

The results of monitoring will be made available to the Koala Working Group as referred to in the Recovery Plan for the endangered population.

SECTION 6

TIMING OF WORKS

The following table outlines the timing of works proposed as part of this Koala Plan of Management.

TABLE A3.1
TIMING OF KOALA HABITAT MANAGEMENT WORKS

	Pre-construction	Construction	Occupation
Habitat Protection			
Identification of protection areas	√		
Erection and maintenance of temporary protection fencing	√	√	
Establishment of reserve areas	√		
Protective covenants on trees	√		
Long term tree protection measures	√		
Monitoring of trees	√		√
Habitat Restoration			
Establishment of corridor and reserve areas	√		
Ecological Site Management Plan	√		
Vegetation management	√	√	√
Signage	√	√	
Traffic Management			
Speed limit traffic (signs)		√	
Speed limit traffic (speed bumps)		√	
Signage		√	
Slashing roadside areas			√
Dog Management			
Dog walks on leash only			√
Council contact details to residences			√
Bushfire Management			
Tree protection measures	√		
Periodic slashing	√	√	√
Prohibit reduction burning	√	√	√

TABLE A3.1 (Cont.) TIMING OF KOALA HABITAT MANAGEMENT WORKS			
	Pre-construction	**Construction**	**Occupation**
Koala Welfare and Public Education			
Pamphlet distribution			√
Signage			√
Monitoring and Reporting			
Bi-annual Koala surveys			√
Habitat and regeneration area monitoring	√	√	√
Annual reporting to relevant consent authority		√	√

SECTION 7

FUNDING OF WORKS

All costs of the implementation of the management strategies detailed within this plan will be met by the applicant, future landowners or the Community Association. Where reserved lands are handed back to public ownership the relevant statutory authority will assume responsibility for any ongoing works.

SECTION 8

CONCLUSION

While there are no recent records for the Koala within the area to be developed and no evidence of recent use of the site has been detected, the potential of the Koala to occur within the site indicates the requirement for suitable Koala and habitat management strategies to be implemented for the planning, developmental and occupational phases of the proposed development. The presence of the Hawks Nest and Tea Gardens Endangered Koala (*Phascolarctos cinereus*) Population within the area increases the importance of the management of the Koala in future planning decisions within the local area.

This report has been prepared as a strategic approach to guide future planning and management decisions in relation to the Koala within Riverside. This Koala Management Strategy may be used as a guide in developing specific management planning reports, decisions and actions for various future stages of the Riverside proposal. It is considered that the works and measures detailed in this plan provide for a high level of consideration of Koala management within the site. These measures have been developed to provide for persistence of the Koala in the area and maintenance of Koala populations, habitat and connectivity within the locality.

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APPENDIX 4

ECOLOGICAL SITE MANAGEMENT STRATEGY

ECOLOGICAL SITE MANAGEMENT STRATEGY

RIVERSIDE
TEA GARDENS

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PREFACE

This Ecological Site Management Strategy (ESMS) has been completed to provide a range of ecological management strategies in protecting the long term environmental and ecological values of lands within the proposed development for Riverside at Tea Gardens.

This report has been prepared to accompany an Environmental Assessment to be submitted as part of a development application for the "Riverside" lands known as Lots 10 and 34 DP 270100 Myall Road Tea Gardens. The Environmental Assessment has been prepared in accordance with the Director Generals Environmental Assessment Requirements (DGEAR's). These DGEARs have been provided in accordance with Part 3A Major Infrastructure and Other Projects of the *Environmental Planning and Assessment Act* (1979).

The ESMS has been prepared to specifically address the following:

- Vegetation and Bushland Management
- Bushfire Management
- Fauna and Habitat Management
- Provision and Establishment of Environmental Corridors
- Provision of Environmental Buffers
- Erosion and Sediment Control
- Stormwater Quality and Management
- Cultural Values and Management
- Community Education, Vigilance and Reporting
- Access, Signage and Fencing
- Prohibited Use Identification and Management
- Feral Pest Species
- Monitoring and Reporting Regime

This ESMS uses the site and local area information collected across a large number of studies in recommending suitable environmental management objectives and actions in the long term protection of the environmental values of the area proposed to be developed.

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TABLE OF CONTENTS

SECTION 1

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION 1
1.2 BACKGROUND 1
1.3 PROCEDURES FOR THE PREPARATION OF THE MANAGEMENT STRATEGY 2
1.4 AREA TO WHICH THIS MANAGEMENT STRATEGY APPLIES 3
1.5 LIFESPAN AND REVIEW OF THE MANAGEMENT STRATEGY 3
1.6 FORMAT OF THE MANAGEMENT STRATEGY 3
1.7 ENVIRONMENTAL MANAGEMENT OBJECTIVES 4
1.8 SITE DESCRIPTION 4

SECTION 2

MANAGEMENT OBJECTIVES AND ACTIONS

2.1 VEGETATION AND BUSHLAND MANAGEMENT 8
2.2 BUSHFIRE MANAGEMENT 10
2.3 PROVISION AND ESTABLISHMENT OF ENVIRONMENTAL CORRIDORS 11
2.4 PROVISION OF ENVIRONMENTAL BUFFERS 12
2.5 EROSION AND SEDIMENT CONTROL 13
2.6 STORMWATER QUALITY AND MANAGEMENT 14
2.7 CULTURAL HERITAGE VALUES AND MANAGEMENT 15
2.8 COMMUNITY EDUCATION, VIGILANCE AND REPORTING 15
2.9 PROHIBITED USES IDENTIFICATION AND MANAGEMENT 16
2.10 NATIVE FAUNA, HABITAT AND FERAL PEST SPECIES MANAGEMENT 17
2.11 ACCESS, SIGNAGE AND FENCING 21
2.12 MONITORING AND REPORTING REGIME 22

SECTION 3

IMPLEMENTATION OF MANAGEMENT ACTIONS

3.1 IMPLEMENTATION OF MANAGEMENT ACTIONS 26

REFERENCES

SECTION 1

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

This Ecological Site Management Strategy (ESMS) has been completed to provide a range of environmental management strategies for protecting the long term environmental and ecological values of lands within the proposed development area and associated retained natural areas herein known as Riverside at Tea Gardens.

This report has been prepared to accompany an Environmental Assessment to be submitted as part of a development application for the Riverside site. The Environmental Assessment has been prepared in accordance with the Director Generals Environmental Assessment Requirements (DGEAR's). These DGEARs have been provided in accordance with Part 3A Major Infrastructure and Other Projects of the *Environmental Planning and Assessment Act* (1979).

Conacher Environmental Group have been engaged by *Crighton Properties* as proponents of the application for the development of Riverside to prepare this ESMS.

The land subject to the provisions of this ESMS consists of those areas bound by Lots 10 and 34 DP 270100 Myall Road Tea Gardens and herein known as Riverside.

1.2 BACKGROUND

The Riverside estate is bound by Toonang Drive in the north, the Myall River in the east, Shearwater Estate in the south and Myall Road to the west. The subject site area is approximately 230 hectares in size.

The proposed development is for a mixed use commercial, industrial and residential development. According to the Concept Masterplan the proposal will include the following:

- Residential lot development as Community Title;
- Proposed home based business precinct (approximately 50 allotments);
- Conference and Clubhouse facilities and low rise Townhouse accommodation;
- Low density "Lodge Houses" associated with Conference facilities;
- Wildlife movement corridors;
- Water management corridors;
- Open space corridors;
- Sporting ovals and tennis courts;
- Lake areas for water quality management;
- Public Reserve areas incorporating sporting ovals and tennis courts;
- Community parks incorporating walking trails, gazebo and other facilities.

The Masterplan design includes the retention of large areas of the site for the purposes of environmental protection. These areas include:

- SEPP 14 Wetlands;
- Conservation zoned lands;

- Asset Protection Zones and environmental buffers;
- Wildlife Corridors;
- Drainage Corridors;
- Open Space areas.

The possible future ownership of these areas and the responsibility of management of these areas is outlined in Section C of this Strategy.

1.3 PROCEDURES FOR THE PREPARATION OF THE MANAGEMENT STRATEGY

This ESMS has been prepared using information obtained from a range of sources including the following:

- Ecological Site Assessment for Riverside at Tea Gardens (*Conacher Environmental Group* 2008);

- Local Environmental Study – Myall Quays (and related Supplementary Reports) (Gardner Browne Planning Consultants, Resource Planning, Patterson Britton and Partners 1991, 1992);

- Flora and Fauna Assessment Report – Myall Quays Estate (*Conacher Travers* 2002);

- Local Environmental Study – Myall River Downs (PPK Environment and Infrastructure 2000);

- Local Environmental Study – North Hawkes Nest (ERM Mitchell McCotter 1997);

- Species Impact Statement – Myall River Downs (*Conacher Travers* 2007);

- Recovery Plan – Hawkes Nest Tea Gardens Endangered Koala Population (Department of Environment and Conservation 2003);

- Ecological Studies of the Squirrel Glider Myall River Downs (D. Sharpe and R. Goldingay 2006);

- Draft Environmental Site Management Plan Rural Residential Subdivision Myall River Downs (*Conacher Travers* 2007).

This Ecological Site Management Strategy details the strategies and measures to be implemented in protecting the natural values of the post development landscape at Riverside at Tea Gardens. In particular the Ecological Site Management Strategy provides information on the following:

- Vegetation and Bushland Management;
- Bushfire Management;
- Provision and Establishment of Environmental Corridors;
- Provision of Environmental Buffers;

- Erosion and Sediment Control;
- Cultural Values and Management;
- Community Education, Vigilance and Reporting;
- Access, Signage and Fencing;
- Prohibited Use Identification and Management;
- Fauna and Fauna Habitat Management;
- Feral Pest Species;
- Monitoring and Reporting Regime.

Each of the above issues is addressed separately in Part B through the process outlined below:

i) Identification of objectives to be achieved for each issue;

ii) A statement of the proposed actions to be implemented to address each issue and the objectives provided;

iii) More detailed information on methods, procedures or quantifying information supporting proposed actions is to be provided as operational or works plans prepared to meet the objectives and requirements identified in the strategy.

1.4 AREA TO WHICH THIS MANAGEMENT STRATEGY APPLIES

The area to which this Management Strategy applies is the area bound by the Concept Masterplan for the proposed development and known as Riverside at Tea Gardens. The area bound by the Masterplan is detailed in the Masterplan by ERM. This area consists of Lots 10 and 34 DP 270100 Myall Road Tea Gardens.

1.5 LIFESPAN AND REVIEW OF THE MANAGEMENT STRATEGY

The ESMS will be implemented for ten years following the date of sign-off of the plan by the Department of Planning. The plan will be reviewed at Year one, Year two and Year five to assess the adequacy of implementation of the management actions.

Those areas within the Riverside Masterplan area that are proposed to be managed under Community Title will have the management actions provided in this ESMS to be included in the Community Management Statement for the Community Title areas. However this will require a full review and amendment of the ESMS at the ten year period. This process may require individual management plans to be prepared to accompany individual Development Applications as part of the development staging process.

1.6 FORMAT OF THE MANAGEMENT STRATEGY

The overall Management Strategy is provided as a single document separated into several sections as outlined below.

SECTION 1 Introduction and Background

Outlines the purpose/ objectives and procedures for preparing this Management Strategy.

SECTION 2 Management Objectives and Proposed Actions

This part identifies the various management objectives and Management Actions to achieve the objectives of the Management Strategy.

SECTION 3 Implementation of Management Actions

This part details how the Management Strategy will be implemented, who is responsible for implementing various actions and provides details on the monitoring and reporting for the life of this management strategy.

1.7 ENVIRONMENTAL MANAGEMENT OBJECTIVES

The environmental management objectives for the areas covered within this Management Strategy are:

i) Protection of the environmental and ecological values of the retained and conserved areas of the site.
ii) Minimisation of the impacts of development within adjacent land upon the retained vegetation and habitat areas during construction and occupation phases of adjoining residential areas.
iii) Maintenance of biodiversity and protection of native flora and fauna species and their habitats (including threatened species) within the area.
iv) Increased awareness and promotion of a culture of protection of the environmental values of the retained and conserved areas of the site by the community.
v) Long term monitoring of the area to determine changes (if any) to flora and fauna, particularly threatened species, and vegetation communities and recommend corrective actions if required.

1.8 SITE DESCRIPTION

Landform Features

Topography and slopes

The topography of the site consists predominantly of flat land of negligible slope and less than 5 metres AHD. In the north of the site a small ridge with a southerly aspect rises to approximately twenty metres.

Drainage

Drainage from the site is via overland flow and through small drainage channels into the Myall River. Areas of the site drain into SEPP 14 Wetland No. 746 on the shores Myall River in the east of the site.

Soils

Two soil landscapes occur within the subject site. These are the Tea Gardens and Pindimar Road Soil Landscapes (Murphy 2002).

The majority of the site consists of soils of the Tea Gardens soil landscape. These soils are found in local relief usually less than 1 metre and elevation 5-8 metres. Soils consist of deep (<300 cm) imperfectly drained Humus Podzols on ridges with poorly drained Peaty Humus Podzols in swales. The soils are prone to seasonal and permanent waterlogging, ground water pollution hazards and are of very low fertility.

The soils associated with the upslope and ridge areas in the north of the site are within the Pindimar Road soil landscape. These soils are found locally on undulating to rolling hills to local relief 30-60m. Soils consist of Brown and Yellow Podzolic soils and Soloths in poorly drained areas. These soils are of low fertility and exhibit high erosion, strong acidity and seasonal waterlogging.

Vegetation

The subject site is bounded to the west by the Myall Road, disturbed grasslands with scattered trees, industrial and residential development; to the south, by predominately existing residential and commercial development; to the east, by the Myall River; and to the north, by a mixture of open forest vegetation communities, areas of rural residential development and agricultural lands.

The majority of the vegetation of the site forms a mosaic of highly disturbed vegetation with scattered trees and woodland/open forest communities. However, the eastern portion of the Riverside site is dominated by a remnant of naturally vegetated Swamp Forests, Heathlands and Estuarine vegetation communities associated with the low lying areas adjoining the Myall River. This remnant is largely isolated from adjoining vegetation to the south by exiting residential development and to the north by an area of cleared agricultural land.

The northern boundary of the subject site is largely dominated by a mixture of open forest vegetation communities and areas of rural residential development. Connectivity exists between the sites eastern remnant vegetation and the areas of remnant open forest to the north, via a mosaic of disturbed woodland and open forest vegetation communities occupying the north eastern areas of the site. These vegetation communities have been impacted by a history of agricultural land use and grazing, resulting in a sparse understorey layer. Continued habitat fragmentation has also resulted from the development of the rural residential areas of Shearwater Estate to the north of the site.

Fauna

Surveys within the subject site and the local area have recorded a range of fauna species. These fauna observations consisted of bird species, mammal species, frog species and reptile species.

During the fauna surveys of the subject site the following threatened fauna species were observed. These species are:

- Osprey (*Pandion haliaetus*);
- Barking Owl *(Ninox connivens);*
- Wallum Froglet (*Crinia tinnula*);
- Squirrel Glider (*Petaurus norfolcensis*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*).
- Little Bentwing-bat (*Miniopterus australis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Large-footed Myotis (*Myotis adversus*);

A number of other threatened fauna species have been observed within the Tea Gardens area as the result of past local area surveys. These are:

- Black-necked Stork (*Ephipiorhynchus asiaticus*);
- Powerful Owl (*Ninox strenua*);
- Masked Owl (*Tyto novaehollandiae*);
- Koala (*Phascolarctos cinereus*);
- Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*);
- Eastern Pygmy-possum (*Cercatetus nanus*);
- Eastern Blossom-bat (*Synconycterus australis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*).

Habitats

A range of fauna habitats are present within the subject site reflecting the diversity in the vegetation communities present. The majority of the site is of decreased habitat quality due to the large amount of disturbance through removal and modification of the groundcover and shrublayer through grazing, slashing and previous clearing for pine plantations.

The following fauna habitats are present on the site and on land adjacent to the site:

- Flower, nectar, fruit and seed producing tree and shrub species;
- Hollow-bearing trees;
- Cleared pasture;
- Aquatic areas associated with permanent farm dams and water courses;
- Semi-aquatic habitats associated with low lying areas;
- Dense understorey areas;
- Leaf litter;
- Drainage depressions;
- Aquatic areas associated with the Myall River foreshore and wetland areas.

The flower, nectar, seed and fruit producing tree and shrub species within the site provide a seasonal foraging resource for a range of fauna species, particularly bird and arboreal mammal species. The site contains a relatively low number of hollow-bearing trees with mostly small hollows. These hollows contain potential den, roost and breeding hollows for bird, arboreal mammal, microchiropteran bat and reptile species.

The site consists predominantly of disturbed vegetation types with no shrublayer and a groundcover dominated by pasture grasses. As such the habitat values are decreased for small terrestrial mammal, bird and reptile species. The lack of cover however does increase foraging opportunities for raptorial and other bird species. The open grassed areas contain suitable habitat for macropod species, particularly the Eastern Grey Kangaroo and Red-necked Wallaby.

Areas of the subject site are prone to ponding after rain providing suitable habitat for a range of amphibian species. The drainage depressions associated with tracks and tree removal holes contain suitable foraging and breeding habitat for these locally occurring amphibian species.

The denser, less disturbed vegetation types associated with the Myall River foreshore provide higher quality habitat due to the increased density and diversity of the various structural layers. These less disturbed habitats provide increased foraging, refuge and breeding opportunities for

mammal, bird, reptile and amphibian species. This is reflected in the species richness of these vegetation types in comparison to the majority of the site containing the disturbed vegetation communities. These higher quality vegetation and habitat types will be retained as part of the proposed development.

The fauna habitats within the site are typical of those associated with low lying areas of the lower reaches and estuarine areas of the Myall River. The habitats are isolated to the south by Myall Quays estate and the Tea Gardens township and to the east by the Myall River. The highest degree of connectivity extends to the north of the subject site. The area to the north of the site consists of bushland of higher habitat quality due to decreased levels of disturbance. The site also shows some connectivity to similar, larger areas of vegetation and habitat to the west, including lands within Myall River Downs. This area shows connectivity via the slope and low ridgeland areas in the north of the site to large areas of vegetation to the north-west of the subject site.

SECTION 2

MANAGEMENT OBJECTIVES AND ACTIONS

The following section provides details on the objectives and actions of each broad management category. The responsibility and timing for each of the management actions is provided within Table 1 of Section C with each management action sub-heading corresponding with a similar action category within Table 1.

2.1 VEGETATION AND BUSHLAND MANAGEMENT

Objectives

- **Identify and protect vegetation to be retained within bushland and reserve areas**
- **Implement measures to reduce the extent of weed species within retained areas**
- **Improve the current bushland and biodiversity values of retained areas**
- **Implement measures to control the risk of weeds spreading from residential development**
- **Promote community involvement in the bushland management and improvement of bushland values**

Actions

i) Preparation of Vegetation Management Works Plan

Reserve and corridor areas within the site are to be targeted for weed removal and rehabilitation with native, provenance specific species. The rehabilitation of these areas will ultimately improve and restore the vegetation and habitat values of those reserve and corridor areas. A specific Vegetation Management Works Plan will be produced for those reserve and corridor areas to direct the specific management actions in relation to vegetation management. These Vegetation Management Plans will include information on:

- the use of provenance specific species in revegetation works
- lists of provenance specific species to be used for revegetation
- identification of key priority areas for works
- detailed weed removal and vegetation management/protection strategies
- inter-relationship of fuel and vegetation management
- timetable for works and details of implementation, responsibility, timing and funding of specific vegetation management works.

ii) Implementation of weed removal programs

All weed control and vegetation management works will be co-ordinated by the developer of the land or the Community Association who will engage the relevant bush regeneration contractors to complete works as per the Vegetation Management Works Plan for the site.

The majority of weeds occur outside and at the edges of the bushland areas and proposed reserves. However there are also disturbed areas within the site that contain high numbers of weeds.

Species targeted for control include:

- *Lantana camara* (Lantana);
- *Chrysanthemoides monilifera subsp. monilifera* (Bitou Bush);
- *Cinnamomum camphora* (Camphor Laurel);
- *Erythrina x sykesii* (Coral Tree);
- *Ligustrum lucidum* (Broad-leaved Privet);
- *Ligustrum sinense* (Small-leaved Privet);
- *Pinus ellolti* (Pine);
- *Rubus fruticosis* (Blackberry).

Where weeds are identified as occurring appropriate weed control will be undertaken. Weed control can be carried out either through the careful and localised use of chemicals or through physical control methods as outlined below:

- *Physical control methods* involve using physical means such as hand removal and the use of hand tools to remove either specific or broad ranges of weeds. A common physical method for weed removal and subsequent natural revegetation is the Bradley Method. This method involves hand removal and is best for small areas. The use of machinery such as Bobcats, Backhoes, Slashers, etc should not be used for weed removal due to the potential for large scale disturbance to result.

- *Chemical control methods* involve the use herbicides. These herbicides can be specific to a particular plant or more broad ranging types of chemicals. Problems with the use of herbicides include chemical residues affecting soils, herbicide runoff into waterbodies and the health and safety of the operator involved in the application of the herbicide. Advantages of herbicide use include the low time taken to spray weeds as opposed to physically removing them, especially for large infestations of weeds. Broad area spray application is considered inappropriate for this program. Herbicides will be applied by cut and paint or hand held application methods only. Suitable physical control methods are to be the preferred option.

Weed control in the reserve and corridor areas is to be carried out by professional bush regeneration contractors having TAFE qualifications in bushland regeneration (minimum Certificate 2) and under the supervision of a professional bush regenerator who is a member or is eligible for membership of the Australian Association of Bush Regenerators (AABR). Any individuals or groups undertaking weed removal or bush regeneration activities must currently possess or obtain a licence from the NSW Department of Environment and Climate Change.

iii) Rehabilitation of disturbed areas

In conjunction with weed removal programs, and as part of the Vegetation Management Works Plan, those disturbed areas identified within the site will be targeted for rehabilitation. The Vegetation Management Works Plan will detail strategies for those areas to be rehabilitated including the use of provenance specific species, long term protection of rehabilitation areas and monitoring and maintenance of rehabilitation areas.

iv) Erection of signage delineating protection areas

Signs will be erected throughout Riverside delineating corridor and reserve areas and identifying vegetation protection areas and strategies. This will include information discouraging residents from dumping lawn and garden waste that will have future impacts upon natural areas in terms of potential for weed infestation.

Signs, in conjunction with fencing, can also aid in restricting access to sensitive areas.

Further details on signage management actions are contained in Section B11.

v) Erection of fencing delineating protection areas

Fencing can be used to delineate vegetation and bushland protection areas, particularly those areas undergoing vegetation rehabilitation. Sensitive areas such as the SEPP 14 wetland area can also be fenced to restrict pedestrian and vehicular access.

Further details on fencing management actions are contained in Section B11.

vi) Monitoring of vegetation management areas

Full details of monitoring are included in Section B12.

vii) Encouragement of Landcare community initiatives

The encouragement and establishment of local community Landcare groups will aid in the organisation and carrying out of weed removal and vegetation rehabilitation programs will encourage partial ownership of the bushland values of Riverside by the community.

The establishment of site specific community Landcare groups should be developed as an initiative between the developers of the land and the Community Association.

2.2 BUSHFIRE MANAGEMENT

Objectives

- **Ensure all bushfire protection measures occur outside of retained bushland areas**
- **Maximise tree and habitat protection**
- **Ensure that bushfire protection measures are implemented to reduce the risk of bushfire from retained bushland areas upon adjacent property**

Actions

i) Review of Bushfire Protection Assessment detailing the requirements for bushfire protection measures

A Bushfire Protection Assessment has been prepared for the site. This Bushfire Protection Assessment identifies the bushfire protection strategies required to protect developed areas within Riverside. These strategies need to be incorporated into the vegetation management of the site.

ii) Identification of retained areas and Asset Protection Zone (APZ) boundaries prior to construction

Prior to construction commencing those areas to be retained as corridor and reserve and their adjacent APZ's are to be delineated on site plans and survey marked in the field. This will minimise the risk of damage to vegetation contained within retained areas and APZ's during construction.

iii) Maximise tree protection in APZ's

A discontinuous tree canopy is required as establishment of the Inner Protection Area of APZ's. It is considered that due to the relatively open nature of the vegetation communities present within that site that tree clearing required as part of the establishment of APZ's will be minimal.

iv) Monitor bushfire risk within retained bushland areas

While all hazard reduction is to occur outside of reserve and corridor areas the vegetation and accumulation of fuel and consequent bushfire risk over time within the reserve and corridor areas is to be monitored as a long term strategy. Full details of monitoring will be included within the Vegetation and Bushfire Management Plan.

iv) Implementation fire hazard reduction where considered necessary in accordance with vegetation management principles

This may require future ecological burn strategies to be implemented using a sector/mosaic burn plan based on best knowledge of appropriate regimes for the various vegetation communities present within the site. The results of monitoring will be used to plan for any subsequent fuel reduction operations carried out in conjunction with the RFS and other relevant statutory authorities such as the NSW Department of Environment and Climate Change.

2.3 PROVISION AND ESTABLISHMENT OF ENVIRONMENTAL CORRIDORS

Objectives

- **Protect the sites ecological value as a movement area for local fauna**
- **Minimise the impacts of development upon local fauna**
- **Provide green space for residents to maximise the sites aesthetic values and recreational opportunity**

- **Maximise environmental values of drainage and water management areas**

Actions

i) Establish Wildlife Corridors as key component of the concept design

The Wildlife Corridors areas have been provided within the proposal to retain connectivity within the post development landscape and provision for fauna movement through the area. These consist of a north-west running corridor in the east of the site and an east-west running corridor at the northern boundary of the site. These areas will allow movement through the site to greater areas of habitat to the north, particularly for arboreal and terrestrial fauna species. These areas will also provide a lesser open space/recreational role.

These Wildlife Corridors will provide continuity of habitat and movement areas for local fauna within the development and between habitat areas within the local landscape. This includes movement areas and habitats for threatened species including the Squirrel Glider, Koala and threatened microchiropteran bat species.

Vegetation and habitats within these areas will be managed under specific vegetation and habitat management planning proposed fro the site.

ii Establish Drainage Corridors as key component of the concept design

Drainage corridors have been proposed as part of the development concept layout for water/drainage management. These areas will serve a function in providing landscape linkage and providing habitat for semi-aquatic species within the site, particularly amphibian species, including the Wallum Froglet. These areas will also provide a lesser open space/recreational role.

2.4 PROVISION OF ENVIRONMENTAL BUFFERS

Objectives

- **Protect the values of retained vegetation and habitats within the site**
- **Reduce occurrence and severity of edge effects on retained vegetation**
- **Maximise use of Asset Protection Zones in acting as environmental buffers**
- **Maximise the opportunity for vegetation management within environmental buffers**
- **Protect sensitive environments including riparian, estuarine and wetland areas**

i) Establish buffer areas between development areas and environments associated with the Myall River

The less disturbed vegetation communities within the site associated with the Myall River will be retained as part of the concept development proposal. This includes the retention of Swamp Forest, Closed Heathland, Closed Rushland and Mangrove complex vegetation communities.

The retention of these communities will provide an approximately 150m to 500m buffer between the development edge and the banks of the Myall River. The establishment retention of these areas as buffers will provide for the protection of the Myall River from potential offsite and downstream impacts of adjacent development. This also includes the protection of areas of the endangered ecological community Coastal Saltmarsh. These buffers were identified and included in environmental protection zones as part of the outcomes of the rezoning process.

ii) Implement vegetation management strategies within buffer areas

The outer 20 metres of the buffer areas will be targeted for vegetation management. The implementation of vegetation management actions within buffer areas will increase these areas ability to protect vegetation and habitats from the impacts of development. These actions will include:

- weed removal
- replanting
- erosion and sediment control
- fencing
- monitoring
- ongoing maintenance

iii) Restrict vehicle access to buffer areas

Access to buffer areas by vehicles will be restricted and prohibited, other than for vegetation management purposes.

2.5 EROSION AND SEDIMENT CONTROL

Objectives

- **Protect the soil properties of the area during the construction and occupation phases of the development**
- **Minimise risk of sedimentation of downstream aquatic areas**
- **Maximise use for in-situ replacement and use of displaced topsoil**

Actions

i) Prepare an Erosion and Sediment Control Plan for the site

Development within the site is adjacent to sensitive areas including the Myall River and associated SEPP 14 wetlands. To minimise the impacts of downstream sedimentation to aquatic environments an Erosion and Sediment Control Plan will be prepared for the site.

The Erosion and Sediment Control Plan will detail the strategies required for the minimisation of erosion within the site and the control of potential sedimentation impacts likely as a result of any erosion. The Erosion and Sediment Control Plan will detail the strategies required for the construction and occupation phases of the development.

This plan is to be prepared by a qualified Engineer and in accordance with best practice industry standards and Great Lakes Councils Erosion and Sediment Control Policy. The plan will also consider Council's Port Stephens/Myall Lakes Estuary Management Plan.

ii) Provide erosion and sediment control devices in accordance with best practice industry standards

The Erosion and Sediment Control Plan will detail measures for the installation, ongoing use monitoring and maintenance of erosion and sediment control devices during all construction and occupation phases of development.

iii) Implement suitable protection measures for storing of topsoil and on-site re-use

All topsoil stripped from the site will be stored and re-used on site. Topsoil and spoil shall be stockpiled in non-hazard areas and protected from surface run-off by diversion drains or similar. Stockpiles are to be surrounded on down-stream sides by silt fencing and stockpiles shall be suitably compacted to inhibit erosion. Where the stockpiling period exceeds four (4) weeks, the stockpile shall be seeded to encourage vegetation growth and reduce further loss due to water/wind erosion.

iv) Restrict access to disturbed areas during construction

Access to disturbed areas during construction will be restricted, particularly following rainfall.

v) Rehabilitate disturbed areas immediately upon the cessation of construction activities

All disturbed areas will be rehabilitated according to actions detailed within the Erosion and Sediment Control Plan and Vegetation Management Plan immediately following the completion of site construction activities.

vi) Monitor erosion and sediment control devices and downstream and aquatic areas for evidence of soil loss and sedimentation

2.6 STORMWATER QUALITY AND MANAGEMENT

Objectives

- **Provide suitable stormwater control devices that maximise habitat opportunities for flora and fauna**
- **Provide suitable stormwater control devices that maximise passive recreational opportunities**
- **Locate and design stormwater structures within the development in accordance with the conservation and protection principles of this Management Strategy to minimise environmental impacts**

Actions

i) Integrate landscape design initiatives into stormwater control structures that maximise benefits to local aquatic and semi-aquatic flora and fauna species

Measures are to include promotion of growth of native fringing vegetation, monitoring of water quality, weed removal and monitoring for presence of predatory *Gambusia holbrooki.* Design of detention and sedimentation structures will incorporate features to facilitate *Gambusia* eradication. These measures may be addressed within individual habitat management plans for each proposed basin.

2.7 CULTURAL HERITAGE VALUES AND MANAGEMENT

Objectives

- **Protect the cultural heritage values of the local area**
- **Provide information to the community on the cultural heritage values of the Riverside area**

Actions

Consider the implementation of the recommendations of the Cultural Heritage Report by ERM Australia.

2.8 COMMUNITY EDUCATION, VIGILANCE AND REPORTING

Objectives

- **Promote ownership and appropriate use of the natural areas within Riverside by the community**
- **Promote community vigilance in reporting prohibited use**
- **Promote community involvement in wildlife observation and protection**
- **Encourage local involvement in bushland rehabilitation schemes**
- **Provide information to the community on the environmental, cultural and recreational values of the area**

Actions

i) Provide informative pamphlet to residents at point of sale and update/supply regularly

A pamphlet will be supplied to residents at the point of sale to supply information in regards to the sites natural area values. The pamphlet will include information on:

- The area covered by the Riverside development and the reserve and corridors within;
- History of the area;
- Access points and any walking trails;
- Prohibited uses and reasons for restricted use;
- Location of any facilities or important ecological/cultural features;
- Accepted passive recreational uses of the area;
- Significant flora and fauna (particularly threatened species) and habitats;

- Practices to reduce the impacts of adjacent use upon the corridor (eg. Use of locally occurring garden species, limited use of fertilisers, controlling pets, weed management, fauna monitoring, habitat creation);
- Contact details with regard to reporting prohibited use, fauna injuries;
- Landcare/Bush regeneration details;
- Sources of further information (e.g. Great Lakes Council, DECC websites);

ii) Provide interpretive signing around extent of retained reserve and corridor areas to inform community of values and appropriate use

Signage will include information on:

- Ownership and management of the land;
- Bushland values;
- Prohibited activities (eg: rubbish dumping, vehicular access, entry of cats, off lead dogs);
- Permitted activities;
- Contact/Reporting details;
- Penalties for misuse;
- Indicative map of natural areas within riverside.

iii) Encourage community and resident ownership and involvement through use of Community Title initiatives

Residential areas of the site are to be administered under the provisions of Community Title. This approach allows for ongoing regulation of activities, including maintenance within the entire development area, within individual allotments, within bushfire protection areas, vegetation retention areas and within common community association areas. This approach also provides substantial benefits in terms of regulating the impact of the development upon the natural environment into the future.

The Community Management Statement embodies the Legal Framework under which the Community Association operates defining its purpose, responsibilities, procedures and by-laws which regulate the association and its members. The Community Management Statement, by definition, places the burden of ongoing environmental management works upon the landholders thus ensuring the implementation of these works in perpetuity.

2.9 PROHIBITED USE IDENTIFICATION AND MANAGEMENT

Objectives

- **Identify likely uses of the natural areas within the Riverside development that may have impacts upon ecological and environmental values**

- **Encourage appropriate uses of the natural areas within Riverside by the community**
- **Promote community awareness and vigilance of reporting of prohibited uses**

- **Implement mechanisms for penalties for mis-use of natural areas**

Actions

i) Erect prohibited use signage

Expected uses of the natural areas of Riverside to be identified as prohibited uses are:

- Rubbish dumping;
- Vehicular (4WD and trail bike) access;
- Off-leash dogs;
- Flora/fauna harm or removal;
- Horse riding;
- Dead wood removal.

ii) Create system or framework for the imposition of fines and penalties for any incidences of improper or prohibited use of natural areas

A legal framework whereby penalties, including fines, can be imposed for improper use of the site can be developed. Signs indicating prohibited uses and the penalties for these are to be placed throughout the Riverside area. Information on prohibited uses is to be included in the pamphlet to be circulated to residents.

iii) Implement community education programs to encourage the appropriate low impact, passive use of reserve and corridor areas

Community education material (pamphlets/signage) will include information on appropriate use of the natural areas within the site. Passive use of the site will be encouraged with activities such as walking, fauna observation to have facilities provided for (eg. walking trails, boardwalks, viewing platforms). Those recreation al activities likely to cause will be discouraged (walking off set trails, trailbiking, horse riding, unleashed dog walking, camping).

iv) Restrict access to reserve and corridor areas, particularly to vehicles, trail bikes and horses

The recreational opportunities and use of the site will be controlled by the provision of services and access to those services. Access to reserve areas and the facilities within those areas will be restricted to service vehicles and pedestrian traffic only.

Access to walking/service trails will be restricted by locked gates or bollards. Unauthorised vehicular access will not be permitted and identified as a prohibited use.

2.10 NATIVE FAUNA, HABITAT AND FERAL PEST SPECIES MANAGEMENT

Objectives

- **Provide suitable strategies for the protection of native fauna species within the post development landscape**

- **Provide adequate protection and habitats for threatened species known from the area**

- **Provide compensatory habitat for native fauna**

- **Minimise human related impacts upon local native fauna**

- **Protect key den, nest, roost and foraging resources by establishing adequate bushland reserves**

- **Remove pest fauna species from the site**

- **Reduce the risk of damage to native flora and fauna resulting from the occurrence of pest species related to human occupation**

Actions

i) Provide compensatory habitat within retained areas, particularly nest and roost boxes

a. Nest Boxes

Relative low densities of hollow-bearing trees have been recorded within the subject site. These hollows ranged in size from small to medium (<5cm to 30cm) suitable for a number of hollow dependent fauna species observed during surveys. These include:

* Green Tree Snake
* Galah
* Scaly-breasted Lorikeet
* Eastern Rosella
* Common Brushtail Possum
* Microchiropteran bat species
* Rainbow Lorikeet
* Musk Lorikeet
* Squirrel Glider
* Feather-tail Glider
* Common Ringtail Possum

As part of the Master planning process it is proposed to retain all hollow-bearing trees within the undeveloped areas of the site. However, in the interests of providing net gains in habitat nest and roost boxes are proposed to be erected within trees in those reserve and corridor areas to be retained by the development.

It is considered that 2-3 nest boxes per hectare of current suitable habitat to be cleared will be erected as compensatory habitat within the retained and protected reserve and corridor areas. This equates to between 200-300 replacement nest boxes. This will consist of a mix of Squirrel Glider, possum, micro chiropteran bat, small and large parrot boxes.
The following specific management strategies are to be carried out in relation to nest boxes:

- All replacement nest boxes are to be secured to trees at a minimum height of four metres above ground level facing the east to north east direction. An experienced arborist is required to install the nest boxes. Nest boxes and re-erected limbs are not to be placed near locations where public access is planned along entrance points or tracks. All nest boxes and re-erected limbs will be inspected annually and any damaged, or in danger of falling, are to be repaired or replaced. The locations of each of the erected nest boxes or re-erected hollows will be mapped for later reference.

- A fauna ecologist (Project Ecologist) is to co-ordinate the construction and erection of nest boxes and locate appropriate trees and locations for installing the nest boxes. The locations of all nest boxes and re-erected hollows are to be included on plans provided

with annual progress reports. Each box is to be identified with a readable, weather resistant number (75mm) in size for identification and recording purposes.

- All nest boxes will be inspected regularly for the life of this plan. Any damaged or dangerous boxes will be replaced. Any boxes seen to contain exotic fauna (Indian Myna, European Bees) will have fauna removed or the nest box replaced.

- The locations of all nest boxes will be fixed by GPS as part of ongoing monitoring strategies.

- All nest boxes will be constructed of a durable marine ply material and fixed to trees by qualified climbers using stainless steel bolts. Boxes will be hinged for ease of future monitoring.

The habitats within the reserve and corridor areas will be enhanced by the implementation of vegetation management strategies. The removal of weeds and rehabilitation of disturbed areas and community involvement has been discussed within Section B1.

ii) Supervise clearing works during construction

The removal of hollow bearing trees will occur as part of this development. To minimise the impact on hollow dependant fauna during tree felling operations the following measures will be used were considered appropriate:

- Identification and marking of hollow bearing trees required to be cleared;

- Inspection of tree hollows by spotlight survey and appropriate bat detection methods immediately prior to clearing to determine if hollows are being utilised by tree dwelling fauna, including threatened species;

- Implementation of a trapping program prior to tree clearing to trap any mammal fauna within areas proposed for staged clearing. Any trapped animals will be released into appropriate areas on dusk;

- Inspection of hollow bearing trees marked for clearing. Trees will be felled in sections of approximately one-metre lengths. Inspections of hollow sections prior to felling will be undertaken to determine if fauna is present within hollows. Fauna occupying hollows will be carefully removed by an experienced and licensed fauna expert and relocated to another tree away from the area of clearing;

- Restriction of clearing hollow bearing trees during the breeding season for microchiropteran bats and Squirrel Glider (September-March);

- Implementation of hollow log salvage and re-erection program in order to retain roosting and nesting opportunities for hollow dependent fauna, including Owls, Squirrel Gliders and threatened bat species;

Two options are available for removing tree hollows or felling hollow bearing trees. These are:

i) Hollow bearing trees containing fauna are to be sectionally dismantled. This will involve an arborist / tree climber to hand removal hollow limbs into one metre lengths. Each hollow length will be inspected for fauna occupation. Once all hollow limbs are dismantled the tree can be felled by machine. Fauna occupying hollows will be carefully removed by the Project Ecologist and relocated to adjoining corridor or reserve areas.

ii) Where machinery is required to fell hollow trees, the blade or bucket of the machinery will be tapped against the base of the tree to disturb any fauna present. The tree will then be felled as gently as possible. All hollow limbs will be inspected after felling for occupation by fauna. Any fauna will be removed and relocated to adjoining bushland.

Any felling of hollow bearing trees will be supervised by a qualified fauna ecologist (Project Ecologist).

All hollow limbs will be removed from those trees felled by a licensed contractor. These hollow limbs will be returned to the Project Ecologist for re-use at a later date.

iii) Provide information within community education material encouraging the provision of habitat for native fauna species within residential allotments

Information will be included within interpretive material on the importance of providing suitable landscape initiatives within residential areas for the provision of habitat for native species within urban areas.

iv) Implement suitable initiatives to control impacts of domestic pets upon local fauna

The following will form part of strategies in minimising the risks posed to native wildlife of domestic animals:

- All domestic pets kept within fenced yards
- Covenants restricting cat ownership
- Curfews on cats
- All dogs to be kept on leash when out of yards and in open space areas
- Penalties for unrestrained animals

v) Implement feral pest control programs, particularly for rabbits, foxes, Mosquitofish and Noisy Miner

Suitable management strategies will be implemented for the control of feral animals, particularly the fox, rabbits, Mosquito fish and Noisy Miner. This will include engaging a licensed pest controller to carry out regular programs, when required, within the site, particularly those corridor and reserve areas.

vi) Monitor distribution and abundance within the site of threatened species, native fauna and pest species

Regular monitoring will be implemented to gather information on the occurrence of native fauna, particularly threatened species, and pest species within the site. Full details are provided within Section B12.

2.11 ACCESS, SIGNAGE AND FENCING

Objectives

- **Protect the environmental values of natural areas throughout the Riverside development through appropriate signage and fencing**
- **Protect environmentally sensitive areas through restriction of access**
- **Increase community awareness of environmental values of natural areas through appropriate signage**

Actions

i) Erect interpretive signing around corridor and reserve areas providing community and residents with information on access restriction, appropriate use, prohibited use and environmental values

Interpretive signing will be erected around the boundaries and within reserve and corridor areas. This will include information on:

- Location of reserve and corridor areas (site plan);
- Prohibited uses;
- Natural features of the site (flora/fauna/habitats/wetlands etc);
- Recreational opportunities;
- Contact details;
- "No go" areas;
- Penalties for misuse.

ii) Erect fencing during construction to protect individual trees

Where trees are identified for retention and are in areas adjacent to construction areas tree protection fencing will be erected to eliminate risk of damage during construction. Fencing will be erected to adequately protect the root zone of trees from excavation or compaction damage.

iii) Erect fencing during construction to protect reserve and corridor areas

Where corridor or reserve areas are adjacent to construction areas temporary fencing will be erected to indicate these no go areas. This will be supported by site contractor inductions notifying personnel of protection areas and restricted access to these.

iv) Erect bollards or fencing to restrict access to environmentally sensitive areas

Bollards or fencing will be erected to control access to environmentally sensitive areas within the site such as SEPP 14 Wetland areas and conservation zones. Temporary fencing will also be erected to protect areas that are undergoing vegetation management to protect juvenile plants.

v) Monitor signage and fencing and repair/replace when necessary

The management program will include monitoring of condition of signs, fencing and bollards to allow for damaged structures to be relaced or repaired. Full details of monitoring are included within Section 2.12.

2.12 MONITORING AND REPORTING REGIME

Objectives

- **Collect long term information on the environmental and ecological quality of natural areas and impacts of development within the Riverside development**
- **Collect long term information on impacts of the development upon reserve and corridor areas and make contingency for the implementation of appropriate rehabilitative and compensatory measures**
- **Collect long term information on the success of ameliorative measures introduced as part of this management strategy**
- **Collect information on the occurrence of threatened species, native fauna and condition of vegetation within reserve and corridor areas**
- **Provide regular meaningful reports to statutory authorities on the results of monitoring and other ongoing issues and make these available to the Community Association and other local interest groups**

Actions

The monitoring program will be designed to collect information over the long term on key environmental and ecological parameters to provide information on the long term environmental health of the reserve and corridor areas. These consist of the following:

- Threatened species:
  - Wallum Froglet;
  - Osprey;
  - Barking Owl;
  - Squirrel Glider;
  - Koala;
  - Grey-headed Flying-fox;
  - Greater Broad-nosed Bat;
  - Eastern Bentwing-bat
  - Little Bentwing-bat;
  - Large-footed Myotis.
- Native fauna
- Native vegetation and bushland
- Weeds
- Rubbish

- Nest boxes
- Pest species

i) Monitor occurrence and persistence of threatened species

Wallum Froglet

The Wallum Froglet has been recorded within a number of locations within the site. The monitoring program is to be designed so as to detect the continued presence of this species within those suitable habitat areas retained within the site. Surveys are to be completed bi-annually and annually and consist of call detection and call playback, particularly during times of peak detection (i.e. after rain April-Nov).

Osprey

The Osprey was been recorded within the subject site during surveys conducted in February 2008. This species was observed roosting in trees on the shoreline of the Myall River. Monitoring programs are to be designed so as to detect the continued presence of this species within the area. Bi-annual surveys are to be carried out to detect the continued presence of this species within the subject site and to record any nesting activity that may occur. Surveys are to consist of diurnal observation surveys.

Barking Owl

The Barking Owl was been recorded calling in areas to the north of the subject site during nocturnal owl call playback surveys conducted in February 2008. Monitoring programs are to be designed so as to detect the continued presence of this species within the area. Bi-annual surveys are to be carried out to detect the continued presence of this species within the subject site and to record any nesting activity that may occur. Surveys are to consist of nocturnal call playback and spotlighting surveys.

Squirrel Glider

The Squirrel Glider has been recorded within vegetation near the northern boundary of the site. Monitoring programs are to be designed so as to detect the continued presence of this species within the area. Bi-annual surveys are to be carried out to detect the continued presence of this species within reserve and corridor areas. Surveys are to consist of arboreal Elliott trapping, spotlighting and nest box inspection.

Koala

There are no recent local records for the Koala within the subject site; however it is known to occur within the local area. The site contains suitable foraging and refuge habitat for this species. Monitoring is to be carried out bi-annually for this species to detect any future use of the site. Monitoring is to consist of Spot Assessment Techniques, spotlighting and call playback. Full details of the monitoring program are included within the Koala Management Strategy prepared for the site.

Grey-headed Flying-fox

The Grey-headed Flying-fox was been recorded within the subject site during nocturnal surveys conducted in February 2008. This species was observed foraging in flowering eucalypt trees within the subject site. Monitoring programs are to be designed so as to detect the continued presence of this species within the area. Bi-annual surveys are to be carried out to detect the continued presence of this species within the subject site and to record any roosting camp activity that may occur. Surveys are to consist of nocturnal spotlighting surveys.

Microchiropteran Bat Species (Greater Broad-nosed Bat, Little Bentwing-bat, Eastern Bentwing-bat. Large-footed Myotis)

Four threatened microchiropteran bat species have been recorded within the site during previous surveys. The area contains foraging, roosting and breeding habitat for these species. Monitoring programs are to be designed so as to detect the continued presence of this species within the area. Surveys for these species are to be carried out biannually and consist of Anabat echolocation recording.

ii) Monitor abundance and diversity of native fauna species

The monitoring program is to include collection of information on the diversity of fauna species within the site. Standard fauna survey methods targeting vertebrate groups (mammals, birds, reptiles, amphibians) is to be completed seasonally and bi-annually to gather information on the diversity of fauna species within the site for year to year comparison and also comparison against baseline data.

iii) Monitor condition of native vegetation and bushland including rehabilitation areas

The monitoring program will include monitoring the condition of vegetation within those areas undergoing vegetation management works within the site, particularly those rehabilitation areas. Monitoring is to be carried out annually to assess the condition of rehabilitation areas and make contingency for additional rehabilitation and protection works if the results of monitoring indicate the need.

iv) Monitor occurrence and extent of weeds and rubbish

The extent of weeds within the retained areas are to be monitored annually. Where weeds are observed to be increasing removal programs will be carried out. This could be implemented as part of community initiatives as discussed in Section B8.

Monitoring for incidences of rubbish dumping will be carried out regularly. Where build up of rubbish is observed removal programs are to be carried out. This could also be implemented as part of community initiatives as discussed in Section B8.

vi) Monitor occurrence of pest fauna species

Monitoring will include gathering information on the presence of the following pest species:

- Foxes;
- Rabbits;

- Gambusia;
- Common Myna;
- Cats;
- Dogs.

The collection will allow for the occurrence of pest species to be recorded and provision made for their removal from those retained areas.

Any signs of predation by foxes, dogs or cats will also be monitored and reported on.

vii) Produce regular meaningful reports on results of surveys and provide analysis against baseline information

Reports will be supplied regularly to the Community Association and relevant statutory authorities in conjunction with the end of each monitoring period.

At the completion of each monitoring period an assessment report will be completed detailing all methodologies used and results gained during surveys for that monitoring period. The report is included as a minimum:

- details on survey methods;
- results of surveys;
- comparison between monitoring/reporting periods;
- management issues;
- any suggested amendments to management plan.

viii) Make contingency for review of management actions where monitoring identifies significant impacts

Management actions will be reviewed regularly as part of the monitoring and reporting process. Where impacts are identified that indicate the failure of management actions or the requirement for new management actions contingency will be made for these to be addressed within the ongoing environmental management framework.

SECTION 3

IMPLEMENTATION OF MANAGEMENT ACTIONS

3.1 IMPLEMENTATION OF MANAGEMENT ACTIONS

It is envisaged that the management strategies included within this plan will be enforced as conditions of consent for various stages of approval for the development application. Following review of the application by the various authorities it is considered that further refinement of the management actions and implementation will be required for the various stages of the approved development. This may be achieved by the preparation of individual Management Plans for the various development stages with this Ecological Site Management Strategy to form the basis of the objectives, actions and implementation strategies of those plans.

The actions detailed within this Management Strategy will be implemented over a minimum ten year period following signoff of the plan by the Department of Planning. The long term timing, implementation and responsibility of those actions will ultimately depend upon the development of the various stages of the development and the title on the land

The following table (Table 1) provides details on the implementation of management actions contained within Section B. Each of the actions relates to a Management Area within the Riverside area. These areas have been identified to ensure that only those actions relevant to certain areas are applied to the relevant area. These Management Areas have been separated as per the following:

- Management Area A – SEPP 14 Wetlands;
- Management Area B – Conservation Zoned Lands;
- Management Area C – Asset Protection Zones and Environmental Buffers;
- Management Area D – Wildlife Corridors;
- Management Area E – Drainage Corridors;
- Management Area F – Developable Area.

Management Area A – SEPP 14 Wetlands
The area within Management Area A is that low-lying land associated with the Myall River and bound by State Environmental Protection Policy No. 14 Coastal Wetlands known as wetland number 746. This area corresponds with an area mapped as 7(a) Wetlands and Littoral Rainforest Zone within the Great Lakes LEP. This area will be wholly retained as part of the proposed development. The SEPP 14 Wetland will also be buffered by the retention of vegetation communities between the wetland boundary and the development edge. Management within this area will primarily consist of weed management via regular inspections, and low impact weed control works where and when necessary.

Management Area B – Conservation Zoned Land
This area consists of land zoned 7(b) Conservation Zone and contains land of conservation and environmental significance. This area is adjacent to the land within SEPP 14 wetlands and serves a buffer function in protecting the wetland area from adjacent use. The vegetation within this land zoned for conservation consists of relatively high quality Closed Heathland and Swamp Forest vegetation. Management within this area will primarily consist of weed management via regular inspections, and low impact weed control works where and when necessary.

Management Area C – Asset Protection Zones and Environmental Buffers
These areas consist of those areas adjacent to development that are retained as buffer areas to adjacent reserved lands or are retained and modified as part of Asset Protection Zones (APZs). These areas serve as the interface between developed lands and those areas of native vegetation retained due to high conservation value, environmental significance or habitat and landscape function. These areas will contain a reduced amount of vegetation within semi-natural areas. Areas designated as bushfire APZs will be managed in accordance with the requirements for APZs in Planning for Bushfire Protection (RFS 2006). It is likely that some of these areas will incorporate grassy swale / nutrient sinks, some stormwater management areas, ephemeral drainage lines and parklands.

Asset Protection Zones and Environmental Buffers are located within or adjacent to a large number of habitat types across the site. Replanting zones labelled A to G having different treatment requirements have been created to better define the species to be used and the densities required to be planted (See Figures A4.1 and A4.2 and Table 2). This is to ensure that future revegetated areas are consistent with the habitat and existing vegetation types within or adjacent to the replanting zones. Where revegetation is required within these areas species to be planted and the densities of plantings required are shown in Table 2. The location of zones (labelled with a prefix of A to G) that may require replanting is shown in Figure A4.2 - Re-vegetation Zones.

Management Area D – Wildlife Corridors
These Wildlife Corridor areas have been provided to retain connectivity within the post development landscape and provision of fauna movement through the area. These consist of a north-west running corridor in the east of the site and an east-west running corridor at the northern boundary of the site. Management within these areas will primarily consist of weed management via regular inspections, and low impact weed control works where and when necessary.

These areas will allow movement through the site to greater areas of habitat to the north, particularly for arboreal and terrestrial fauna species. Those other areas retained in Management Areas A and B will also function in a landscape connectivity capacity.

The Wildlife Corridors will be consolidated / augmented by replanting within existing disturbed areas. Areas of replanting works are shown in Figure A4.2 – Re-vegetation Zones which designates zones with a prefix between A and G. The species and the densities to be replanted within the specific zones are shown in Table 2.

Management Area E – Drainage Corridors and Open Space Areas
The lands contained within Management Area E consist of areas set aside for water/drainage management. These areas will also serve a function in providing landscape linkage and providing habitat for semi-aquatic species within the site, particularly amphibian species. These areas will also provide a lesser open space/recreational role.

The drainage corridors will contain a number of habitat types such as Parkland, Freshwater Edges, Fresh Waterbodies and Saline Shores. Areas of replanting works are shown in Figure A4.2 – Re-vegetation Zones which designates zones with a prefix of G for the Drainage Corridor areas. The species and the densities to be replanted within the G zones are shown in Table 2.

Management Area F – Developable Area

This area consists of the land to be developed for residential and commercial purposes. The management actions to be implemented within Management Areas A to E are ultimately as a result of the activities that are to be carried out within Management Area F.

TABLE 1 APPLICATION OF MANAGEMENT STRATEGY ACTIONS TO VARIOUS MANAGEMENT AREAS WITHIN RIVERSIDE									
		APPLICABILITY OF MANAGEMENT ACTION FOR MANAGEMENT AREA							
SITE ISSUE	**ACTION**	**A**	**B**	**C**	**D**	**E**	**F**	**RESPONSIBILITIES**	**TIMING**
B1. Vegetation and Bushland Management	i) Prepare Vegetation Management Plan	√	√	√	√	√		Applicant	Pre-construction
	ii) Weed removal programs	√	√	√	√	√		As part of Development Consent Contractor	Pre-construction, construction and ongoing through occupation
	iii) Rehabilitate disturbed areas	√	√		√	√		As part of Development Consent Contractor	Pre-construction, construction and ongoing through occupation
	iv) Erect signage	√	√	√	√	√	√	Contractor	Pre-construction
	v) Erect protective fencing		√	√	√	√	√	Contractor	Pre-construction
	vi) Monitor vegetation management areas	√	√	√	√	√		Project Ecologist	Construction and ongoing through occupation
	vii) Encourage Landcare initiatives	√	√	√	√	√	√	Project Ecologist	Occupation
B2. Bushfire Management	i) Prepare Bushfire Protection Assessment			√	√	√	√	Applicant	
	ii) Identify APZ's prior to construction			√	√	√	√	Project Ecologist	
	iii) Maximise tree protection in APZ's			√	√	√	√	Contractor	
	iv) Monitor bushfire risk	√	√					Project Ecologist	
	v) Fire hazard reduction	√	√	√	√	√		Contractor	

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TABLE 1 (Cont.) APPLICATION OF MANAGEMENT STRATEGY ACTIONS TO VARIOUS MANAGEMENT AREAS WITHIN RIVERSIDE									
		APPLICABILITY OF MANAGEMENT ACTION FOR MANAGEMENT AREA							
SITE ISSUE	**ACTION**	**A**	**B**	**C**	**D**	**E**	**F**	**RESPONSIBILITIES**	**TIMING**
B3. Provision &Establishment of Environmental Corridors	i) Establish Wildlife Corridors				√			Applicant Consent Conditions	Pre-construction and ongoing through occupation
	ii) Establish Drainage Corridors					√		Applicant Consent Conditions	Pre-construction and ongoing through occupation
B4. Provision of Environmental Buffers	i) Establish buffer areas between development and Myall River	√	√	√				Applicant Consent Conditions	Pre-construction and ongoing through occupation
	ii) Implement vegetation management strategies	√	√	√				Applicant Consent Conditions	Pre-construction and ongoing through occupation
	iii) Restrict vehicle access	√	√	√				Applicant Consent Conditions	Pre-construction and ongoing through occupation
B5. Erosion and Sediment Control	i) Prepare Erosion and Sediment Control Plan						√	Contractor	Pre-construction and ongoing through occupation
	ii) Provide erosion and sediment control devices				√		√	Contractor	Pre-construction, operational through construction
	iii) Implement topsoil storage and re-use methods						√	Contractor	Construction
	iv) Restrict access to disturbed areas						√	Contractor	Construction
	v) Rehabilitate disturbed areas						√	Contractor	Construction
	vi) Monitor erosion and sediment control devices/effectiveness						√	Project Ecologist	Construction

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TABLE 1 (Cont.) APPLICATION OF MANAGEMENT STRATEGY ACTIONS TO VARIOUS MANAGEMENT AREAS WITHIN RIVERSIDE									
		APPLICABILITY OF MANAGEMENT ACTION FOR MANAGEMENT AREA							
SITE ISSUE	**ACTION**	**A**	**B**	**C**	**D**	**E**	**F**	**RESPONSIBILITIES**	**TIMING**
B6. Stormwater Quality Management	i) Landscape/habitat design initiatives in structures				√		√	Applicant	Pre-construction
	ii) Advice from qualified ecologists				√		√	Applicant/Consultant	Pre-construction
	iii) Landscape and habitat design plans				√		√	Applicant/Consultant	Pre-construction
	iv) Locate structures in appropriate areas				√		√	Consent Conditions	Pre-construction
B7. Cultural Heritage Values and Management	i) Identification and protection of sites	√	√	√	√	√	√	Consent Conditions	Pre-construction
	ii) Provision of information to community	√	√	√	√	√	√	Applicant	Occupation
B8. Community Education, Vigilance and Reporting	i) Informative pamphlet to residents						√	Applicant	Occupation
	ii) Interpretive signage	√	√	√	√	√	√	Applicant/Consultant	Construction
	iii) Encourage community and resident ownership	√	√	√	√	√	√	Applicant	Occupation
B9. Prohibited Use Identification and Management	i) Erect prohibited use signage	√	√	√	√	√	√	Contractor	Construction

TABLE 1 (Cont.) APPLICATION OF MANAGEMENT STRATEGY ACTIONS TO VARIOUS MANAGEMENT AREAS WITHIN RIVERSIDE									
		APPLICABILITY OF MANAGEMENT ACTION FOR MANAGEMENT AREA							
SITE ISSUE	**ACTION**	**A**	**B**	**C**	**D**	**E**	**F**	**RESPONSIBILITIES**	**TIMING**
	ii) Create fines/ penalties system	√	√	√	√	√	√	Consent Conditions	Occupation
	iii) Promote low impact/passive use	√	√	√	√	√	√	Applicant	Occupation
	iv) Restrict access to reserve areas	√	√	√	√	√		Consent Conditions	Construction
B10. Native Fauna, Habitat and Feral Pest Species Management	i) Provide compensatory habitat (nest boxes)		√		√	√		Applicant/Consent Conditions	Pre-construction
	ii) Supervise clearing works					√	√	Project Ecologist	Construction
	iii) Protection of threatened species	√	√	√	√	√	√	Contractor	Construction
	iv) Community education material	√	√	√	√	√	√	Applicant Conditions of Consent	Occupation
	v) Domestic pet control						√	Community Title Plan	Occupation
	vi) Feral pest control	√	√	√	√	√	√	Community Title Plan	Pre-construction to ongoing works during occupation
	vii) Monitor fauna distribution and abundance	√	√	√	√	√	√	Project Ecologist	Pre-construction to ongoing works during occupation
B11. Access, Signage and Fencing	i) Erect interpretive signing	√	√	√	√	√	√	Contractor	Construction

TABLE 1 (Cont.) APPLICATION OF MANAGEMENT STRATEGY ACTIONS TO VARIOUS MANAGEMENT AREAS WITHIN RIVERSIDE									
		APPLICABILITY OF MANAGEMENT ACTION FOR MANAGEMENT AREA							
SITE ISSUE	**ACTION**	**A**	**B**	**C**	**D**	**E**	**F**	**RESPONSIBILITIES**	**TIMING**
	ii) Erect tree protection fencing			√	√	√	√	Contractor	Pre-construction
	iii) Erect fencing corridor/reserve protective fencing		√	√	√	√		Contractor	Pre-construction
	iv) Erect fencing/bollards for environmentally sensitive areas	√	√	√	√	√		Contractor	Pre-construction
	v) Monitor signage and fencing	√	√	√	√	√		Project Ecologist	Construction to ongoing works during occupation
B12. Monitoring and Reporting Regime	i) Monitor threatened species	√	√	√	√	√	√	Project Ecologist	Pre-construction to ongoing works during occupation
	ii) Monitor native fauna	√	√	√	√	√	√	Project Ecologist	Pre-construction to ongoing works during occupation
	iii) Monitor native vegetation condition	√	√	√	√	√		Project Ecologist	Pre-construction to ongoing works during occupation
	iv) Monitor weeds and rubbish	√	√	√	√	√		Project Ecologist	Pre-construction to ongoing works during occupation
	v) Monitor pest species	√	√	√	√	√		Project Ecologist	Pre-construction to ongoing works during occupation
	vi) Produce regular meaningful reports	√	√	√	√	√	√	Project Ecologist	Pre-construction to ongoing works during occupation

TABLE 1 (Cont.) APPLICATION OF MANAGEMENT STRATEGY ACTIONS TO VARIOUS MANAGEMENT AREAS WITHIN RIVERSIDE									
		APPLICABILITY OF MANAGEMENT ACTION FOR MANAGEMENT AREA							
SITE ISSUE	**ACTION**	**A**	**B**	**C**	**D**	**E**	**F**	**RESPONSIBILITIES**	**TIMING**
	vii) Review management actions	√	√	√	√	√	√	Project Ecologist Community Title Plan Council	Pre-construction to ongoing works during occupation
Management Area A – SEPP 14 Wetland Management Area B – Conservation zoned lands Management Area C – Asset Protection Zones/Buffers Management Area D – Wildlife Corridors Management Area E – Drainage Corridors Management Area F – Development Area									

TABLE 2 SPECIES TO BE USED IN REVEGETATION WORKS		
REVEGETATION AREAS "A-PREFIX" Open Forest *(Angophora costata, Corymbia gummifera)*		
Species		**Total Number of Plants***
Trees	**Plantings per 100m^2 = 5**	
Angophora costata (Smooth-barked Apple)	1.6	816
Corymbia gummifera (Red Bloodwood)	1.6	816
Eucalyptus microcorys (Tallowwood)	1.6	816
Shrubs	**Plantings per 100m^2 = 10**	
Melaleuca nodosa (Ball Honey Myrtle)	3.3	1683
Leptospermum polygalifolium (Yellow Tea Tree)	3.3	1683
Leucopogon lanceolatus	3.3	1683
Groundcovers	**Plantings per 100m^2 = 15**	
Lomandra longifolia (Spiky-headed Mat Rush)	3.75	1912
Themeda australis (kangaroo Grass)	3.75	1912
Microlaena stipoides (Weeping Rice Grass)	3.75	1912
Entolasia stricta (Wiry Panic)	3.75	1912
REVEGETATION AREAS "B-PREFIX" Open Forest *(Eucalyptus microcorys)*		
Species		**Total Number of Plants***
Trees	**Plantings per 100m^2 = 5**	
Eucalyptus microcorys (Tallowwood)	1.6	230
Angophora costata (Smooth-barked Apple)	1.6	230
Eucalyptus resinifera (Red Mahogany)	1.6	230
Shrubs	**Plantings per 100m^2 = 10**	
Leptospermum polygalifolium (Yellow Tea Tree)	2.5	360
Acacia longifolia var. longifolia (Sydney Golden Wattle)	2.5	360
Breynia oblongifolia (Coffee Bush)	2.5	360
Callistemon salignus (Willow Bottlebrush)	2.5	360

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TABLE 2 (Cont.) SPECIES TO BE USED IN REVEGETATION WORKS		
REVEGETATION AREAS "B-PREFIX" (Cont.) Open Forest *(Eucalyptus microcorys)*		
Species		**Total Number of Plants***
Groundcovers	**Plantings per 100m^2 = 15**	
Entolasia stricta (Wiry Panic)	3.75	540
Lomandra longifolia (Spiky-headed Mat Rush)	3.75	540
Imperata cylindrica var. *major* (Blady Grass)	3.75	540
Entolasia stricta (Wiry Panic)	3.75	540
REVEGETATION AREAS "C-PREFIX" Open Forest *(Eucalyptus pilularis)*		
Species		**Total Number of Plants***
Trees	**Plantings per 100m^2 = 5**	
Eucalyptus pilularis (Blackbutt)	1	28
Angophora costata (Smooth-barked Apple)	1	28
Banksia serrata (Old-man Banksia)	1	28
Corymbia gummifera (Red Bloodwood)	1	28
Eucalyptus robusta (Swamp Mahogany)	1	28
Shrubs	**Plantings per 100m^2 = 10**	
Monotoca elliptica (Tree Broom-heath)	3.33	94
Pultenaea villosa	3.33	94
Notolaea longifolia (Large Mock Olive)	3.33	94
Groundcovers	**Plantings per 100m^2 = 15**	
Imperata cylindrica var. *major* (Blady Grass)	5	140
Lomandra longifolia (Spiky-headed Mat Rush)	5	140
Baloskion tetraphyllum subsp. *meiostachyum*	5	140

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TABLE 2 (Cont.) SPECIES TO BE USED IN REVEGETATION WORKS		
REVEGETATION AREAS "D-PREFIX" Woodland *(Eucalyptus resinifera)*		
Species		**Total Number of Plants***
Trees	**Plantings per 100m^2 = 5**	
Eucalyptus resinifera (Red Mahogany)	1.25	473
Eucalyptus robusta (Swamp Mahogany)	1.25	473
Angophora costata (Smooth-barked Apple)	1.25	473
Eucalyptus signata (Scribbly Gum)	1.25	473
Shrubs	**Plantings per 100m^2 = 10**	
Melaleuca sieberi	2	756
Leptospermum polygalifolium (Yellow Tea Tree)	2	756
Melaleuca thymifolia	2	756
Leptospermum liversidgei	2	756
Callistemon pachyphyllus (Wallum Bottlebrush)	2	756
Groundcovers	**Plantings per 100m^2 = 15**	
Entolasia stricta (Wiry Panic)	3	1134
Hemarthria uncinata (Matgrass)	3	1134
Lepyrodia scariosa (Scale Rush)	3	1134
Xanthorrhoea latifolia subsp. *latifolia*	3	1134
Aristida benthamii	3	1134
REVEGETATION AREAS "E-PREFIX" Woodland / Open Forest *(Eucalyptus robusta)*		
Species		**Total Number of Plants***
Trees	**Plantings per 100m^2 = 5**	
Eucalyptus robusta (Swamp Mahogany)	2.5	1083
Melaleuca linifolia (Snow in Summer)	2.5	1083
Shrubs	**Plantings per 100m^2 = 10**	
Melaleuca nodosa (Ball Honey Myrtle)	3.33	1442
Pultenaea villosa	3.33	1442
Epacris pulchella (NSW Coral Heath)	3.33	1442

TABLE 2 (Cont.) SPECIES TO BE USED IN REVEGETATION WORKS		
REVEGETATION AREAS "E-PREFIX" (Cont.) Woodland / Open Forest *(Eucalyptus robusta)*		
Groundcovers	**Plantings per 100m^2 = 15**	
Entolasia stricta (Wiry Panic)	3	1300
Imperata cylindrica var. *major* (Blady Grass)	3	1300
Lomandra longifolia (Spiky-headed Mat Rush)	3	1300
Dianella caerulea var. *producta* (Blue Flax Lily)	3	1300
Baloskion tetraphyllum subsp. *meiostachyum*	3	1300
REVEGETATION AREAS "F-PREFIX" Woodland / Open Forest *(Eucalyptus umbra)*		
Species		**Total Number of Plants***
Trees	**Plantings per 100m^2 = 5**	
Eucalyptus umbra (Broad-leaved White Mahogany)	1	347
Eucalyptus globoidea (White Stringybark)	1	347
Angophora costata (Smooth-barked Apple)	1	347
Corymbia gummifera (Red Bloodwood)	1	347
Eucalyptus microcorys (Tallowwood)	1	
Shrubs	**Plantings per 100m^2 = 10**	
Callistemon salignus (Willow Bottlebrush)	2.5	868
Leptospermum polygalifolium (Yellow Tea Tree)	2.5	868
Persoonia linearis (Narrow-leaved Geebung)	2.5	868
Lomatia silaifolia (Crinkle Bush)	2.5	868
Groundcovers	**Plantings per 100m^2 = 15**	
Entolasia stricta (Wiry Panic)	3	1041
Imperata cylindrica var. *major* (Blady Grass)	3	1041
Lomandra longifolia (Spiky-headed Mat Rush)	3	1041
Microlaena stipoides (Weeping Rice Grass)	3	1041
Themeda australis (Kangaroo Grass)	3	1041

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TABLE 2 (Cont.) SPECIES TO BE USED IN REVEGETATION WORKS		
REVEGETATION AREAS "G-PREFIX" Aquatic Corridor / Parkland		
PARKLAND		
Species		**Total Number of Plants**
Trees	**Plantings per 100m^2 = 1**	
Eucalyptus resinifera (Red Mahogany)	0.5	827
Eucalyptus robusta (Swamp Mahogany)	0.5	827
Shrubs	**Plantings per 100m^2 = 2**	
Melaleuca sieberi	0.5	827
Leptospermum polygalifolium (Yellow Tea Tree)	0.5	827
Melaleuca thymifolia	0.5	827
Leptospermum liversidgei	0.5	827
Groundcovers	**Plantings per 100m^2 = 150**	
Entolasia marginata (Bordered Panic)	50	82,700
Themeda australis (Kangaroo Grass)	50	82,700
Panicum simile (Two-coloured Panic)	50	82,700
FRESHWATER EDGE		
Species		**Total Number of Plants**
Trees	**Plantings per 100m^2 = 1**	
Eucalyptus resinifera (Red Mahogany)	0.5	145
Eucalyptus robusta (Swamp Mahogany)	0.5	145
Shrubs	**Plantings per 100m^2 = 15**	
Leptospermum polygalifolium (Yellow Tea Tree)	5	1445
Melaleuca thymifolia	5	1445
Leptospermum liversidgei	5	1445
Groundcovers	**Plantings per 100m^2 = 150**	
Paspalum distichum (Native Water Couch)	50	14,450
Themeda australis (Kangaroo Grass)	20	14,450
Lomandra longifolia (Spiky-headed Mat-rush)	20	14,450
Dianella caerulea (Blue Flax Lily)	20	14,450
Juncus usitatus (Common Rush)	40	14,450

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TABLE 2 (Cont.) SPECIES TO BE USED IN REVEGETATION WORKS		
REVEGETATION AREAS "G-PREFIX" (Cont.) Aquatic Corridor / Parkland		
FRESHWATER BODY		
Species		**Total Number of Plants**
Waterplants	**Plantings per 100m^2 = 100**	
Eleocharis sphacelata (Tall Spike Rush)	20	23,540
Potamogeton crispus (Curly Pondweed)	20	23,540
Triglochin microtuberosum (Water Ribbons)	20	23,540
Ottelia ovalifolia (Swamp Lily)	20	23,540
Vallisneria gigantea (Ribbon Weed)	20	23,540
SALINE SHORE		
Species		**Total Number of Plants**
Halophiles	**Plantings per 100m^2 = 60**	
Juncus kraussii (Sea Rush)	20	670
Sarcocornia quinqueflora (Glasswort)	20	670
Spinifex sericeus	20	670

* Numbers may change subject to the existing on-ground presence of native trees, shrubs or groundcovers.

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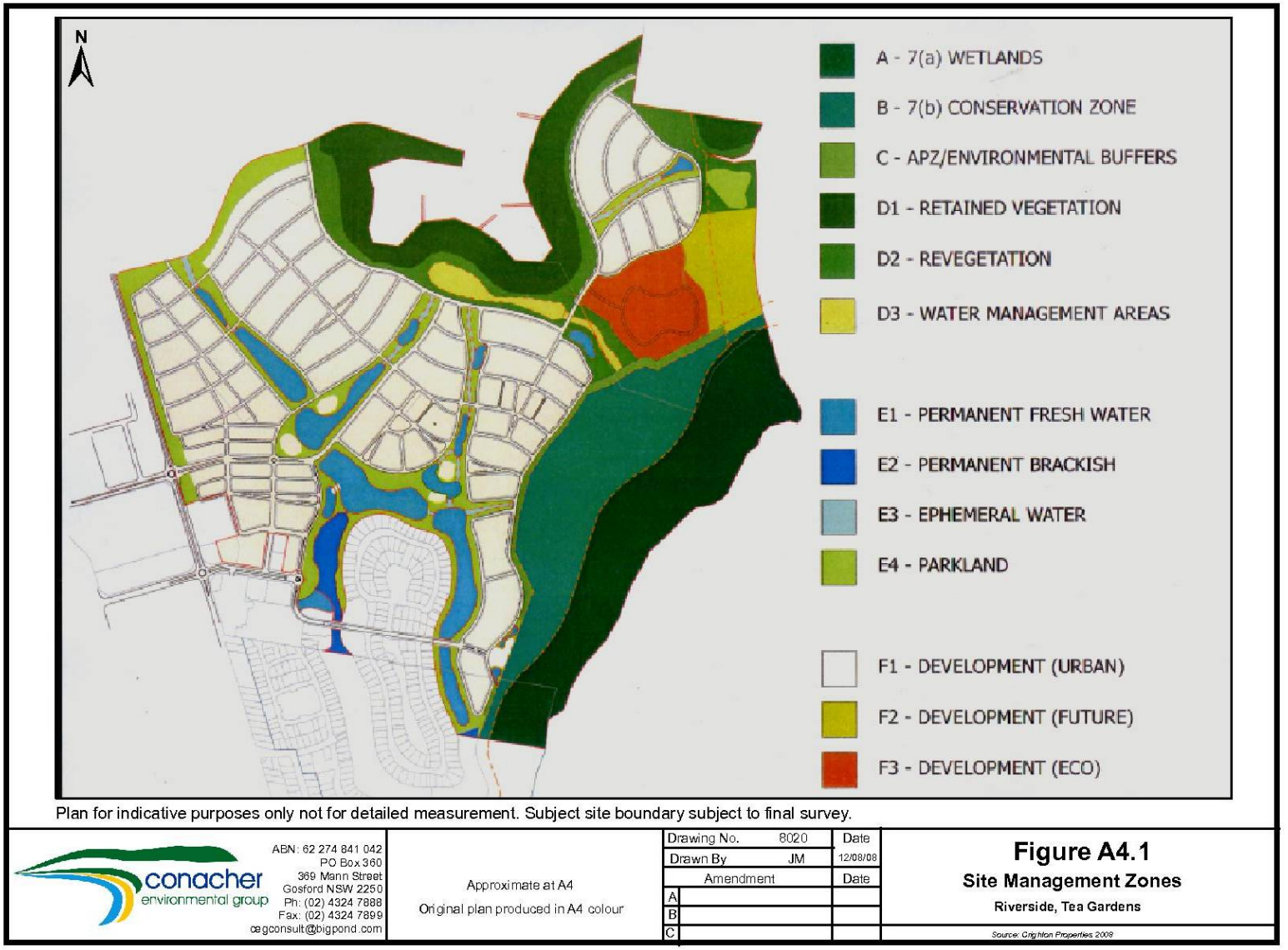

Plan for indicative purposes only not for detailed measurement. Subject site boundary subject to final survey.

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Approximate at A4

Original plan produced in A4 colour

Drawing No.	8020	Date
Drawn By	JM	12/08/08
Amendment		Date
A		
B		
C		

Figure A4.1

Site Management Zones

Riverside, Tea Gardens

Source: Crighton Properties 2009

Flora survey locations are approximate and have not been fixed by land survey. *Subject Site boundary subject to final survey.
Plan for indicative purposes only. Not for detailed measurement. Original plan produced in A3 colour

Legend

- Subject Site Boundary
- A — Pasture with Scattered Trees
- B — Open Forest (*E. microcorys*)
- C — Open Forest (*E. pilularis*)
- D — Woodland (*E. resinifera*)
- E — Woodland / Open Forest (*E. robusta*)
- F — Woodland / Open Forest (*E. umbra*)
- G — Aquatic / Dam Areas

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Figure A4.2
Re-vegetation Zones
Riverside, Teagardens

By:JM
12/08/08
Ref.No.8020

Source: Aerial © Department of Lands (2007)

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APPENDIX 5

ENVIRONMENTAL PROTECTON AND BIODIVERSITY CONSERVATION ACT ASSESSMENT

INTRODUCTION

The *Environment Protection and Biodiversity Conservation 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 environment 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, and 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 Heritage and Arts (DEWHA).

A protected matters search was undertaken on 8 May 2008 using a 10km search area centred on the subject site. The results of this search are provided as Attachment 5.1 within this Appendix.

Items listed within the search results require consideration or assessment under EP&BC Act (1999). An assessment of the matters raised by the 10km EPBC search are provided below:

Wetlands of International Significance (Ramsar Sites)
Myall Lakes are the only wetlands of international significance listed within the search. The subject site is situated near the lower reaches of the Myall River approximately two kilometres from the southern most extent of Myall Lakes National Park. The subject site is located downstream from this wetland area on the western bank of the Myall River which is tidal. Incoming tidal flows pass the shores of the subject site on the way into the lake system. The proposed development has incorporated large areas of native foreshore and swamp vegetation to be retained along the riverbank. These areas of retained native vegetation are expected to act as a natural buffer between the proposed development and the river, therefore it is considered that the proposed action is not likely to have any detrimental impact on any Wetlands of International Significance.

Threatened Species
The 10km search results list 18 threatened bird species, 2 threatened frog species, 4 threatened terrestrial mammal species and 6 threatened plant species as occurring within 10km of the subject site. Species that are wholly marine are not assessed as there is no suitable habitat within the subject site and the proposed development is not expected to impact upon them. The subject site provides suitable habitat for the following EP&BC listed threatened species.

Species	Habitat Present	Found on-site
Swift Parrot	Foraging only	No
Regent Honeyeater	Foraging only	No
Green and Golden Bell Frog	Breeding & Foraging	No
Large-eared Pied Bat	Foraging only	No
Grey-headed Flying Fox	Foraging and Roosting	Yes

Cryptostylis hunteriana	Suitable Habitat	No
Eucalyptus parramattensis subsp. *decadens*	Sub-optimal habitat	No
Syzygium paniculatum	Sub-optimal habitat	No
Tetratheca juncea	Sub-optimal habitat	No

No threatened flora species as listed under EP&BC Act (1999) were observed on the subject site.

The Grey-headed Flying Fox was observed foraging within the subject site. It is expected that this species will use the wider locality for foraging and not the subject site exclusively. Therefore it is expected that the proposed development will not have a significant impact on the Grey-headed Flying Foxes foraging habitat within the local area. Similarly, the proposed development is not expected to have a significant impact on any of the EP&BC listed threatened species that may occur in the local area.

Threatened Ecological Communities
No Threatened Ecological Communities listed in the EP&BC Act (1999) were identified on or within 10km of the subject site.

Migratory Species
The 10km search results lists 8 threatened migratory terrestrial bird species, 6 threatened migratory wetland bird species and 24 migratory marine birds which may potentially use the site for roosting, foraging or overflying.

Of the 8 threatened migratory terrestrial bird species listed in the 10km search, five species (White-bellied Sea-eagle, White-throated Needletail, Great Egret, Cattle Egret and the Rainbow Bee-eater) were observed on-site or in the local area. The proposed development is expected to decrease the area of suitable habitat for these species, however, large areas of suitable (and higher quality) habitat is to be retained within vegetated corridors and foreshore areas. As a result it is considered that the proposed development will not cause a significant decrease in habitat for these migratory terrestrial bird species within the local area.

Five (5) of the six threatened migratory wetland bird species known within 10km have been observed on or near the subject site. These species are the Great Egret, Cattle Egret, Latham's Snipe, Eastern Curlew and the Whimbrel. The proposed development is expected to remove or modify a small area of disturbed wetland habitat however, the development will also retain large areas of good quality wetland in the foreshore and lower elevated portions of the site.

Two of the 24 migratory marine birds listed within the 10km search have been recorded within the subject site. The two species observed were the Great Egret and the Cattle Egret. The subject site does not provide any strictly marine habitat. It is considered that the proposed development will not have any significant effect on the habitat for the Great Egret, the Cattle Egret or any other migratory marine birds within the local area.

Commonwealth Lands
There are two (2) Commonwealth Lands listed within the 10km search. These are:

1 - Communications, Information Technology and the Arts – Telstra Corporation Limited;
2 - Defence – Defence Housing Authority.

The subject site does not contain any of these two Commonwealth Lands. It is unknown if any of these lands are adjoining the subject site. It is expected that the proposed development will not have any effect on these Commonwealth Lands.

Places on the Register of National Estate
There are six (6) places listed on the RNE these are:

1 - Corrie Island NSW,
2 - Fly Point, Halifax Park Aquatic Reserve NSW,
3 - John Gould Island Nature Reserve NSW,
4 - Myall Lakes National Park NSW,
5 – Port Stephens Estuary NSW,
6 - Tomaree National Park NSW.

The subject site does not contain or adjoin any of these six Commonwealth Lands, therefore it is expected that the proposed development will not have any effect on these lands. The subject site is situated approximately 2km south of Myall Lakes National Park.

It is considered that a referral of this project to the Department of Environment, Water Heritage and Arts (DEWHA) is not required as it is not likely to impact on a significant population of nationally listed threatened species, any nationally listed endangered ecological community or on any nationally listed migratory or marine species.

ATTACHMENT 5.1

EPBC PROTECTED MATTERS SEARCH RESULTS

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Australian Government
Department of the Environment, Water, Heritage and the Arts

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Protected Matters Search Tool

You are here: Environment Home > EPBC Act > Search

8 May 2008 12:25

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at http://www.environment.gov.au/atlas may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

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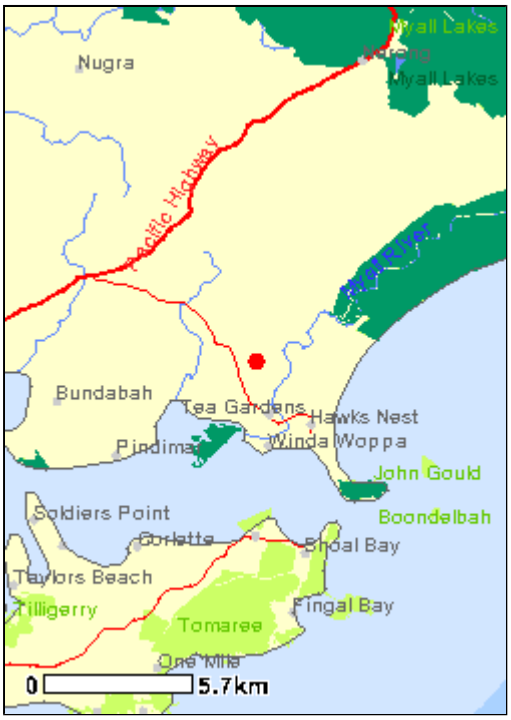

This map may contain data which are
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© 2007 MapData Sciences Pty Ltd, PSMA

Search Type: Point

Buffer: 10 km

Coordinates: -32.64596,152.1552

Report Contents:

Summary
Details
- Matters of NES
- Other matters protected by the EPBC Act

- Extra Information

Caveat
Acknowledgments

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance: (Ramsar Sites)	1
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	39
Migratory Species:	49

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area

you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	2
Commonwealth Heritage Places:	None
Places on the RNE:	6
Listed Marine Species:	63
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	5
Other Commonwealth Reserves:	None
Regional Forest Agreements:	1

Details

Matters of National Environmental Significance

Wetlands of International Significance [Dataset Information]
(Ramsar Sites)

MYALL LAKES

Threatened Species [Dataset Information]	Status	Type of Presence
Birds		
Diomedea amsterdamensis * Amsterdam Albatross	Endangered	Species or species habitat may occur within area
Diomedea antipodensis * Antipodean Albatross	Vulnerable	Species or species habitat may occur within area
Diomedea dabbenena * Tristan Albatross	Endangered	Foraging may occur within area
Diomedea exulans (sensu lato) * Wandering Albatross	Vulnerable	Species or species habitat may occur within area
Diomedea gibsoni * Gibson's Albatross	Vulnerable	Species or species habitat may occur within area
Lathamus discolor * Swift Parrot	Endangered	Species or species habitat may occur within area
Macronectes giganteus * Southern Giant-Petrel	Endangered	Species or species habitat may occur within area
Macronectes halli * Northern Giant-Petrel	Vulnerable	Species or species habitat may occur within area
*Pterodroma leucoptera leucoptera** Gould's Petrel	Endangered	Breeding known to occur within area
*Pterodroma neglecta neglecta** Kermadec Petrel (western)	Vulnerable	Species or species habitat may occur within area
Rostratula australis * Australian Painted Snipe	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri * Buller's Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) * Shy Albatross, Tasmanian Shy Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche impavida * Campbell Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris * Black-browed Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini * Salvin's Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi * White-capped Albatross	Vulnerable	Species or species habitat may occur within area
Xanthomyza phrygia * Regent Honeyeater	Endangered	Species or species habitat may occur within area
Frogs		
Litoria aurea * Green and Golden Bell Frog	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus * Stuttering Frog, Southern Barred Frog (in Victoria)	Vulnerable	Species or species habitat likely to occur within area

Mammals

Balaenoptera musculus * Blue Whale	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri * Large-eared Pied Bat, Large Pied Bat	Vulnerable	Species or species habitat may occur within area
*Dasyurus maculatus maculatus (SE mainland population)** Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered	Species or species habitat may occur within area
Eubalaena australis * Southern Right Whale	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae * Humpback Whale	Vulnerable	Species or species habitat known to occur within area
*Potorous tridactylus tridactylus** Long-nosed Potoroo (SE mainland)	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus * Grey-headed Flying-fox	Vulnerable	Roosting known to occur within area

Reptiles

Chelonia mydas * Green Turtle	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea * Leathery Turtle, Leatherback Turtle, Luth	Vulnerable	Species or species habitat may occur within area

Sharks

*Carcharias taurus (east coast population)** Grey Nurse Shark (east coast population)	Critically Endangered	Species or species habitat may occur within area
Carcharodon carcharias * Great White Shark	Vulnerable	Species or species habitat may occur within area
Pristis zijsron * Green Sawfish, Dindagubba, Narrowsnout Sawfish	Vulnerable	Species or species habitat may occur within area
Rhincodon typus * Whale Shark	Vulnerable	Species or species habitat may occur within area

Plants

Cryptostylis hunteriana * Leafless Tongue-orchid	Vulnerable	Species or species habitat may occur within area
Diuris praecox * Newcastle Doubletail	Vulnerable	Species or species habitat likely to occur within area
*Eucalyptus parramattensis subsp. decadens** Earp's Gum, Earp's Dirty Gum	Vulnerable	Species or species habitat likely to occur within area
Prostanthera densa * Villous Mintbush	Vulnerable	Species or species habitat likely to occur within area
Syzygium paniculatum * Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry	Vulnerable	Species or species habitat likely to occur within area

Tetratheca juncea *	Vulnerable	Species or species habitat likely to occur within area
Migratory Species [Dataset Information]	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Migratory	Species or species habitat may occur within area
Merops ornatus * Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Migratory	Breeding may occur within area
Monarcha trivirgatus Spectacled Monarch	Migratory	Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher	Migratory	Breeding likely to occur within area
Rhipidura rufifrons Rufous Fantail	Migratory	Breeding may occur within area
Xanthomyza phrygia Regent Honeyeater	Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Birds		
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Gallinago hardwickii * Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew	Migratory	Species or species habitat likely to occur within area
Numenius phaeopus Whimbrel	Migratory	Species or species habitat likely to occur within area
Rostratula benghalensis s. lat. Painted Snipe	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Calonectris leucomelas	Migratory	Species or species habitat may occur

Streaked Shearwater		within area
Diomedea amsterdamensis Amsterdam Albatross	Migratory	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross	Migratory	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross	Migratory	Foraging may occur within area
Diomedea exulans (sensu lato) Wandering Albatross	Migratory	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross	Migratory	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel	Migratory	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel	Migratory	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel	Migratory	Breeding known to occur within area
Puffinus griseus Sooty Shearwater	Migratory	Breeding known to occur within area
Puffinus leucomelas Streaked Shearwater	Migratory	Species or species habitat may occur within area
Puffinus pacificus Wedge-tailed Shearwater	Migratory	Breeding known to occur within area
Puffinus tenuirostris Short-tailed Shearwater	Migratory	Breeding known to occur within area
Sterna albifrons Little Tern	Migratory	Breeding may occur within area
Thalassarche bulleri Buller's Albatross	Migratory	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross	Migratory	Species or species habitat may occur within area
Thalassarche chlororhynchos Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross	Migratory	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross	Migratory	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross	Migratory	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross	Migratory	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross	Migratory	Species or species habitat may occur within area

Migratory Marine Species

Mammals

Balaenoptera edeni Bryde's Whale	Migratory	Species or species habitat may occur within area
Balaenoptera musculus * Blue Whale	Migratory	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale	Migratory	Species or species habitat may occur within area
Eubalaena australis * Southern Right Whale	Migratory	Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin	Migratory	Species or species habitat may occur within area
Megaptera novaeangliae * Humpback Whale	Migratory	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca	Migratory	Species or species habitat may occur within area
Reptiles		
Chelonia mydas * Green Turtle	Migratory	Species or species habitat may occur within area
Dermochelys coriacea * Leathery Turtle, Leatherback Turtle, Luth	Migratory	Species or species habitat may occur within area
Sharks		
Carcharodon carcharias Great White Shark	Migratory	Species or species habitat may occur within area
Rhincodon typus Whale Shark	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Dataset Information]	Status	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater	Listed	Species or species habitat may occur within area
Catharacta skua Great Skua	Listed	Species or species habitat may occur within area

Diomedea amsterdamensis Amsterdam Albatross	Listed	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross	Listed	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross	Listed	Foraging may occur within area
Diomedea exulans (sensu lato) Wandering Albatross	Listed	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross	Listed	Species or species habitat may occur within area
Eudyptula minor Little Penguin	Listed	Breeding known to occur within area
Gallinago hardwickii ***** Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
Lathamus discolor ***** Swift Parrot	Listed - overfly marine area	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel	Listed	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel	Listed	Species or species habitat may occur within area
Merops ornatus ***** Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
Monarcha trivirgatus Spectacled Monarch	Listed - overfly marine area	Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
Numenius madagascariensis	Listed	Species or species habitat likely to

Eastern Curlew		occur within area
Numenius phaeopus Whimbrel	Listed	Species or species habitat likely to occur within area
Pelagodroma marina White-faced Storm-Petrel	Listed	Breeding known to occur within area
Puffinus griseus Sooty Shearwater	Listed	Breeding known to occur within area
Puffinus pacificus Wedge-tailed Shearwater	Listed	Breeding known to occur within area
Puffinus tenuirostris Short-tailed Shearwater	Listed	Breeding known to occur within area
Rhipidura rufifrons Rufous Fantail	Listed - overfly marine area	Breeding may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Sterna albifrons Little Tern	Listed	Breeding may occur within area
Thalassarche bulleri Buller's Albatross	Listed	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross	Listed	Species or species habitat may occur within area
Thalassarche chlororhynchos Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross	Listed	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross	Listed	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross	Listed	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross	Listed	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross	Listed	Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri New Zealand Fur-seal	Listed	Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal	Listed	Species or species habitat may occur within area
Ray-finned fishes		
Acentronura tentaculata Hairy Pygmy Pipehorse	Listed	Species or species habitat may occur within area
Festucalex cinctus	Listed	Species or species habitat may occur

Girdled Pipefish		within area
Filicampus tigris Tiger Pipefish	Listed	Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish	Listed	Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish	Listed	Species or species habitat may occur within area
Hippocampus abdominalis Eastern Potbelly Seahorse, New Zealand Potbelly, Seahorse, Bigbelly Seahorse	Listed	Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse	Listed	Species or species habitat may occur within area
Histiogamphelus briggsii Briggs' Crested Pipefish, Briggs' Pipefish	Listed	Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish	Listed	Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish	Listed	Species or species habitat may occur within area
Notiocampus ruber Red Pipefish	Listed	Species or species habitat may occur within area
Phyllopteryx taeniolatus Weedy Seadragon, Common Seadragon	Listed	Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse	Listed	Species or species habitat may occur within area
Solenostomus cyanopterus Blue-finned Ghost Pipefish, Robust Ghost Pipefish	Listed	Species or species habitat may occur within area
Solenostomus paradoxus Harlequin Ghost Pipefish, Ornate Ghost Pipefish	Listed	Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish	Listed	Species or species habitat may occur within area
Stigmatopora nigra Wide-bodied Pipefish, Black Pipefish	Listed	Species or species habitat may occur within area
Syngnathoides biaculeatus Double-ended Pipehorse, Alligator Pipefish	Listed	Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bend Stick Pipefish, Short-tailed Pipefish	Listed	Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish	Listed	Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish	Listed	Species or species habitat may occur within area
Reptiles		
Chelonia mydas ***** Green Turtle	Listed	Species or species habitat may occur within area

Dermochelys coriacea * Leathery Turtle, Leatherback Turtle, Luth	Listed	Species or species habitat may occur within area
Pelamis platurus Yellow-bellied Seasnake	Listed	Species or species habitat may occur within area
Whales and Other Cetaceans [Dataset Information]	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera musculus * Blue Whale	Cetacean	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale	Cetacean	Species or species habitat may occur within area
Delphinus delphis Common Dolphin	Cetacean	Species or species habitat may occur within area
Eubalaena australis * Southern Right Whale	Cetacean	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus	Cetacean	Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin	Cetacean	Species or species habitat may occur within area
Megaptera novaeangliae * Humpback Whale	Cetacean	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca	Cetacean	Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin	Cetacean	Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	Cetacean	Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin	Cetacean	Species or species habitat may occur within area

Commonwealth Lands [Dataset Information]

Communications, Information Technology and the Arts - Telstra Corporation Limited

Defence - Defence Housing Authority

Places on the RNE [Dataset Information]
Note that not all Indigenous sites may be listed.

Natural

Corrie Island NSW

Fly Point, Halifax Park Aquatic Reserve NSW

John Gould Island Nature Reserve NSW

Myall Lakes National Park NSW

Port Stephens Estuary NSW

Tomaree National Park NSW

Extra Information

State and Territory Reserves [Dataset Information]

Corrie Island Nature Reserve, NSW

Fly Point Aquatic Reserve, NSW

John Gould Nature Reserve, NSW

Myall Lakes National Park, NSW

Tomaree National Park, NSW

Regional Forest Agreements [Dataset Information]
Note that all RFA areas including those still under consideration have been included.

Lower North East NSW RFA, New South Wales

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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APPENDIX 6

THREATENED FAUNA SPECIES
IMPROVE OR MAINTAIN ASSESSMENT

THREATENED FAUNA SPECIES – IMPROVE OR MAINTAIN ASSESSMENT

The following assessments have been completed for each of the threatened species identified as occurring on the site due to the presence of suitable habitat and known local occurrence of that species. These assessments have been completed to determine the areas of suitable habitats to be removed or modified and areas to be maintained or improved. Vegetation communities were used as indicators of suitable habitat type. The site masterplan was overlain on habitat maps for each species and the areas to be removed, modified or maintained/improved determined.

1. Wallum Froglet (*Crinia tinnula)*

This species was observed calling within a number of areas of the subject site during all surveys. It is considered that this species would use a range of locations within the subject site periodically for foraging, breeding, shelter/refuge and dispersal. The Wallum Froglet is likely to disperse from the core habitat areas (located in the eastern part of the site) into suitable microhabitat locations within the lower quality Disturbed/Cleared Land and Woodland/Open Forest habitat types following rain and during periods of inundation.

The higher quality, less disturbed vegetation and habitat types (wetland variant vegetation communities) for this species within the subject site will be retained by the proposed development. The Ecological Site Management Plan for the site details strategies for the control of water quality and maintenance of hydrological conditions for those areas to be protected and retained.

TABLE A6.1
WALLUM FROGLET HABITAT – IMPROVE OR MAINTAIN

Habitat Area	Existing Habitat (ha)	Removed (ha)	Maintained (ha)	Improved (ha)
Suitable Habitat	37.2	13.4	23.8	5.0

A further 12.73 hectares of suitable habitat will be created in the form artificial water management areas within drainage corridors. These areas will be managed as part of habitat enhancement works detailed in the Environmental Site Management Strategy.

Those areas to be removed, modified and created for the Wallum Froglet are shown in Figure A6.1.

These areas will be protected, conserved and managed as part of ecological management planning strategies developed for the site and to be implemented in the long term. It is considered that the proposed development is not likely to have an adverse effect on the life cycle or habitats of this species within the local area such that a viable local population is likely to be placed at risk of extinction.

2. Pied Oystercatcher (*Haematopus longirostris*)
Sooty Oystercatcher (*Haematopus fuliginosus*)

The subject site contains areas of suitable habitat for the Pied and Sooty Oystercatcher. These species were not detected within the subject site during surveys. The higher quality vegetation and habitat types for this species along the shores of the Myall River and within the Saltmarsh vegetation communities will be protected and retained as part of the concept

proposal. The local area provides extensive areas of suitable habitat for these species within the SEPP 14 foreshore areas associated with the Myall River, including those lands reserved within Myall Lakes National Park and other local reserves.

There are approximately 25 hectares of suitable habitat present within the subject site for the Pied Oystercatcher and Sooty Oystercatcher. These habitats are restricted to areas within the Rushland (*Baumea juncea*), Mangrove and Saltmarsh (*Juncus krausii*) vegetation communities. The proposal will not require the removal of a significant area of suitable or sub-optimal habitat for the Pied Oystercatcher or Sooty Oystercatcher.

With the exception of the area of saltmarsh required to be removed for enlargement of the lake outlet channel, suitable, higher quality habitat will be conserved and maintained as part of the offset strategies developed for the concept plan. These areas will be protected, conserved managed as part of ecological management planning strategies developed for the site and to be implemented in the long term. It is considered that the proposed development is not likely to have an adverse effect on the life cycle or habitats of this species within the local area such that a viable local population is likely to be placed at risk of extinction.

3. Black-necked Stork (*Ephipiorhynchus asiaticus*)

The subject site contains areas of suitable habitat for this species within ephemerial ponds and drains within the site and along the tidal edges of the Myall River. This species was not detected within the subject site during surveys. The higher quality vegetation and habitat types for this species will be protected and retained as part of the concept proposal. The local area provides extensive areas of suitable habitat for this species within the SEPP 14 foreshore areas associated with the Myall River, including those lands reserved within Myall Lakes National Park and other local reserves.

4. Osprey (*Pandion haliaetus*)

The subject site contains areas of suitable roosting and nesting habitat for this species within the trees fringing the Myall River and within several of the larger trees within the Swamp Forest vegetation. This species was detected flying over the subject site during surveys. The higher quality vegetation and habitat types for this species will be protected and retained as part of the concept proposal. The local area provides extensive areas of suitable habitat for this species within the SEPP 14 foreshore areas associated with the Myall River, including those lands reserved within Myall Lakes National Park and other local reserves.

All of the suitable, higher quality habitat will be protected, conserved and managed as part of ecological management planning strategies developed for the site.

5. Swift Parrot (*Lathamus discolour*)

The subject site contains areas of suitable habitat for the Swift Parrot. This species was not detected within the subject site during surveys.

Table A6.2 provides details on suitable habitats within the site based upon habitat attributes within each suitable vegetation community type.

TABLE A6.2 SWIFT PARROT HABITAT –IMPROVE OR MAINTAIN				
Vegetation Community	**Existing Habitat (ha)**	**Removed (ha)**	**Maintained (ha)**	**Improved (ha)**
Pasture with Scattered Trees	50.4	33.8	-	16.6
Open Forest (*Eucalyptus microcorys*)	8.4	2.1	6.3	-
Woodland / Open Forest (*Eucalyptus robusta*)	37.4	21.0	16.4	-
Paperbark Forest	1.5	0.0	1.5	-
TOTAL	97.7	56.9	24.2	16.6

The subject site contains approximately 97.7 hectares of suitable habitat for the Swift Parrot. The proposal will require the removal of approximately 60 hectares.

A further 16.6 hectares of suitable habitat will be improved/created in the form parklands and enhanced vegetation. These areas will be managed as part of habitat enhancement works detailed in the Environmental Site Management Plan.

Those areas to be removed, modified and offset for the Swift Parrot are shown in Figure A6.2.

It is considered that the proposed development is not likely to have an adverse effect on the life cycle or habitats of this species within the local area such that a viable local population is likely to be placed at risk of extinction.

6. Large Forest Owls - Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*) and Powerful Owl (*Ninox strenua*)

The Barking Owl was heard calling within the north-east of the site during surveys in 2008. The site contains suitable habitat for the Powerful Owl and Masked Owl however these species have not been recorded on the site.

Table A6.3 provides details on suitable habitats within the site based upon habitat attributes within each suitable vegetation community type.

TABLE A6.3 LARGE FOREST OWLS HABITAT – IMPROVE OR MAINTAIN				
Vegetation Community	**Existing Habitat (ha)**	**Removed (ha)**	**Maintained (ha)**	**Improved (ha)**
Pasture with Scattered Trees	50.4	33.8	16.6	11.0
Acacia / Melaleuca Regrowth Scrub	2.0	0	2.0	0
Open Forest (*Corymbia gummifera*)	11.0	11.0	0	0
Open Forest (*Corymbia maculata, Eucalyptus paniculata*)	7.7	0.1	7.6	0
Open Forest (*Eucalyptus microcorys*)	8.4	2.1	6.3	0
Open Forest (*Eucalyptus pilularis*)	11.5	6.6	4.9	4.0
Woodland / Open Forest (*Eucalyptus robusta*)	37.4	21.0	16.4	0
Woodland (*Eucalyptus signata*)	1.1	1.1	0	0
Woodland / Open Forest (*Eucalyptus umbra*)	2.6	0.1	2.5	0
TOTAL	132.1	75.8	56.3	15.0

Approximately 56.3 hectares of suitable, habitat will be conserved and improved as part of the offset strategies developed for the concept plan. A further 15 hectares of suitable habitat will be managed within parklands and enhanced/regeneration areas. These areas will be revegetated with site specific flora species and habitat enhancement works as detailed in the Environmental Site Management Strategy.

Areas of habitat to be removed, retained and improved for the Large Forest Owls are shown in Figure A6.3.

The proposal also includes the retention of hollow trees on site. It is considered that the proposed development is not likely to have an adverse effect on the life cycle or habitats of these species within the local area such that a viable local population is likely to be placed at risk of extinction.

7. Koala (*Phascolarctos cinereus*)

The subject site contains areas of suitable foraging and refuge/shelter habitat for this species however it was not detected during surveys. The most recent record for this species within the subject site is from 1995 (NPWS 2006). The higher quality vegetation and habitat types for this species will be retained within the subject site. There are larger areas of higher quality habitat available for this species within the local area. A report on Koala Habitat Management has been prepared for the site and proposed development (*Conacher Environmental Group* 2008).

Table A6.4 provides details on suitable habitats within the site based upon habitat attributes within each suitable vegetation community type.

TABLE A6.4 KOALA HABITAT – IMPROVE OR MAINTAIN				
Biodiversity Component Vegetation Community	**Existing Habitat (ha)**	**Removed (ha)**	**Maintained (ha)**	**Improved (ha)**
Pasture with Scattered Trees	50.4	33.8	-	16.6
Open Forest (*Corymbia gummifera*)	11.0	11.0	0	0
Open Forest (*Corymbia maculata, Eucalyptus paniculata*)	7.7	0.1	7.6	0
Open Forest (*Eucalyptus microcorys*)	8.4	2.1	6.3	0
Open Forest (*Eucalyptus pilularis*)	11.5	6.6	4.9	4
Woodland / Open Forest *Eucalyptus robusta*)	37.4	21.0	16.4	1
Woodland (*Eucalyptus signata*)	1.1	1.1	0	0
Woodland / Open Forest (*Eucalyptus umbra*)	2.6	0.1	2.5	0
Paperbark Forest (*Melaleuca quinquenervia*)	1.5	0.0	1.5	0
TOTAL VEGETATED AREA	131.6	75.8	39.2	21.6

Approximately 39.2 hectares of suitable habitat will be conserved with 21.6 hectares improved as part of the offset strategies developed for the concept plan. A further 16 hectares of suitable habitat will be created in the form of parklands and enhanced vegetation within corridor areas. These areas will be managed as part of habitat enhancement works detailed in the Environmental Site Management Strategy.

Those areas to be removed, modified and offset for the Koala are shown in Figure A6.4

8. Spotted-tailed Quoll (*Dasyurus maculatus*) and Eastern Pygmy-possum (*Cercatetus nanus*)

The subject site contains areas of suitable foraging and den habitat for these species however they were not detected within the subject site during surveys. Table A6.5 provides details on suitable habitats within the site based upon habitat attributes within each suitable vegetation community type.

TABLE A6.5 EASTERN PYGMY POSSUM AND SPOTTED-TAILED QUOLL HABITAT – IMPROVE OR MAINTAIN				
Vegetation Community	**Existing Area (ha)**	**Removed (ha)**	**Maintained (ha)**	**Improved (ha)**
Acacia Regrowth	2.0	0	2.0	0
Open Forest (*Corymbia maculata, Eucalyptus paniculata*)	7.7	0.1	7.6	0
Open Forest (*Eucalyptus microcorys*)	8.4	2.1	6.3	0
Open Forest (*Eucalyptus pilularis*)	11.5	6.6	4.9	4
Pasture with Scattered Trees	0	0	0	11
Woodland / Open Forest (*Eucalyptus robusta*)	37.4	21.0	16.4	1
Woodland / Open Forest (*Eucalyptus umbra*)	2.6	0.1	2.5	0
Open Forest (*Corymbia gummifera*)	11.0	11.0	0	0
Scrub (*Melaleuca ericifolia*)	9.5	0	9.5	0
Paperbark Forest (*Melaleuca quinquenervia*)	1.5	0	1.5	0
TOTAL	91.6	40.9	50.7	16

Approximately 51 hectares of suitable habitat will be conserved as part of the conservation strategies developed for the concept plan. A further 16 hectares of suitable habitat will be created in the form parklands and enhanced vegetation. These areas will be managed as part of habitat enhancement works detailed in the Environmental Site Management Strategy.

Those areas to be removed, modified and offset for the Eastern Pygmy-possum and Spotted-tailed Quoll are shown in Figure A6.5.

It is considered that the proposed development is not likely to have an adverse effect on the life cycle or habitats of this species within the local area such that a viable local population is likely to be placed at risk of extinction.

9. Squirrel Glider (*Petaurus norfolcensis*)

The Squirrel glider was recorded within the subject site during surveys. There are a number of records for this species within the local area. The subject site contains suitable foraging, den and refuge habitat for the Squirrel Glider.

Table A6.6 provides details on suitable habitats within the site based on habitat attributes within each suitable vegetation community type.

TABLE A6.6 SQUIRREL GLIDER HABITAT – IMPROVE OR MAINTAIN				
Vegetation Community	**Existing Area (ha)**	**Removed (ha)**	**Maintained (ha)**	**Improved (ha)**
Pasture with Scattered Trees	0	0	0	11
Acacia / Melaleuca Regrowth Scrub	2.0	0	2.0	0.0
Open Forest (*Corymbia gummifera*)	11.0	11.0	0	0.0
Open Forest (*Corymbia maculata, Eucalyptus paniculata*)	7.7	0.1	7.6	0.0
Open Forest (*Eucalyptus microcorys*)	8.4	2.1	6.3	0.0
Open Forest (*Eucalyptus pilularis*)	11.5	6.6	4.9	6
Melaleuca scrub	9.5	0.0	9.5	-
Woodland / Open Forest (*Eucalyptus robusta*)	37.4	21.0	16.4	2
Woodland (*Eucalyptus signata*)	1.1	1.1	0	0.0
Woodland / Open Forest (*Eucalyptus umbra*)	2.6	0.1	2.5	0.0
Paperbark	1.5	0.0	1.5	0.0
TOTAL	92.7	42.0	50.7	19

Approximately 50.7 hectares of suitable habitat will be conserved as part of the offset strategies developed for the concept plan. A further 19 hectares of suitable habitat will be created in the form parklands and enhanced vegetation. This includes areas reserved within corridors designed to maintain habitat connectivity for the local population within the site and surrounding vegetation. These areas will be managed as part of habitat enhancement works detailed in the Environmental Site Management Strategy. These actions include nest boxes as supplementary habitat, retention of hollow trees and revegetation using preferred foraging plants and trees.

Those areas to be removed, modified and offset for the Squirrel Glider are shown in Figure A6.6.

All retained habitat areas will be protected, conserved and managed as part of ecological management strategies developed for the site. It is considered that the proposed development is not likely to have an adverse effect on the life cycle or habitats of this species within the local area such that a viable local population is likely to be placed at risk of extinction.

10. Grey-headed Flying-fox (*Pteropus poliocephalus*)

The subject site provides suitable foraging habitat for this species, however no colonies or camp sites were located on the subject site during surveys. The Grey-headed Flying-fox has been detected within the vicinity of the subject site on several occasions. There are extensive areas of foraging habitat for this species within the local area including those lands contained within Myall Lakes National Park and other local reserves.

Table A6.7 provides details on suitable habitats within the site based upon habitat attributes within each suitable vegetation community type. Areas for each as they relate to the masterplan details are also included.

TABLE A6.7
GREY-HEADED FLYING-FOX HABITAT - IMPROVE OR MAINTAIN

Vegetation Community	Existing Area (ha)	Removed (ha)	Maintained (ha)	Improved (ha)
Pasture with Scattered Trees	50.4	33.8	-	11
Acacia / Melaleuca Regrowth Scrub	2.0	0	2.0	0
Open Forest (*Corymbia gummifera*)	11.0	11.0	0	0
Open Forest (*Corymbia maculata, Eucalyptus paniculata*)	7.7	0.1	7.6	0
Open Forest (*Eucalyptus microcorys*)	8.4	2.1	6.3	0
Open Forest (*Eucalyptus pilularis*)	11.5	6.6	4.9	4
Woodland (*Eucalyptus resinifera*)	52.9	49.9	3.0	0
Woodland / Open Forest (*Eucalyptus robusta*)	37.4	21.0	16.4	0
Woodland (*Eucalyptus signata*)	1.1	1.1	0	1
Woodland / Open Forest (*Eucalyptus umbra*)	2.6	0.1	2.5	0
Paperbark Forest (*Melaleuca quinquenervia*)	1.5	0	1.5	0
TOTAL	186.5	125.7	44.2	16

The subject site contains approximately 186 hectares of suitable habitat for the Grey-headed Flying-fox. The proposal will require the removal of approximately 125 hectares of that total.

Approximately 44.2 hectares of suitable habitat will be conserved as part of the offset strategies developed for the concept plan. A further 16 hectares of suitable habitat will be created in the form parklands and enhanced vegetation. These areas will be managed as part of habitat enhancement works detailed in the Environmental Site Management Strategy.

Those areas to be removed, modified and offset for the Grey-headed Flying Fox are shown in Figure A6.7.

All retained habitat areas will be protected, conserved and managed as part of the ecological management strategies developed for the site. It is considered that the proposed

development is not likely to have an adverse effect on the life cycle or habitats of this species within the local area such that a viable local population is likely to be placed at risk of extinction.

12. Microbats – Little Bentwing-bat (*Miniopterus australis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), Large-footed Myotis (*Myotis adversus*) Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Eastern Freetail-bat (*Miniopterus australis*)

Table A6.8 provides details on suitable habitats for the microbats within the site based upon habitat attributes within each suitable vegetation community type and known occurrence of specific species.

TABLE A6.8
MICROBATS HABITAT – IMPROVE OR MAINTAIN

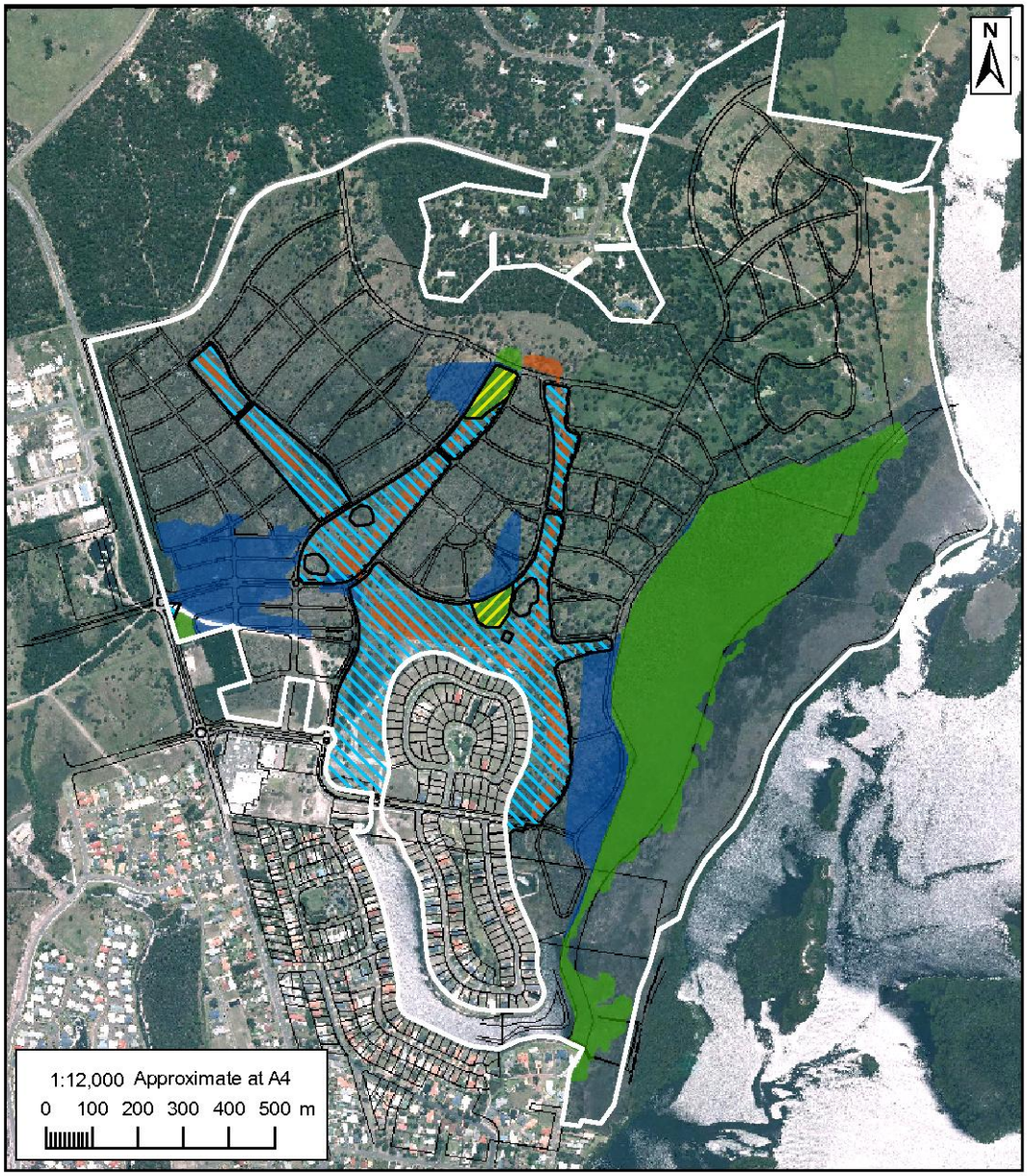
Vegetation Community	Existing Habitat (ha)	Removed (ha)	Maintained (ha)	Improved (ha)
Pasture with Scattered Trees	50.4	33.8	-	11
Acacia / Melaleuca Regrowth Scrub	2.0	0	2.0	0.00
Open Forest (*Corymbia gummifera*)	11.0	11.0	0	0.00
Open Forest (*Corymbia maculata, Eucalyptus paniculata*)	7.7	0.1	7.6	0.00
Open Forest (*Eucalyptus microcorys*)	8.4	2.1	6.3	0.00
Open Forest (*Eucalyptus pilularis*)	11.5	6.6	4.9	4
Woodland (*Eucalyptus resinifera*)	52.9	49.9	3.0	0.04
Woodland / Open Forest (*Eucalyptus robusta*)	37.4	21.0	16.4	1
Woodland (*Eucalyptus signata*)	1.1	1.1	0	0.00
Woodland / Open Forest (*Eucalyptus umbra*)	2.6	0.1	2.5	0.00
Pine Forest (*Pinus eliottii*)	0.3	0.1	0.2	0.00
Disturbed Estuarine Vegetation	0.2	0.0	0.2	0.00
Casuarina Forest (*Casuarina glauca*)	1.2	0.0	1.2	0.00
Mangroves (*Avicennia marina*)	0.3	0.0	0.3	0.00
Saltmarsh (*Juncus krausii*)	17.2	0.1	17.1	0.00
Rushland (*Baumea juncea*)	7.7	0.0	7.7	0.00
Scrub (*Melaleuca ericifolia*)	9.5	0.0	9.5	0.00
Paperbark Forest (*Melaleuca quinquenervia*)	1.5	0.0	1.5	0.00
Total	222.18	125.81	80.2	16

Approximately 80 hectares of suitable habitat will be conserved as part of the offset strategies developed for the concept plan. A further 16 hectares of suitable habitat will be created in the form parklands, water bodies and enhanced vegetation. These areas will be managed as part of habitat enhancement works detailed in the Environmental Site Management Strategy.

Those areas to be removed, modified and offset for the threatened micro-bat species are shown in Figure A6.8

All retained habitat areas will be protected, conserved and managed as part of the ecological management strategies developed for the site. It is considered that the proposed development is not likely to have an adverse effect on the life cycle or habitats of this species within the local area such that a viable local population is likely to be placed at risk of extinction.

FIGURES



*Subject Site boundary subject to final survey. Plan for indicative purposes only. Not for detailed measurement.
Flora and fauna survey locations are approximate and have not been fixed by land survey. Original plan produced in A4 colour

Legend

Property Boundary
Drainage Corridor
Habitat Improved
Habitat Created
Habitat Retained
Habitat Removed

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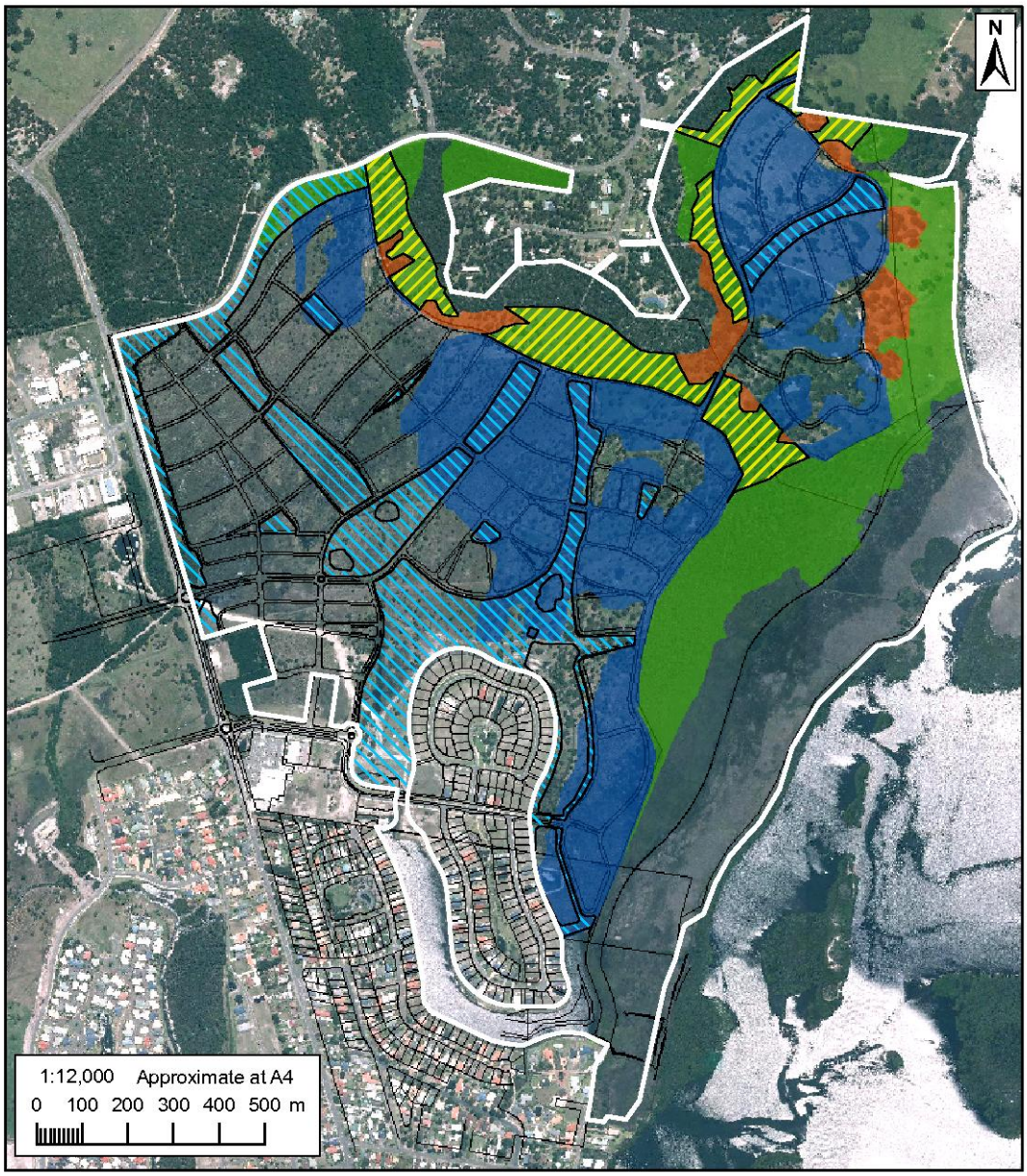
Figure A6.1

Wallum Froglet Habitat

Riverside Tea Gardens

Source: Aerial © Department of Lands (2007)



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Legend

- Property Boundary
- Drainage Corridor
- Habitat Improved
- Habitat Created
- Habitat Retained
- Habitat Removed

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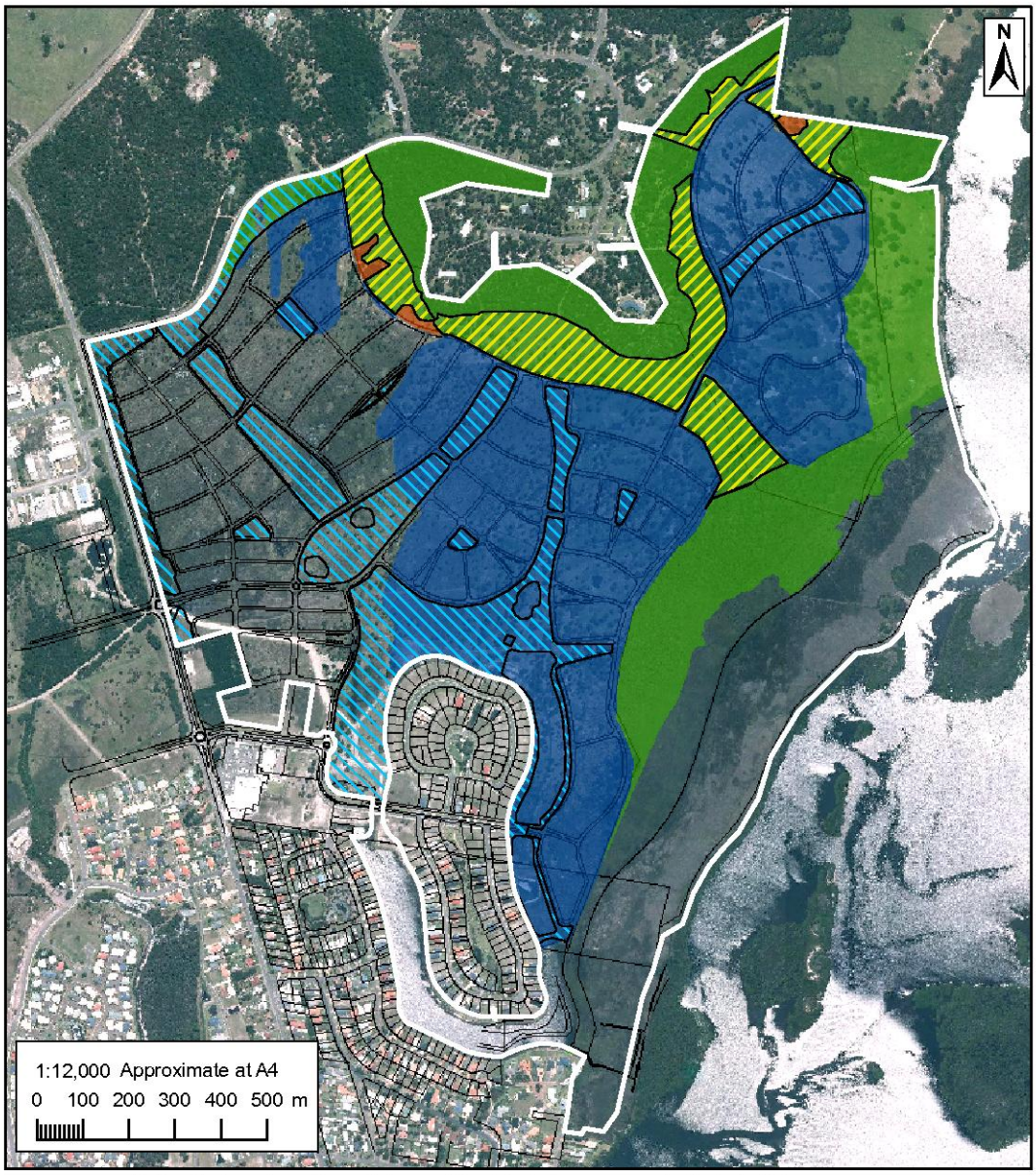
Figure A6.2
Swift Parrot Habitat
Riverside, Tea Gardens

Source: Aerial © Department of Lands (2007)



*Subject Site boundary subject to final survey. Plan for indicative purposes only. Not for detailed measurement.
Flora and fauna survey locations are approximate and have not been fixed by land survey.Original plan produced in A4 colour

Legend

- Property Boundary
- Drainage Corridor
- Habitat Improved
- Habitat Created
- Habitat Retained
- Habitat Removed

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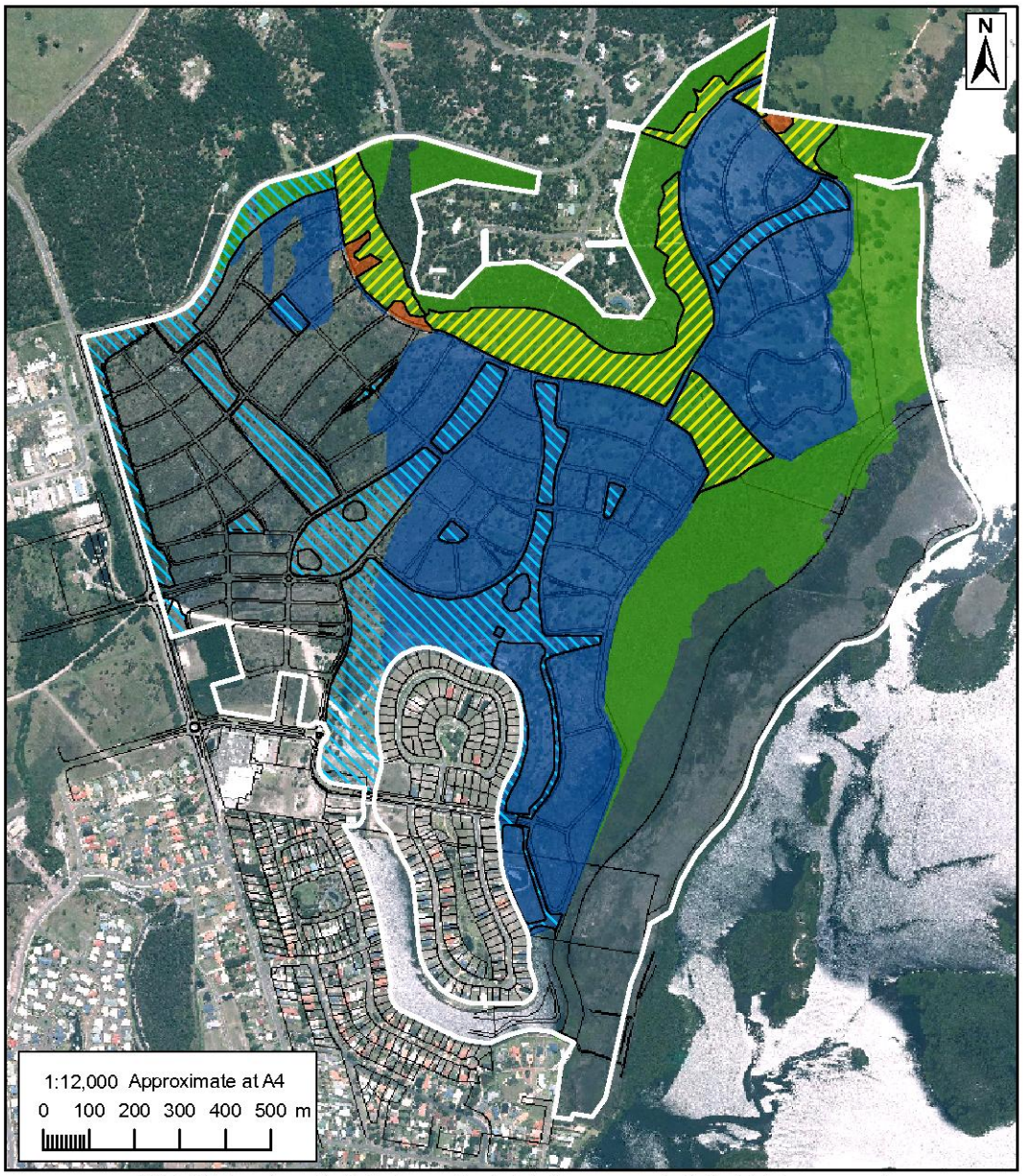
Figure A6.3

Barking Owl, Powerful Owl and Masked Owl Habitat

Riverside Tea Gardens

Source: Aerial © Department of Lands (2007)



*Subject Site boundary subject to final survey. Plan for indicative purposes only. Not for detailed measurement.
Flora and fauna survey locations are approximate and have not been fixed by land survey. Original plan produced in A4 colour

Legend

- Property Boundary
- Drainage Corridor
- Habitat Improved
- Habitat Created
- Habitat Retained
- Habitat Removed

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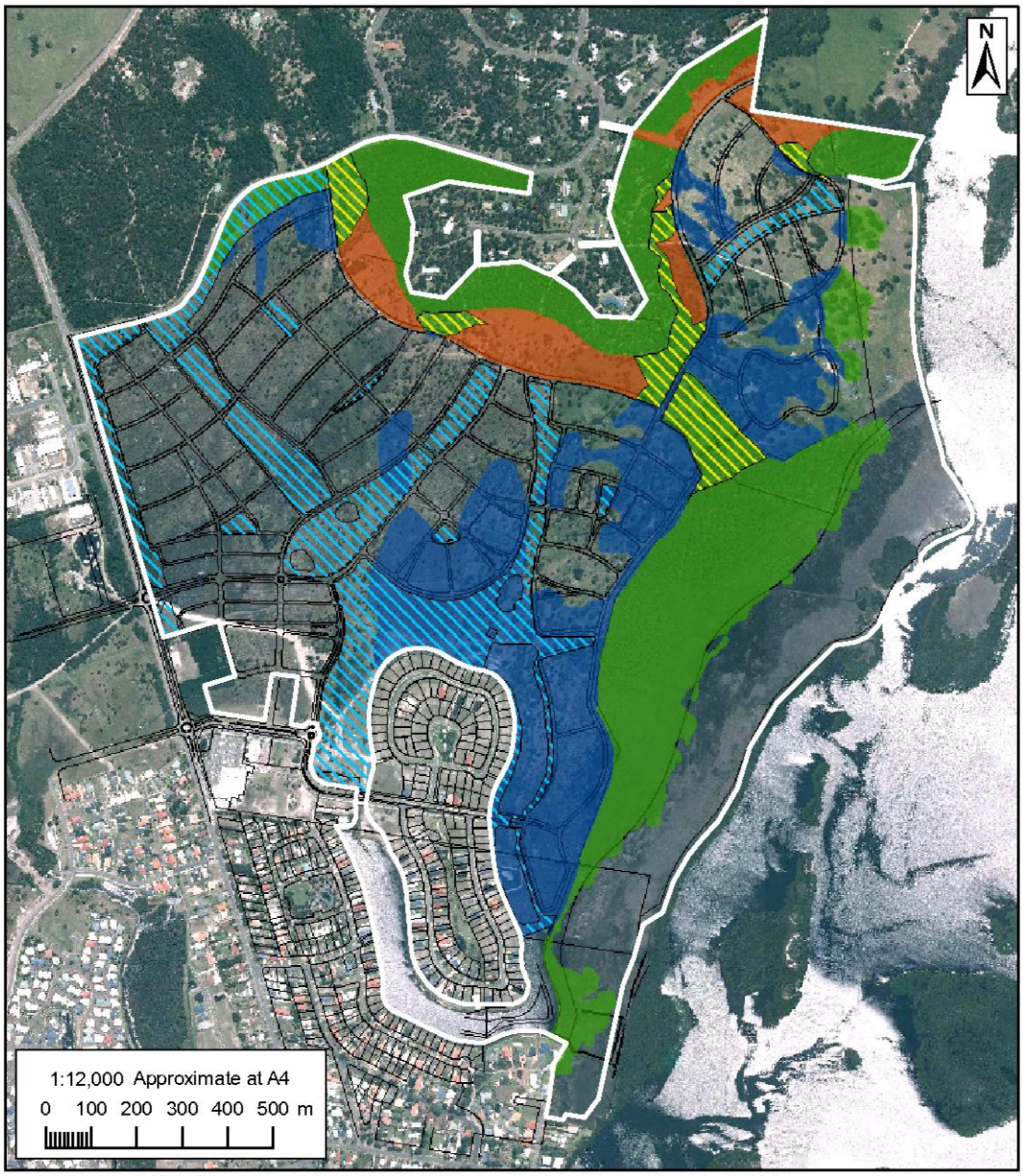
Figure A6.4
Koala Habitat
Riverside Tea Gardens

Source: Aerial © Department of Lands (2007)



*Subject Site boundary subject to final survey. Plan for indicative purposes only. Not for detailed measurement.
Flora and fauna survey locations are approximate and have not been fixed by land survey. Original plan produced in A4 colour

Legend

- Property Boundary
- Drainage Corridor
- Habitat Improved
- Habitat Created
- Habitat Retained
- Habitat Removed

conacher environmental group
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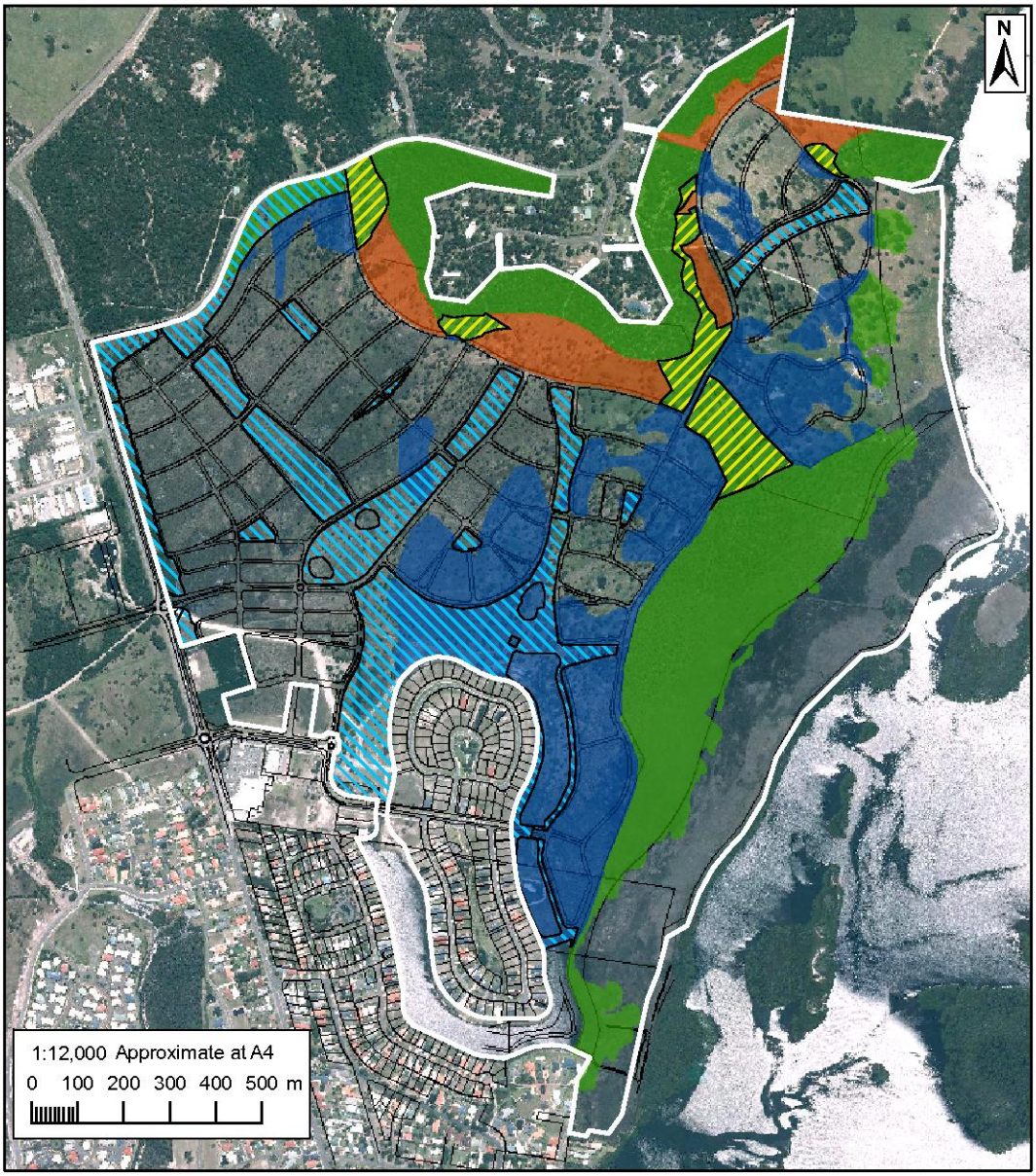
Figure A6.5

Spotted-tailed Quoll and Eastern-pygmy Possum Habitat

Riverside Tea Gardens

Source: Aerial © Department of Lands (2007)



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Property Boundary
Drainage Corridor
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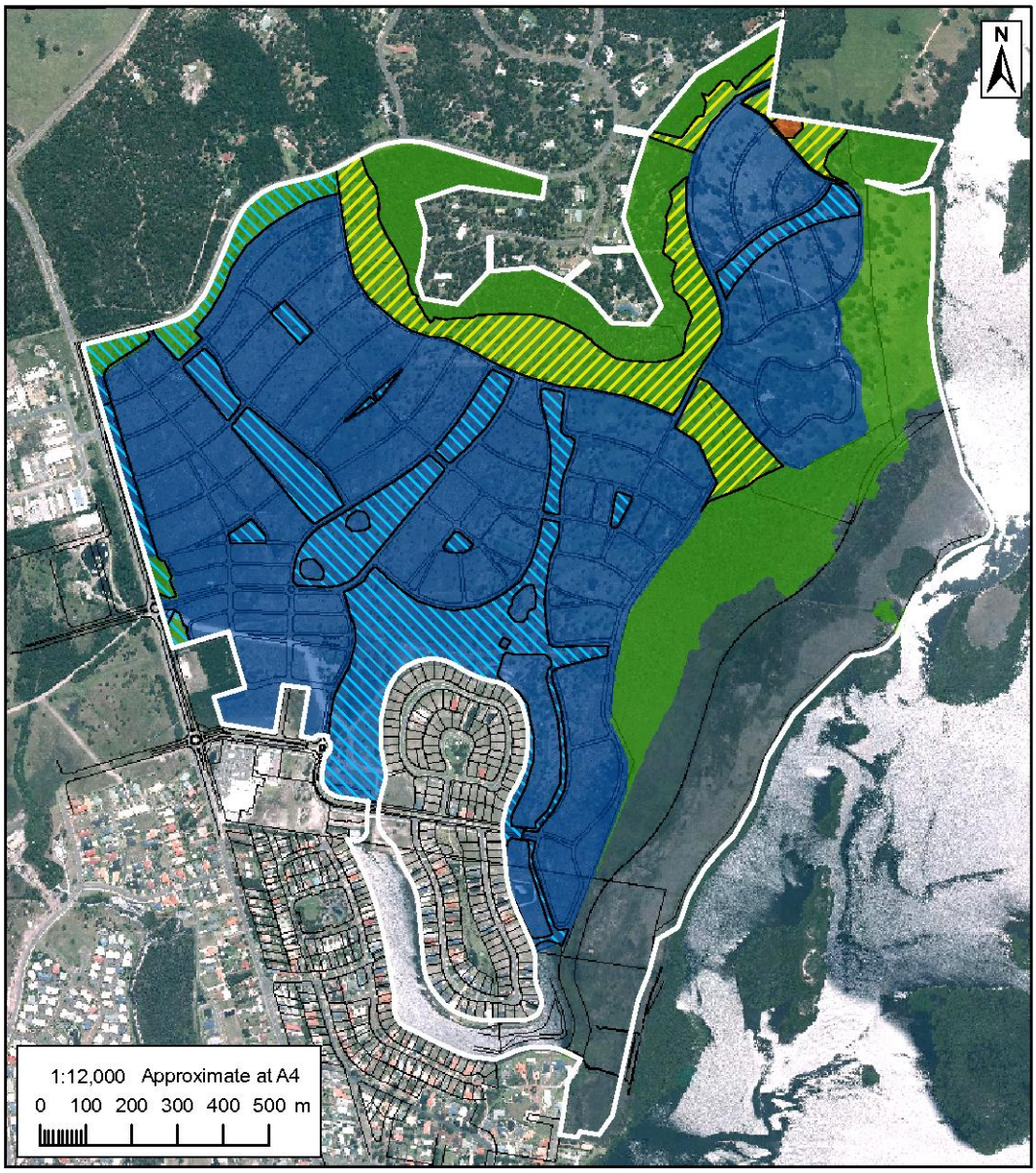
Figure A6.6
Squrriel Glider Habitat
Riverside Tea Gardens

Source: Aerial © Department of Lands (2007)



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Legend

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- Drainage Corridor
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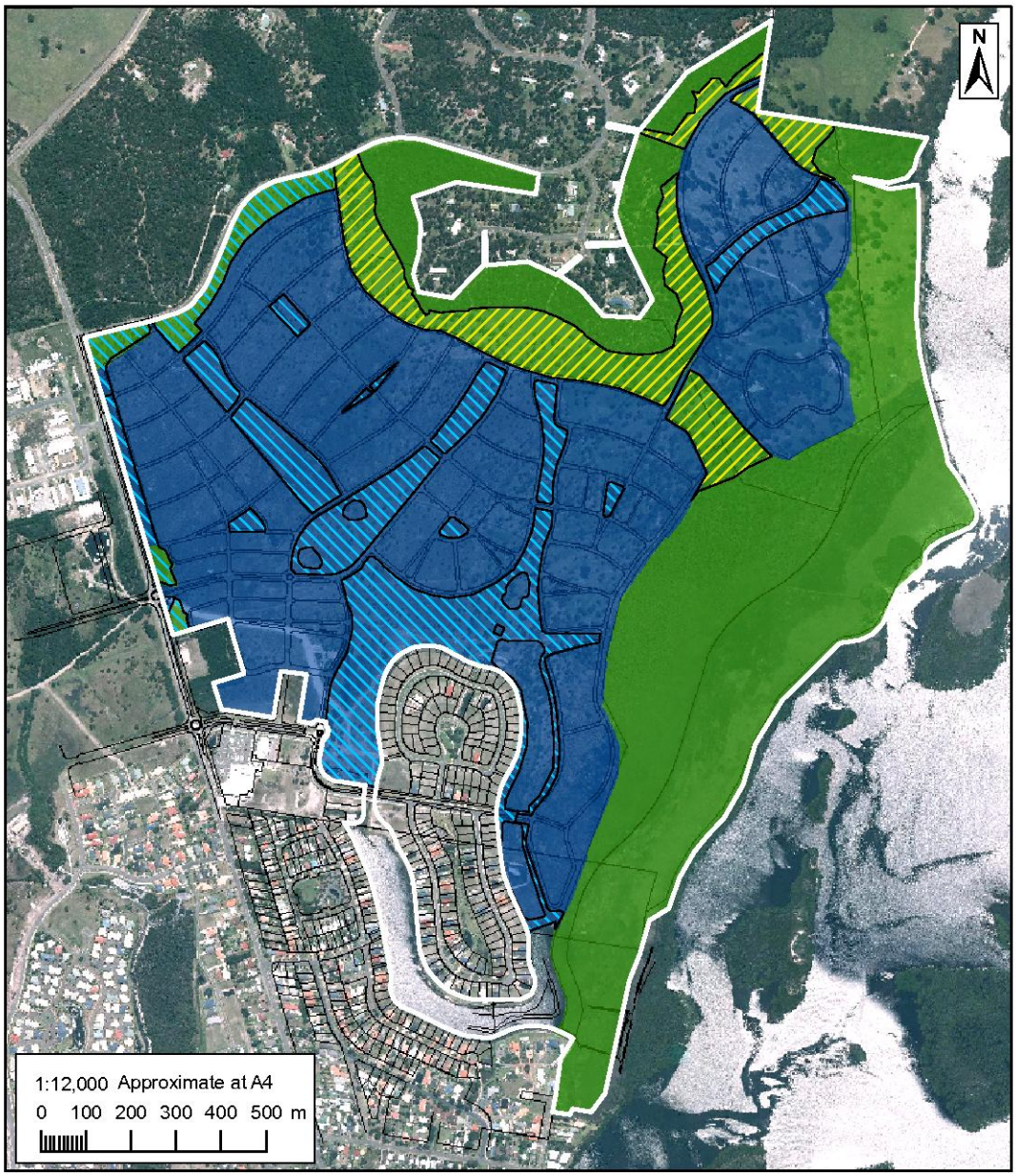
Figure A6.7
Grey-headed Flying-fox Habitat
Riverside Tea Gardens

Source: Aerial © Department of Lands (2007)



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Flora and fauna survey locations are approximate and have not been fixed by land survey. Original plan produced in A4 colour

Legend

Property Boundary
Drainage Corridor
Habitat Improved
Habitat Retained
Habitat Removed

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Figure A6.8

Threatened Microbats Habitat

Riverside Tea Gardens

Source: Aerial © Department of Lands (2007)

Volume 3B: Wetlands Assessment

HWR

07521

Wetlands Assessment for Riverside, Tea Gardens

Report to Crighton Properties

2009

HWR Pty Ltd t/as Hunter Wetlands Research (ABN 71094286147)

Versions of this Report

Version Date	Changes to Previous Version
30 Apr 07	na
4 Jul 07	Incorporate results of groundwater study; refinement of wetland vegetation map.
7 Nov 07	Incorporate latest groundwater and surface water modelling details.
8 May 08	Modify to match latest layout.
25 Jun 08	Incorporate channel widening.
29 Jul 08	Incorporate additional information on channel widening.
7 Nov 08	Incorporate modified channel connection.
10 Nov 08	Minor edits.
21 Jan 09	Incorporate additional information on modified channel connection.
22 Jan 09	Minor edits.
27 Jan 09	Minor edits.

Report Authorship

Personnel	Authorship Role	Research Role
Geoff Winning	sole author	all fieldwork, data analysis & interpretation

Author Contact Details and Background Information

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Winning G 2009, 'Wetlands assessment for Riverside, Tea Gardens', report to Crighton Properties by HWR Pty Ltd.

Wetlands Assessment for Riverside, Tea Gardens

Geoff Winning, 2009
Hunter Wetlands Research (HWR Pty Ltd)

Introduction

The proposed 'Riverside' development covers an area of 217ha, approximately 99ha of which would be developed as residential, commercial and tourism facilities. The remaining 118ha would be retained as open space parks, wildlife corridors and reserves. The reserved land includes approximately 45ha of wetlands which would be retained and protected in recognition of their local and State significance. More than half of the wetland reserve is covered by *State Environmental Planning Policy 14 - Coastal Wetlands* (SEPP 14), and virtually all of the wetland area supports ecological communities that are listed as endangered under the *Threatened Species Conservation Act 1995* (TSC Act). The proposal includes a new channel connecting the Myall Quays lake and a drain leading to the Myall River.

This report applies to the areas of land identified as the 'wetland precinct' and the 'habitat conservation precinct' in Great Lakes Council's *Development Control Plan No. 22 - Myall Quays Estate* (DCP 22). Even though DCP 22 no longer applies to the development proposal, these two precincts of DCP 22 effectively define and delineate the wetlands that are to be retained as part of the proposal. In Great Lakes Councils *Local Environmental Plan* (LEP) the wetland precinct is within 'Zone 7(a) - Wetlands and Littoral Rainforest' and the 'habitat conservation precinct' is mostly covered by 'Zone 7(b) - Conservation' (the southernmost part of the conservation buffer is within 'Zone 2(f) - Mixed Residential-Commercial').

The report complements the flora and fauna assessment prepared by Conacher Travers Pty Ltd, and focuses on wetland-specific matters. More general matters are deferred to the general flora and fauna assessment where appropriate.

Wetlands on the 'Riverside' Site

The wetlands on the site have been the subject of a specific wetlands study in 1988 (SWC, 1988), and were included in other flora and fauna studies of the whole Myall Quays site as part of the local environmental study prepared for the site (Gardner Brown Planning Consultants *et al.* 1991, Lembit 1992, Mount King Ecological Surveys 1992). In addition there have been detailed studies of parts of the wetlands (e.g. Winning 1997).

The wetlands lie on the floodplain of the lower Myall River. Those wetlands immediately adjacent to the river have strong estuarine tidal influences due to the close proximity to Port Stephens. The intertidal areas support characteristic estuarine wetland vegetation (mangroves and saltmarsh). The wetlands dominated by freshwater inputs occur on sands and their vegetation is dominated by plant species that are characteristic of sandplains of the lower north coast of New South Wales.

While the previous studies provide a good general description of the wetlands of the site, these studies are mostly quite dated now, and it was considered necessary to update these previous descriptions of the wetlands. This comprised re-mapping of the wetland vegetation through aerial photograph interpretation supported by ground-truthing undertaken during April 2007.

Wetland Vegetation Mapping Methods

Vegetation mapping is a iterative process of establishing a relationship between the spatial units and the vegetation they contain; the process of developing a map requires the mapper to link each land unit tract to the vegetation units (Thackway *et al.* 2008). Most vegetation mappers in Australia still proceed largely intuitively using qualitative techniques based on visual interpretation of aerial photography combined with substantial periods of fieldwork (Thackway *et al.* 2008).

This is the technique that was applied in this case. Visually evident spatial units on the aerial photography (identified as differences in colour and visual texture) were examined in the field to determine the vegetation present. Several examples of each type of visual pattern were examined to increase confidence in the interpretation of vegetation. Department of Lands 1996 and 2003 aerial photography and 1998 orthophotography were used. Intensive ground truthing was undertaken in April 2007. It is also important to note that the author has undertaken inspections of these wetlands on a number of occasions in the past 20 years.

The information collected on each vegetation unit is presented in Table 1, which includes a photograph of each vegetation unit to demonstrate its condition. The wetland vegetation map is presented in Figure 1.

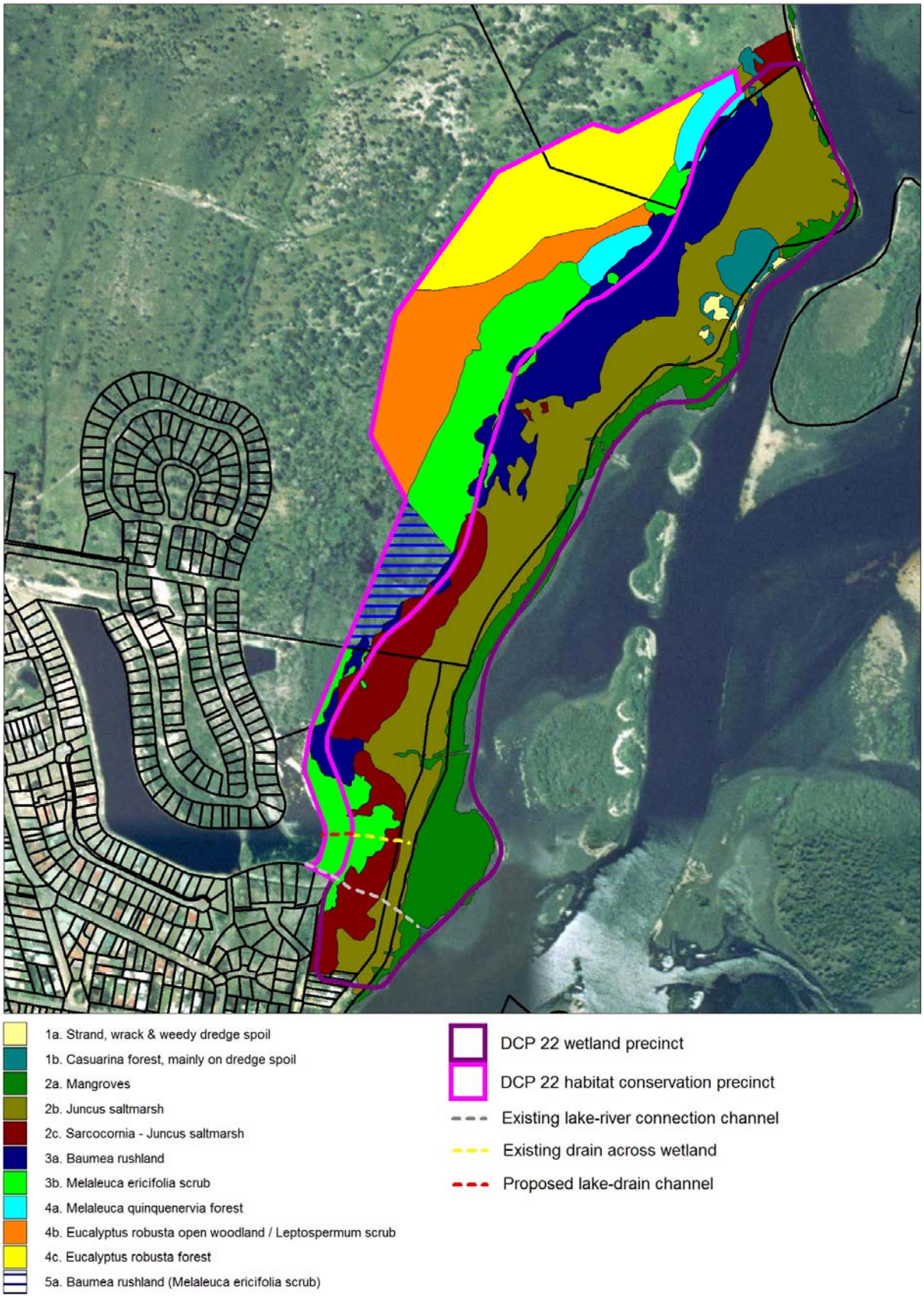
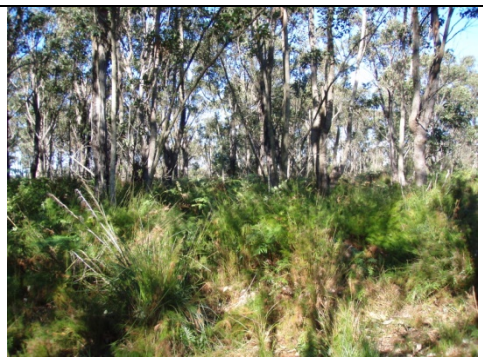


Figure 1. Wetland vegetation of the 'Riverside' site, shown in relation to DCP 22 boundaries.

Table 1. Vegetation map units defined for the 2007 wetland vegetation mapping.

1. Disturbed Estuarine Edge Communities		
1a. Strand, wrack & weedy dredge spoil		
Mapped Area:	0.32ha	
Structure:	variable - sparse grassland to open shrubland	
Characteristic Species:	*Chrysanthemoides monilifera*	
Other Main Species:	*Baumea juncea , Casuarina glauca*	
Notes:	This unit includes sandy beaches (strand), accumulated stream-borne organic litter (wrack) and areas of dredge spoil.	
1b. Casuarina forest		
Mapped Area:	1.08ha	
Structure:	low closed-forest	
Characteristic Species:	*Casuarina glauca*	
Other Main Species:	*Chrysanthemoides monilifera, Tetragonia tetragonoides, Baumea juncea, Sporobolus virginicus*	
Notes:	This unit comprises essentially monospecific stands of *Casuarina glauca,* mostly growing on dredge spoil along the river's edge.	
2. Intertidal Estuarine Communities		
2a. Mangroves		
Mapped Area:	6.28ha	
Structure:	low closed-forest to closed scrub	
Characteristic Species:	*Avicennia marina*	
Other Main Species:	*Aegiceras corniculatum, Myoporum acuminatum*	
Notes:	A variable width fringe of mangroves along the river frontage.	

2b. *Juncus* saltmarsh		
Mapped Area:	15.51ha	
Structure:	closed rushland	
Characteristic Species:	*Juncus kraussii*	
Other Main Species:	*Sporobolus virginicus, Baumea juncea, Samolus repens*	
Notes:	This is the main saltmarsh type on site, dominating most of the higher intertidal area.	
2c. *Sarcocornia* - *Juncus* saltmarsh		
Mapped Area:	5.53ha	
Structure:	open rushland, herbland	
Characteristic Species:	*Sarcocornia quinqueflora, Juncus kraussii*	
Other Main Species:	*Sporobolus virginicus, Samolus repens*	
Notes:	This map unit was defined to cover mosaic areas of several saltmarsh species which were too complex and interlocked to permit separate delineation.	
3. Brackish Communities		
3a. *Baumea* rushland		
Mapped Area:	8.04ha	
Structure:	closed rushland	
Characteristic Species:	*Baumea juncea*	
Other Main Species:	*Juncus kraussii, Sporobolus virginicus*	
Notes:	Although technically part of the saltmarsh, this community is more influenced by freshwater flows from the catchment than from tidal inundation (the latter does occur from time to time). This unit occurs in lower-lying depressions on the landward side of the saltmarsh.	
3b. *Melaleuca ericifolia* scrub		
Mapped Area:	7.04ha	
Structure:	closed scrub	
Characteristic Species:	*Melaleuca ericifolia*	
Other Main Species:	*Baumea juncea, Sporobolus virginicus*	
Notes:	This unit also occurs in lower-lying depressions on the landward side of the saltmarsh, but is further removed from tidal inundation than the previous unit, allowing the dominance of *Melaleuca ericifolia*.	

4. Freshwater Communities		
4a. *Melaleuca quinquenervia* forest		
Mapped Area:	1.46ha	
Structure:	open forest to woodland	
Characteristic Species:	*Melaleuca quinquenervia*	
Other Main Species:	*Casuarina glauca, Eucalyptus robusta, Melaleuca ericifolia*	
Notes:	Small patches of mixed forest dominated by *Melaleuca quinquenervia* occur in areas adjacent to the *Baumea* rushland where it is inferred that catchment surface flows lower the soil salinity sufficiently to give *Melaleuca quinquenervia* a competitive advantage over *Melaleuca ericifolia.*	
4b. *Eucalyptus robusta* open woodland / *Leptospermum* scrub		
Mapped Area:	5.34ha	
Structure:	low open woodland to closed scrub	
Characteristic Species:	*Eucalyptus robusta, Leptospermum juniperinum*	
Other Main Species:	*Callistemon pachyphyllus, Viminaria juncea, Melaleuca nodosa, Melaleuca sieberi, Melaleuca quinquenervia, Acacia longifolia*	
Notes:	This is a diverse community that is best described as a low open woodland of *Eucalyptus robusta* with a dense scrub understorey. *Eucalyptus robusta* is denser in the north and is very sparse towards the south.	
4c. *Eucalyptus robusta* forest		
Mapped Area:	6.34ha	
Structure:	open forest	
Characteristic Species:	*Eucalyptus robusta*	
Other Main Species:	*Melaleuca quinquenervia, Pinus elliottii*	
Notes:	This forest type occurs on areas that are inferred to support surface water for only short periods (typically no more than several weeks at a time), mainly during winter. The understorey is dominated by ferns, sedges and rainforest shrubs.	

5. Modified Communities		
5a. Baumea rushland (*Melaleuca ericifolia* scrub)		
Mapped Area:	3.25ha	
Structure:	rushland	
Characteristic Species:	*Baumea juncea*	
Other Main Species:	*Melaleuca ericifolia*	
Notes:	This unit covers an area of *Melaleuca ericifolia* scrub (map unit 3b) which has been slashed. The frequency of slashing has been sufficiently frequent to permit dominance by *Baumea juncea.* If slashing was discontinued, this areas would readily re-establish as *Melaleuca ericifolia* scrub.	

Direct Impacts on Wetland Communities

The Great Lakes LEP provides for the protection of wetlands on the site. The SEPP 14 wetlands are covered by zone 7(a) which also coincides with the DCP 22 'wetland precinct'. The broad band of freshwater wetland vegetation are covered by the DCP 22 'habitat conservation precinct', most of which is also covered by zone 7(b). The proposed 'Riverside' development is wholly outside of these areas other than for a proposed new channel between the Myall Quays lake and a drain leading to the Myall River which is within the DCP 22 'habitat conservation precinct' although this area is mostly zoned 2(f) (Figure 1).

Details of the proposed construction method and erosion and sedimentation controls have been provided separately by Tattersall Surveyors. In summary, the proposal is to excavate the channel using a dredge pump floated to the site on a small barge. This would obviate the need for the construction of a temporary access track for plant that would be required for other construction methods. The selected construction method should also minimise the risk of collateral impacts outside of the drain footprint.

Construction of this drain would result in the direct loss of approximately 150m^2 (ca. 50m x 3m) of *Melaleuca ericifolia* scrub (3b) with small patches (unmapped) of *Juncus kraussii*. However, the resultant shallow water channel would provide alternative wetland habitat. The channel construction would be included in the wetland management plan (see below).

Potential Indirect Impacts on Wetland Communities

Developments adjacent to wetlands have the potential to indirectly affect the wetland communities in a number of ways:

- changes in quantity and quality of surface and groundwater flows into the wetlands;
- human pedestrian and vehicular intrusion;
- general 'edge effects', including:
  - predation of native fauna by domestic cats and dogs,
  - 'light spill' of street lights which can affect the behaviour of native animals,
  - dumping of rubbish and garden refuse,
  - 'weed creep' from lawn grasses, etc.,
  - mowing of wetland margins.

The general edge effects are applicable to all types of remnant habitats and have been addressed by the general flora and fauna assessment. The first two matters raise issues are specific to wetlands and are addressed below.

Surface and Groundwater Flows into the Wetlands

Quantity of Flows

Influences on Surface and Groundwater Quantity

Urban developments have more 'hard' impermeable surfaces than the natural communities that they replace and, as a result, there is typical a greater of quantity of stormwater flowing from developed areas. If these flows are directed into adjoining wetlands, the increased wetness can alter vegetation and habitats by giving a greater competitive advantage to plants that tolerate wetter conditions. Conversely, retaining the stormwater in some manner (e.g. in rainwater tanks) can lead to drier conditions in the adjoining wetland, again potentially altering the vegetation and habitats.

This issue is compounded on sites with highly permeable soils (e.g. sandy soils) such as the 'Riverside' site. On these soils, infiltration of rainwater into the soil forms a groundwater table, the height of which at any time is determined by the quantity of infiltrated rainwater. Thus, measures to manage surface water flows by, for example, detention ponds can affect the groundwater by influencing the quantity of infiltration.

There is, therefore, a complex link between surface water and groundwater quantity on the 'Riverside' site, and the modelling and management of both are integrally linked.

Potential Effects of Changes in Surface and Groundwater Quantity on Wetlands

Based on current scientific knowledge it is not possible to quantitatively model the potential effects of changes in groundwater quantity on the wetland communities. Rather, it is necessary to make qualitative judgements based on empirical knowledge.

The factors which determine the distribution of saltmarsh and the other wetland communities present on the 'Riverside' site are poorly understood, especially the influence of groundwater. It is generally accepted that soil salinity and water-logging are two major influences on estuarine vegetation but other factors, such as competition, also have an effect. Water-logging is also a major influence on the adjoining freshwater wetland types, and soil chemistry is another important influence, especially acidity and nutrient levels.

While chemistry (water quality) is more specifically addressed below, there is an inextricable link between water quantity and salinity in estuarine wetlands. As with most estuarine wetlands, the salinity of water and soil in the Myall River wetlands is influenced by tidal flows from the river, which have a varying salinity, and freshwater catchment flows, both surface and subsurface. Changes in the quantity of catchment flows can affect the salinity of water and soils in the estuarine wetlands. An increase in catchment flows can lead to lowering of salinity and a decrease in catchment flows can lead to an increase in salinity. Such changes in salinity can result in changes to the distribution of the various wetland communities.

In addition, changes in catchment flows, both surface and subsurface, can affect the hydroperiod of a wetland - the frequency and duration of inundation and/or the height and variability of the groundwater table. Changes in wetness can give different plant species a competitive advantage.

It is important to note that surface water flows and groundwater levels are both naturally highly variable, and it is the 'average' influence that must be considered. In this context, relatively minor changes in groundwater levels are likely to be inconsequential with respect to the overall variability. However, persistent changes, even minor ones, such as a permanent decrease in average groundwater level, can lead to changes in vegetation.

By way of example, a decrease in quantity of catchment flows into the wetlands would be likely to lead to a gradual increase in salinity in the estuarine wetlands, and a gradual expansion of these at the expense of adjoining communities, such as *Melaleuca ericifolia* scrub. There would also be a change in the distribution of the various estuarine communities, such as an increase in the area of *Sarcocornia - Juncus* saltmarsh, which is more competitive in drier conditions. Conversely an increase in catchment flows would lead to a reduction in salinity and an increase in wetness. Likely changes would be the expansion of *Melaleuca ericifolia* scrub into existing saltmarsh areas, and a reduction in the area of *Sarcocornia - Juncus* saltmarsh.

Modelled Impacts on Surface and Groundwater Quantity

Detailed modelling of the existing groundwater conditions has been undertaken by Coffey Geotechnics (2007), and this model has been used to predict the potential changes in groundwater levels that are likely to result from the proposed development. The predicted changes, as interpreted from the Coffey report, with respect to wetlands on the site are shown in Figure 2. As can be seen from Figure 2, the extension of the existing constructed lake would result in a substantial drawdown of average groundwater levels over much of the site, but the wetlands are essentially unaffected by this drawdown.

Detailed modelling of the existing surface water conditions has been undertaken by Cardno Willing (2008), and this model has been used to predict the potential changes in surface water flows that are likely to result from the proposed development.

Cardno Willing (2008, appendix D5) found that the past construction of east-west drains has diverted historical north to south surface water flows across the site in an easterly direction into the wetlands. This historical change was quantified as an increase to an annual average of approximately 704 ML/yr from an annual average of approximately 148 ML/yr. It is important to note that these are average values and that the actual runoff into the wetlands would vary from year to year, and would be sporadic during any year.

Under the proposed post-development conditions the average annual runoff into the wetlands would be approximately 480ML/yr. This represents a reduction from existing flows. However, this is unlikely to have a noticeable impact on the wetland vegetation, as this vegetation is predominantly determined by groundwater levels, which are predicted not to change substantially on all but a small part of the wetlands (Coffey Geotechnics 2007), as discussed above.

While urban developments have historically led to concentrated stormwater flows via pipes into adjoining wetlands or creeks the surface water flows for the proposed Riverside layout have been designed to mimic the existing surface flows, in part by providing for a diffuse input along the edge of the habitat conservation precinct (Cardno Willing 2008). This, combined with the various measures to manage the quantity of runoff, should ensure, as far as can be reasonably predicted, that surface water flows from the proposed development do not adversely affect the adjoining wetlands.

Quality of Flows

Influences on Surface and Groundwater Quality

Both the estuarine and freshwater wetlands on the site are subject to surface flooding (tidal and flood inundation from the river, and stormwater flows from the catchment). However, the dominant chemical influence on the wetlands is the quality of the groundwater, largely because any surface water flooding quickly infiltrates through the sandy soil, and the groundwater is always present. Indeed, it is fluctuations in the ground water level that largely determines whether surface water is present in the wetlands from time to time.

The groundwater chemistry at the ‘Riverside’ has been described by Coffey Geosciences (2004) and Coffey Geotechnics (2007). Key characteristics from these report are:

- salinity is related to proximity to the Myall River, with sites close to the river having a higher salinity;
- groundwater is slightly acidic - pH 5 to 6 (one site approximately 4);
- levels of macronutrients (nitrogen and phosphorus) are generally low.

These chemical characteristics are typical of this type of wetland system. The salinity is directly influenced by tidal water from the Myall River, which infiltrates into the groundwater. The acidic conditions probably derive from humic acids leached from surface and subsurface organic matter by infiltrating stormwater. The low levels of macronutrients are a result of the sandy soil on the site and in the catchment - sands do not generally have the surface electrical charges that bind phosphorus, and other chemicals as clay particles do.

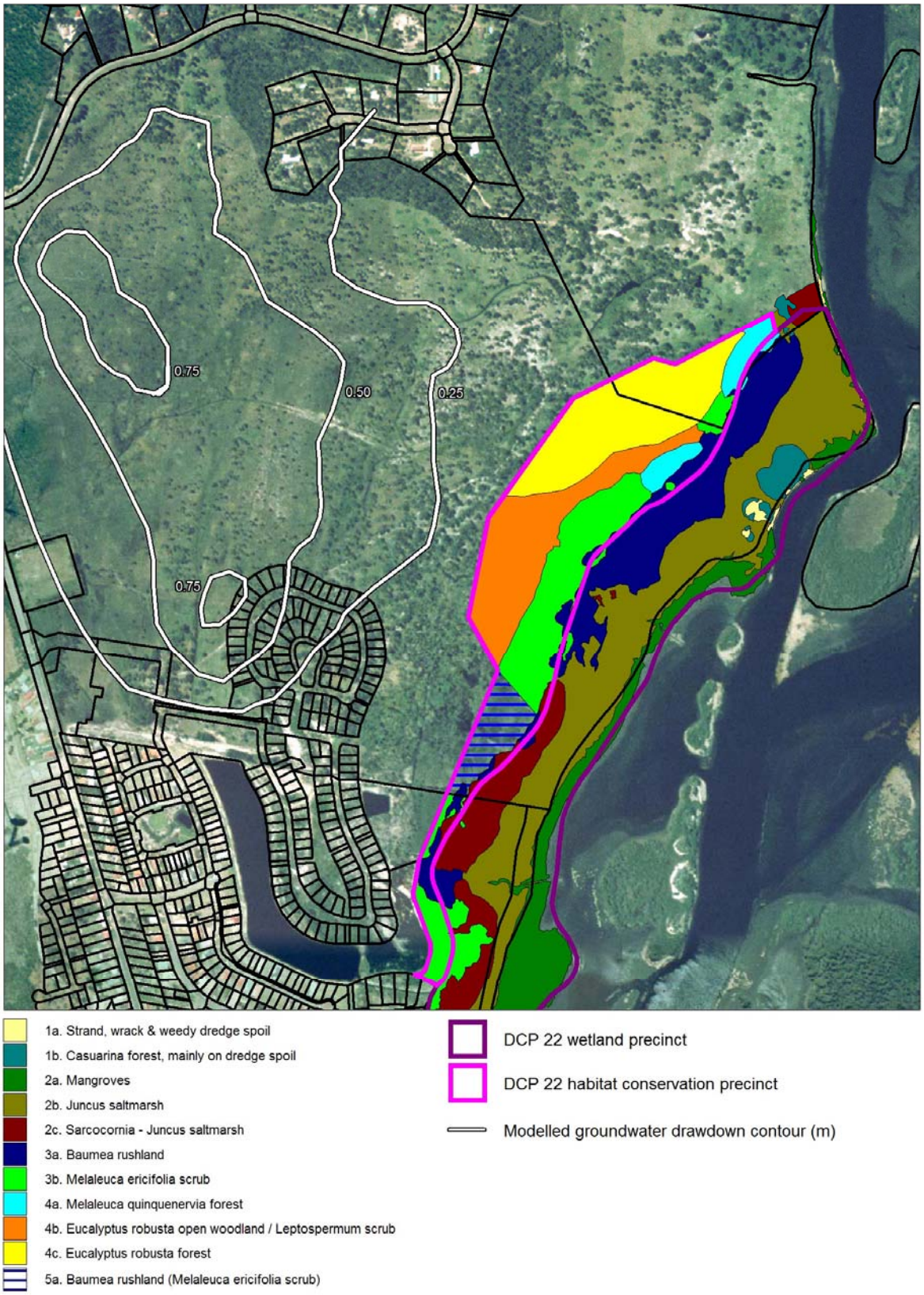


Figure 2. Modelled groundwater changes (Coffey 2007) relative to wetland vegetation.

The combination of this chemistry with the wetland's hydroperiod is probably the major determinant of the vegetation communities present and, to some extent, the site's fauna assemblage.

The main influence on chemistry of surface flows is as a source of substances that may end up in the groundwater through infiltration. Therefore, as with the quantity of water, there is an integral relationship between groundwater quality and surface water quality.

Potential Effects of Changes in Surface and Groundwater Quality on Wetlands

Development on the site could influence groundwater quality by changing the quality of surface water. Changes in quantity of water infiltrating can also influence chemistry, especially salinity, as discussed above.

The most likely potential changes in water quality resulting from urban development are a reduction in groundwater acidity (i.e. an increase in pH), and an increase in macronutrients. Urban stormwater runoff tends to be circum-neutral (ca. pH 7), and discharge of such water into a naturally acidic system can dilute the acids and lead to an increase in pH. If this dilution is sufficient to raise the pH of the groundwater to around neutral, these conditions would give a competitive edge to plant species (and some animal species) that are presently outcompeted by acidophilic plant species. This would result in changes to the wetland communities.

Levels of macronutrients in stormwater runoff from urban areas are characteristically high relative to undeveloped conditions. These elevated nutrient levels derive from a number of potential sources, including:

- fertilisers used on lawns and gardens;
- top soil and other introduced soils with a high clay or silt content;
- organic particulates, such as from leaf mulch;
- dumped organic matter, including lawn clippings, and bread and grain fed to waterbirds;
- faeces of domestic dogs and cats;
- detergents from car washing, etc.

As with changes in pH, an increase in macronutrients levels can give a competitive advantage to plant species that are presently not abundant or are absent. In extreme cases, very high levels of macronutrients can lead to eutrophication of surface waters - copious growth of algae and macrophytes, the decomposition of dead litter from which can lead to depleted oxygen levels and death of aquatic fauna.

Modelled Impacts on Surface and Groundwater Quality

Both the surface water modelling (Cardno Willing 2008) and the groundwater modelling (Coffey Geotechnics 2007) predict a reduction in pollutant loads (suspended solids, total nitrogen, total phosphorus) in water flowing into the wetlands. This is the result of the integrated water management scheme proposed by (Cardno Willing 2008) which includes measures to intercept and treat potentially polluted surface water runoff. Accordingly, there should be no impact on the wetlands resulting from the modelled pollutants.

The reduction of surface flows into the wetland, and the consequent increase in influence of lower pH groundwater flows, should obviate any potential reduction in acidity that may affect vegetation and 'wallum' fauna species.

Human Intrusion into Wetlands

Uncontrolled access into wetlands has the potential to impact the wetlands through trampling of vegetation, dumping of rubbish, etc. However, it is considered important to encourage controlled access into the wetlands to increase public appreciation of wetlands and their flora & fauna, as well as to discourage undesirable activities through increased public visibility of natural areas. Accordingly, the wetland management plan should include details of proposed access points, tracks, boardwalks, interpretation facilities, and measures to limit access into other areas.

Conclusions

The Riverside development has been planned and designed so as to avoid direct and indirect impacts on the wetlands. The only direct impact would be the required widening of the lake - river connection channel which would result in the loss of approximately 150m^2 of wetland vegetation (*Melaleuca ericifolia* scrub), although the resultant shallow water channel would provide alternative wetland habitat. The stormwater management design for the site should effectively prevent water borne impacts via both surface water and groundwater.

A wetland management plan would be prepared that would include:

- measures to mitigate the impacts that may arise from the construction of the connection channel;
- a description of measures to be adopted to rehabilitate any areas disturbed during construction such as for the new connection channel, including confirmation of levels, planting &/or propagule placement, etc.;
- measures to control human access into wetland areas;
- a monitoring program to confirm that the proposed development and associated works do not have adverse effects on the wetlands;
- an adaptive management framework that can permit response to any unanticipated impacts on the wetlands.

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APPENDIX 1 - Standard Report Interpretation

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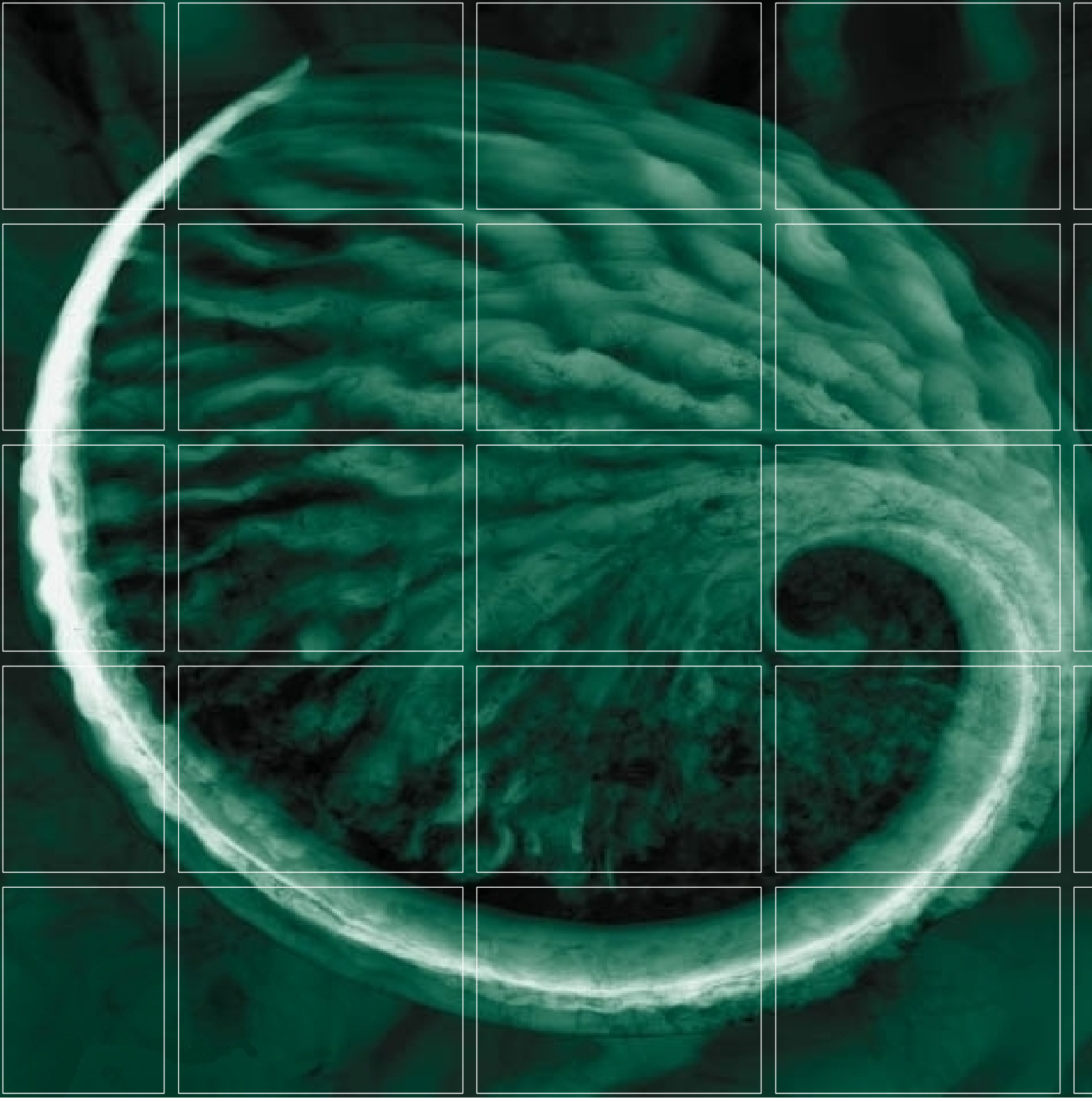
The current knowledge of the ecology of most flora and fauna species is poor. As a consequence, there are often insufficient data to fully objectively assess potential consequences of a proposal for most species. Therefore, ecological assessments typically rely to some extent on professional opinion or judgements based on the personal knowledge of the ecological consultant, investigations undertaken specifically for the proposal, and/or data derived from previous studies (i.e. literature sources). In scientific jargon, such subjective judgements are hypotheses or 'likely' explanations based on the experience of the consultant. These hypotheses are often quite accurate (because of the extensive experience of the consultant) but they nevertheless remain subjective opinions unless tested scientifically. Where possible, HWR seeks to test hypotheses using scientifically sound methods. That is, HWR undertakes studies designed to replace subjective judgements with objective data. However, this is not feasible for many of the issues covered by most ecological assessments due to various constraints, and it is therefore necessary to rely on opinion in parts of the assessment. In keeping with our position that the authors of ecological assessments should be accountable for their opinions, the authors responsible for HWR's reports are clearly stated.

(iii) Independence

Due to the reliance of ecological assessments on professional opinion, they unavoidably reflect the experiences and attitudes of the authors to some extent. Such personal 'bias' cannot be avoided where people are involved in any process. However, the advice provided should be independent. That is, the conclusions of a study should be the same regardless of who the client was. While others may disagree with opinions expressed in HWR's reports, the opinions are independent and represent the best advice of the authors based on the available data.

It is common practice for a client to modify their proposal in response to information supplied by the ecological consultant in order to avoid excessive ecological impact. This typically results in an ecological assessment report that supports the final proposal, which is the considered opinion of the authors but it is in no way adversarial on behalf of the client.

Volume 3B: Aboriginal Heritage Assessment



Riverside at Tea Gardens

Aboriginal Heritage Assessment

For Crighton Properties Pty Ltd

August 2008

0043707 Final

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Riverside at Tea Gardens

Aboriginal Heritage Assessment

For Crighton Properties Pty Ltd

August 2008

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Approved by:	*Steve O'Connor*
Position:	Principal Consultant
Signed:	
Date:	*25 August 2008*

Environmental Resources Management Australia Pty Ltd Quality System

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CONTENTS

1	*INTRODUCTION*	
1.1	*ASSESSMENT AIM AND OBJECTIVES*	*1*
1.2	*STUDY AREA AND PROJECT BACKGROUND*	*1*
1.3	*PROJECT TEAM*	*3*
2	*RELEVANT LEGISLATION*	
2.1	*NATIONAL PARKS AND WILDLIFE ACT 1974 (NSW)*	*4*
2.2	*ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 (NSW)*	*4*
2.3	*ABORIGINAL AND TORRES STRAIT ISLANDER HERITAGE PROTECTION ACT 1984 (COMMONWEALTH)*	*5*
3	*BACKGROUND*	
3.1	*ENVIRONMENTAL CONTEXT*	*6*
3.1.1	*GEOMORPHOLOGY AND LANDFORMS*	*6*
3.1.2	*GEOLOGY AND SOILS*	*6*
3.1.3	*DRAINAGE*	*8*
3.1.4	*LAND USE AND DISTURBANCE*	*9*
3.1.5	*FLORA AND FAUNA*	*9*
3.2	*ARCHAEOLOGICAL CONTEXT*	*9*
3.2.1	*AHIMS RESULTS*	*10*
3.2.2	*PREVIOUS LOCAL STUDIES*	*10*
3.2.3	*REGIONAL ARCHAEOLOGICAL CONTEXT*	*12*
3.3	*PREDICTIVE MODEL OF SITE LOCATION*	*13*
4	*CONSULTATION*	
5	*METHODOLOGY*	
5.1	*SURVEY STRATEGY*	*16*
5.2	*SURVEY COVERAGE*	*16*
5.3	*SURVEY LIMITATIONS*	*17*
6	*SURVEY RESULTS*	
6.1	*SURVEY COVERAGE*	*18*
6.2	*MIDDEN SITE – 38-5-0148*	*18*
6.3	*MIDDEN SITE - RIVERSIDE01*	*18*
6.4	*POTENTIAL ARCHAEOLOGICAL DEPOSIT*	*20*
6.5	*IMPACT ASSESSMENT*	*21*
7	*SIGNIFICANCE ASSESSMENT*	
7.1	*ASSESSMENT OF ABORIGINAL ARCHAEOLOGICAL SIGNIFICANCE*	*23*

CONTENTS

8	*MANAGEMENT MITIGATION MEASUREMENTS*	
8.1	*IMMEDIATE ACTION (RIVERSIDE_01)*	*25*
8.2	*OTHER RECOMMENDATIONS (AGREED WITH KARUAH LALC)*	*25*
REFERENCES		

LIST OF ANNEXES

ANNEX A	*ARCHAEOLOGY SURVEY AT TEA GARDENS NSW, BRAYSHAW 1988*
ANNEX B	*CONSULTATION LOG*
ANNEX C	*CONSULTATION RESPONSES*

LIST OF FIGURES

		Follows Page No.
FIGURE 1.1	*LOCALITY PLAN*	*1*
FIGURE 1.2	*CONCEPT PLAN*	*2*
FIGURE 3.1	*AHIMS SEARCH RESULTS*	*10*
FIGURE 5.1	*SURVEY LOCATIONS*	*16*
FIGURE 6.1	*LOCATION OF RIVERSIDE_01*	*18*
FIGURE 6.2	*CONCEPT PLAN SHOWING BUFFER TO RIVERSIDE_01*	*21*

1 INTRODUCTION

Environmental Resources Management Australia (ERM) was commissioned by Crighton Properties Pty Ltd to prepare an environmental assessment to accompany an application under Part 3A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) for the proposed Riverside mixed use development at Tea Gardens NSW. This report provides an assessment of the potential impacts to Aboriginal heritage arising from the proposed development.

1.1 ASSESSMENT AIM AND OBJECTIVES

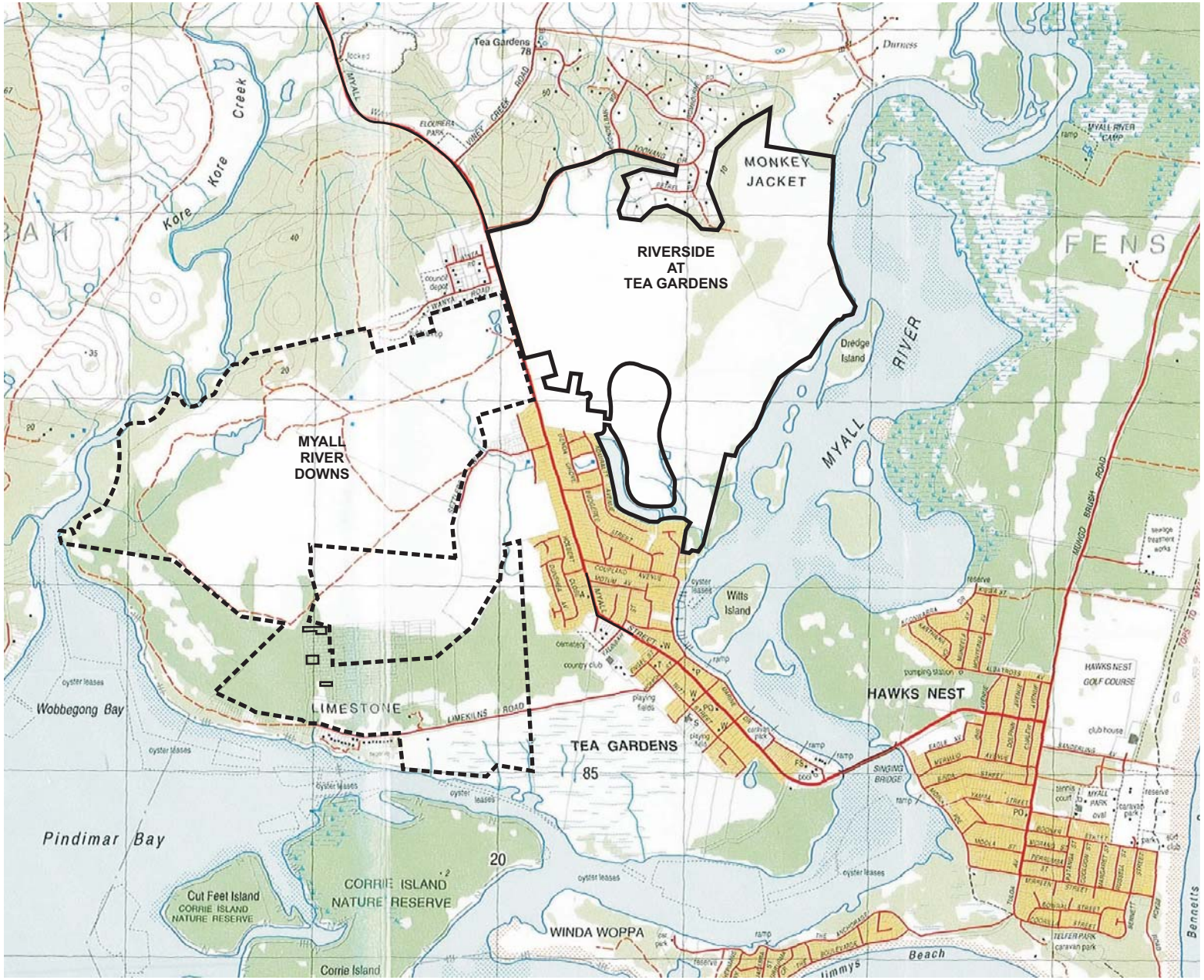
The overall aim of this assessment was to identify whether there are any Aboriginal heritage constraints to the proposed development. In order to achieve this aim, the following objectives were established:

- to review the environmental, historical and archaeological context of the study area;
- to ascertain the history of disturbance in the study area;
- to undertake a search for recorded Aboriginal sites in the local area;
- to consult with the Aboriginal community in regard to the social significance of the study area and any Aboriginal sites/objects incorporated within its boundaries;
- to undertake a field investigation of the survey area in conjunction with members of the Aboriginal community in order to identify and record any Aboriginal sites/objects present;
- to assess the impact of the proposed development on known Aboriginal sites; and
- to prepare recommendations on the management of Aboriginal heritage sites in consultation with the local Aboriginal community.

1.2 STUDY AREA AND PROJECT BACKGROUND

The Riverside study area is located within the Great Lakes local government area (LGA) on the Mid North Coast and incorporates Lot 1 DP 270100, Lot 10 DP 270100, Lot 19 DP 270100, Lot 30 DP 270100 and Lot 38 DP 270100.

It is approximately 229 hectares in area and has approximately a one kilometre frontage to Myall Street and a two kilometre frontage to the Myall River (see *Figure 1.1*). The Shearwater Residential Estate lies to the north of the study area and residential development of Tea Gardens is to the south.



Legend

Riverside at Tea Gardens
Site Boundary

Figure 1.1

Locality Plan

Client:	Crighton Properties Pty Ltd		
Project:	Environmental Assessment Riverside at Tea Gardens - Archaeology Assessment		
Drawing No:	0043707hv_EA_river_arch_01		
Date:	02/07/08	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JW
Source:	1:25,000 Topo Series Port Stephens Sheet		
Scale:	Refer to Scale Bar		

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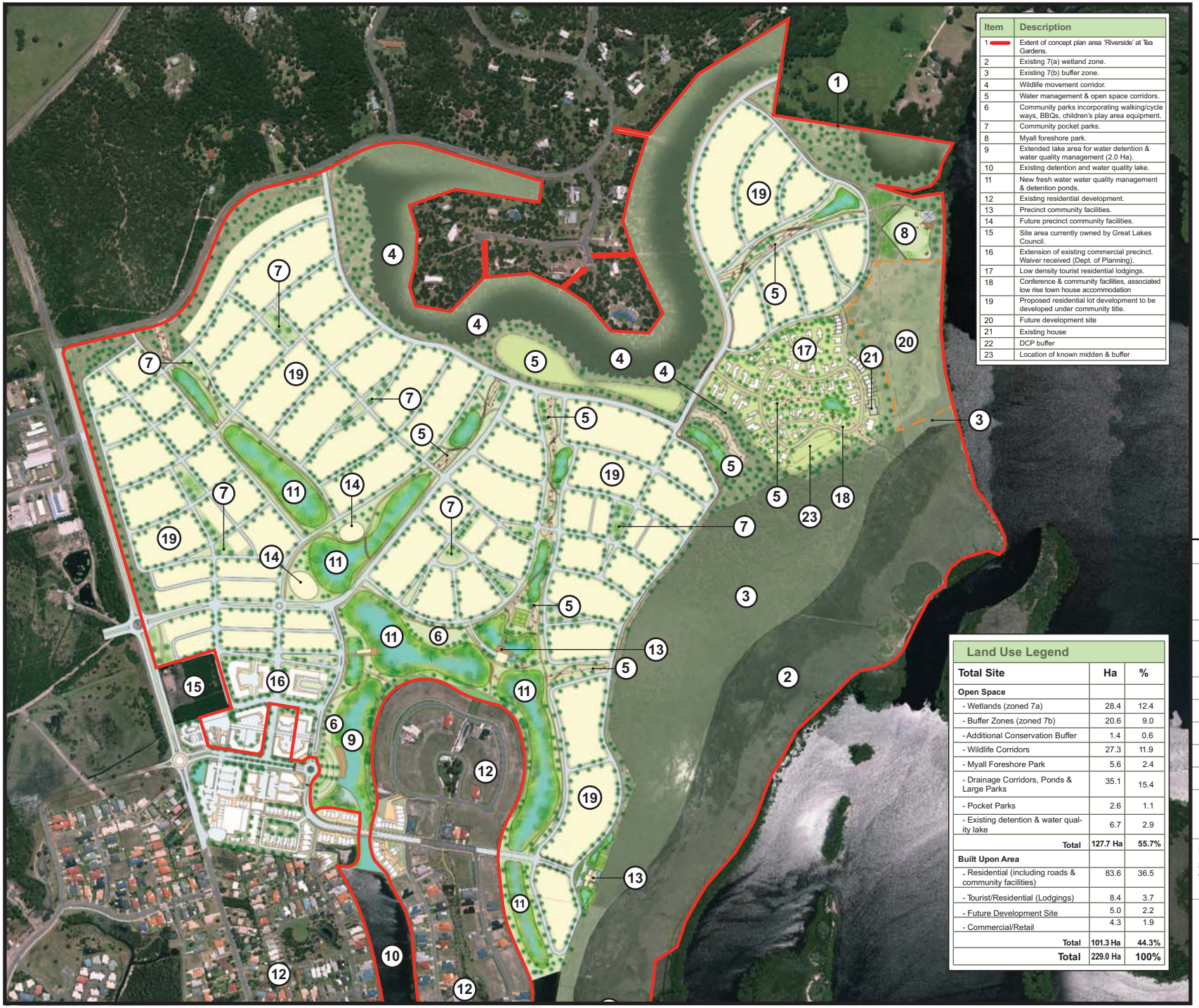
State Environmental Planning Policy No. 14 – Coastal Wetlands (SEPP 14) applies to wetlands within the eastern section of the study area adjacent to the Myall River. These wetlands, together with a significant buffer were clearly identified and zoned for environment protection when the site was rezoned in 2000 and will be conserved within the proposed development. The remainder of the study area is zoned for mixed-use urban development.

The proposed development consists of a mixed use over the majority of the site (see *Figure 1.2*). Concept Plan approval is sought for the following:

- residential development of the site (covering approximately 85 hectares), which will include the potential to create 1045 dwellings;
- an extension of the existing town centre on the north side of Shoreline Drive to accommodate a range of uses including additional retail and commercial uses, a child care and a motel (approximately 4 hectares);
- water sensitive urban design (WSUD) measures including a two hectare extension of the existing detention lake, the creation of three new freshwater detention ponds and numerous additional basins surrounded by parklands and the widening of the existing drainage channel between the detention lake and the Myall River to facilitate water quality management;
- an open space network comprising approximately 127 hectares in total which provides for public recreation, stormwater management and a wildlife corridor, and clubhouse and community facilities;
- an 8 hectare tourist/residential precinct (including a conference centre and accommodation) in the north east portion of the site and a foreshore park of 7.6 hectares;
- substantial areas (approximately 27 hectares) of the Residential 2(f) zoned land are proposed to be protected and enhanced as open space / wildlife movement corridors, over and above those already protected within the Environmental Protection 7(a) and 7(b) zones (which comprise approximately 28 and 20 hectares respectively);
- approximately 35 hectares of drainage reserves and large parks are also proposed;
- upgrading of intersections and associated road works and other construction works (such as cycleways) external to the site;
- access from Toonang Drive and Myall Street;
- an internal road network; and
- associated landscaping and infrastructure works.

Project approval is sought for Stages 1 to 9 and relates to Lot 1 DP 270100, Lot 19 DP 270100, Lot 30 DP 270100 and part of Lot 38 DP 270100.



Item	Description
1	Extent of concept plan area 'Riverside' at Tea Gardens.
2	Existing 7(a) wetland zone.
3	Existing 7(b) buffer zone.
4	Wildlife movement corridor.
5	Water management & open space corridors.
6	Community parks incorporating walking/cycle ways, BBQs, children's play area equipment.
7	Community pocket parks.
8	Myall foreshore park.
9	Extended lake area for water detention & water quality management (2.0 Ha).
10	Existing detention and water quality lake.
11	New fresh water water quality management & detention ponds.
12	Existing residential development.
13	Precinct community facilities.
14	Future precinct community facilities.
15	Site area currently owned by Great Lakes Council.
16	Extension of existing commercial precinct. Waiver received (Dept. of Planning).
17	Low density tourist residential lodgings.
18	Conference & community facilities, associated low rise town house accommodation
19	Proposed residential lot development to be developed under community title.
20	Future development site
21	Existing house
22	DCP buffer
23	Location of known midden & buffer

Land Use Legend

Total Site	Ha	%
Open Space		
- Wetlands (zoned 7a)	28.4	12.4
- Buffer Zones (zoned 7b)	20.6	9.0
- Additional Conservation Buffer	1.4	0.6
- Wildlife Corridors	27.3	11.9
- Myall Foreshore Park	5.6	2.4
- Drainage Corridors, Ponds & Large Parks	35.1	15.4
- Pocket Parks	2.6	1.1
- Existing detention & water quality lake	6.7	2.9
Total	**127.7 Ha**	**55.7%**
Built Upon Area		
- Residential (including roads & community facilities)	83.6	36.5
- Tourist/Residential (Lodgings)	8.4	3.7
- Future Development Site	5.0	2.2
- Commercial/Retail	4.3	1.9
Total	**101.3 Ha**	**44.3%**
Total	**229.0 Ha**	**100%**

Legend

Riverside at Tea Gardens Site Boundary

Figure 1.2

Concept Plan for Riverside at Tea Gardens

Client:	Crighton Properties Pty Ltd		
Project:	Environmental Assessment Riverside at Tea Gardens - Archaeology Assessment		
Drawing No:	0043707hv_EA_arch_02		
Date:	02/07/08	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JW
Source:	Crighton Properties Concept Plan		
Scale:	Refer to Scale Bar		

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0 200 400m

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1.3 PROJECT TEAM

Jenna Lamb and Joanne Woodhouse (ERM Archaeologists) conducted the Aboriginal consultation and authored the report. Dr Diana Neuweger and Guadalupe Cincuinnegi (ERM Archaeologists) completed the field surveys and Oona Nicolson (ERM Principal Heritage Consultant) completed the technical review of the background research and predictive model.

2 *RELEVANT LEGISLATION*

Aboriginal cultural heritage in NSW is protected by the *National Parks and Wildlife Act 1974*. Land managers are required to consider the effects of their activities or proposed development on the environment under several pieces of legislation, principally the *Environmental Planning & Assessment Act 1979*. Cultural heritage, which includes Aboriginal heritage, is subsumed within the definition of "environment". Commonwealth legislation protecting Aboriginal heritage may also apply to Aboriginal heritage places in NSW in certain circumstances. Key legislation is summarised below.

2.1 *NATIONAL PARKS AND WILDLIFE ACT 1974 (NSW)*

All Aboriginal objects within the state of New South Wales are protected under Section 90 of the *National Parks and Wildlife Act 1974* (NPW Act).

Under Section 5 of the Act, "Aboriginal Object" means any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

Sites of traditional significance that do not necessarily contain archaeological materials may be gazetted as "Aboriginal places" and are protected under Section 84 of the Act. This protection applies to all sites, regardless of their significance or land tenure. Under Section 90, a person who, without first obtaining the consent of the Director-General, knowingly destroys, defaces or damages, or knowingly causes or permits the destruction or defacement of or damage to, an Aboriginal object or Aboriginal place is guilty of an offence.

Amendments introduced by the *National Parks & Wildlife Amendment Act 2001* which strengthen the provisions of Section 90 have yet to commence.

The Department of Environment and Climate Change (DECC) is the statutory authority for the protection of Aboriginal objects and places within NSW, with the Director-General of that department the consent authority.

2.2 *ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 (NSW)*

The *Environmental Planning and Assessment Act 1979* (EP&A Act) requires that environmental impacts are considered in land-use planning, including impacts on Aboriginal and historical heritage. Various planning instruments prepared under the Act identify permissible land use and development constraints.

The NSW NPWS (now DECC) provide guidelines for Aboriginal heritage assessment, including those conducted under the EP&A Act 1979. Where

Aboriginal heritage assessment is conducted under the Integrated Development Approval process, a more detailed set of NPWS guidelines applies.

Where a development is approved under Part 3A of the Act, further approvals under the *National Parks & Wildlife Act 1974* and *Heritage Act 1977* are not required. In those instances management of heritage sites must follow the statement of commitments included in the Environmental Assessment.

2.3 *ABORIGINAL AND TORRES STRAIT ISLANDER HERITAGE PROTECTION ACT 1984 (COMMONWEALTH)*

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* protects areas and/or objects which are of significance to Aboriginal people and which are under threat of destruction. The Act can, in certain circumstances override state and territory provisions, or it can be implemented in circumstances where state or territory provisions are lacking or are not enforced. A significant area or object is defined as one that is of particular importance to Aboriginal people according to Aboriginal tradition. The Act must be invoked by or on behalf of an Aboriginal or Torres Strait Islander or organisation.

3 BACKGROUND

3.1 ENVIRONMENTAL CONTEXT

The purpose of this section is to provide environmental contextual information for use in developing a predictive model of site location for the study area.

Interactions between people and their surroundings are of integral importance in both the initial formation and the subsequent preservation of the archaeological record. Although social networks and cultural factors inevitably underpin all human behaviour, the nature and availability of resources including water, flora and fauna and suitable raw materials for the manufacture of stone tools and other items had (and continues to have) a significant influence over the way in which people utilise the landscape. Alterations to the natural environment also impact upon the preservation and integrity of any cultural materials that may have been deposited whilst current vegetation and erosional regimes affect the visibility and detectability of sites and relics. For these reasons, it is essential to consider the environmental context as a component of any heritage assessment.

3.1.1 *Geomorphology and Landforms*

Speight (1990) describes categories of landform divisions, including ten morphological types of landform element units. For archaeological investigations they divide the landscape into standardised elements that can be used for comparative purposes and predictive modelling. A number of landform units were identified within the study area, being slopes, ridges, flats, dunes and gullies/creeks. Site types most likely to occur on these landforms are shell middens and stone artefact sites (scatters and isolated finds; see *Table 3.1*). The study area is predominantly flat and low-lying within the southern portion, with a number of beach ridges and creek lines present in the north. The landscape drains down to the south and to the Myall River estuary to the east.

3.1.2 *Geology and Soils*

The study area predominantly overlies Quaternary sands comprising gravel, sand, silt and clay, with a small section in the north west overlying Carboniferous bedrock of the Wooton Beds, including sandstone, siltstone, claystone, shale, limestone and lavas (Newcastle 1:250,000 geological series). No stone outcrops appear tooccur in the study area. Axe grinding grooves are often located on sandstone where it occurs in association with water, but the lack of such outcrops indicates that this type of site will not occur in the study area. Stone art/engraving sites and shelter sites will also not occur, given the lack of outcrops.

Table 3.1 Aboriginal Archaeological Site Types

Site types	Definition
Stone artefact scatters	Stone artefact scatter sites, also known as open campsites, are usually indicated by surface scatters of stone artefacts and sometimes fire blackened stones and charcoal. Where such sites are buried by sediment they may not be noticeable unless exposed by erosion or disturbed by recent activities. The term campsite is used as a convenient label which, in the case of open sites, does not necessarily imply that Aboriginal people actually camped on the sites; rather it indicates only that some type of activity was carried out there.
Isolated finds	Sites consisting of only one identified stone artefact, isolated from any other artefacts or archaeological evidence. They are generally indicative of sporadic past Aboriginal use of an area.
Shell middens	Middens consist of accumulations of shell that represent the exploitation and consumption of shellfish by Aboriginal people. Shell species may be marine, estuarine or freshwater depending on the environmental context and middens may also include other faunal remains, stone artefacts, hearths and charcoal.
Shelter sites	Sandstone shelters and overhangs were used by Aboriginal people to provide campsites sheltered from the rain and sun. The deposits in such sites are commonly very important because they often contain clearly stratified material in a good state of preservation.
Grinding grooves	Grooves resulting from the grinding of stone axes or other implements are found on flat areas of suitable sandstone. They are often located near waterholes or creek beds as water is necessary in the sharpening process. In areas where suitable outcrops of rock were not available, transportable pieces of sandstone were used.
Quarries	These are areas where stone was obtained for flaked artefacts or ground-edge artefacts, or where ochre was obtained for rock paintings, body decoration or decorating wooden artefacts.
Art sites	Aboriginal paintings, drawings and stencils are commonly found where suitable surfaces occur in sandstone shelters and overhangs. These sites are often referred to as rock shelters with painted art. Rock engravings, carvings or peckings are also found on sandstone surfaces both in the open and in shelters. These are referred to as rock engraving sites.
Scarred trees	Scarred trees bear the marks of bark and wood removal for utilisation such as canoes, shields, boomerangs or containers. It is often difficult to confidently distinguish between Aboriginal scars and natural scars or those made by Europeans.
Burial sites	Burials may be of isolated individuals, or they may form complex burial grounds.
Stone arrangements, carved trees and ceremonial grounds	These site types are often interrelated. Stone arrangements range from simple cairns or piles of rocks to more elaborate arrangements; patterns of stone laid out to form circles and other designs, or standing slabs of rock held upright by stones around the base. Carved trees are trees with intricate geometric or linear patterns or representations of animals carved into their trunks. Ceremonial grounds and graves were often marked by such trees. Bora grounds are a common type of ceremonial site and they are generally associated with initiation ceremonies. They comprise two circles, generally edged with low banks of earth but sometimes of stone, a short distance apart and connected by a path.

Stone from the Nerong Volcanics group outcrops in the area surrounding Port Stephens. The Nerong Volcanics include a range of stone types that are not typically used to manufacture artefacts but have been reported as being utilised and have been found in archaeological sites some distance from their source (Dean-Jones 1990:116; Umwelt 2000:7.8; Dyall 2004:144). To the northwest of Port Stephens, outcrops of various igneous and sedimentary rocks suitable for stone tool manufacture (including tuff) are present (Dean-Jones 1990:18). No cobbles of suitable raw material for stone artefact manufacture appear to occur naturally within the study area. Therefore, stone quarry sites are not expected to occur.

The soils identified within the study area are alluvium, siliceous sand, leached sand, structured plastic clay, salt marsh/heath sands, sand podzols, brown and yellow podzolics and organic sands/muds (Gardner Browne et. al. 1991:30). In the wetland area, salt marsh soils are present, with a number of areas of sand podzols/siliceous sands throughout the study area, including one in the wetlands. Lacustrine structured plastic clays occurred in the north west of the site, with bedrock soils in the central north. The remainder of the study area comprised inner barrier/organic sands/muds. Of particular interest are the salt marsh soils, which were noted to be strongly acid and consist of a dark grey black humate rich quartz sand surface up to 30 cm deep, underlain by a lighter grey sand, with a minor amount of shell material in the sand (Gardner Browne et. al. 1991:31). This type of soil (with black organic sand and shell material noted) occurs in the eastern portion of the study area and appears likely to contain shell midden material.

3.1.3 Drainage

The availability of water has significant implications for the range of resources available and the suitability of an area for human occupation. The study area is located in the Port Stephens catchment, and is bounded to the east by the Myall River estuary. Although the estuary is unsuitable for drinking it would have attracted a wide variety of animals and supported a range of plant species and shellfish/marine species, which are likely to have been used by Aboriginal people in the past.

A small intermittent creek is present in the north eastern corner of the study area, draining into the Myall River. Several indefinite intermittent drainage lines are present in the north, draining down the slope to the low-lying part of the study area. It has also been noted that the study area drains to a basin excavated at its southern end, with a drain providing an outlet to the Myall River (Gardner Browne et. al. 1991:2; see also *Section 3.1.4*).

The location of the estuary indicates that shell middens are likely to be present in the study area. The presence of small creeks indicates that stone artefact sites may occur, however the lack of large creeks in the study area suggests that large stone artefact sites are unlikely to occur. Stone artefacts are most likely to occur in the context of middens, being scattered in very low numbers throughout the remainder of the study area.

3.1.4 Land Use and Disturbance

Apart from a strip of the wetlands and a small area in the north eastern corner, the study area was cleared in 1932 for a pine plantation which has heavily disturbed the area. Large areas of the plantation were burned out in 1979 and it was not maintained after this time.

The Local Environmental Study (LES) undertaken in 1991 (Gardner Browne et. al. 1991:2) also noted the following disturbance to the study area:

- evidence of a former settlement at the northern end of the study area, with associated clearing;
- a gravel track extending into the study area from the Shearwater Estate to the north, where sand had been removed and soil dumped; and
- a basin excavated at the south eastern end of the study area adjoining residential development, with a drain providing an outlet to the Myall River, and associated vegetation clearance.

3.1.5 Flora and Fauna

Vegetation in the study area comprises immature pines and coastal scrub regrowth including Eucalypts, Angophora, Allocasuarina, Blackbutt, Banksia, Acacia, Bottlebrush, Paperbark and ferns (Brayshaw 1988:2; Gardner Browne et. al. 1991:42-3). The wetlands are covered with reeds, swamp grasses and other littoral species, with some stands of *Casuarina glauca* (Swamp Oak). Mangroves fringe the river bank.

As mentioned above, the majority of the study area was cleared in 1932 for a pine plantation, however the north eastern corner was not cleared and contains some large trees in an area of Open Forest and Wet/Swamp Schlerophyll Forest. Despite targeted surveys Brayshaw did not locate any scarred or carved trees in this area during her survey in 1988.

The study area is located adjacent to the Myall River estuary, which supports an extensive seagrass and mangrove habitat as well as providing shellfish such as cockles and oysters. It is likely that shell middens may be present within the study area.

3.2 ARCHAEOLOGICAL CONTEXT

The purpose of this section is to provide archaeological background information for use in developing a predictive model of site location for the study area.

3.2.1 AHIMS Results

A search of the Aboriginal Heritage Information Management System (AHIMS) Aboriginal Sites Database at DECC was undertaken on 21 May 2007, for a 12 km x 13 km area centred on the study area. A total of 31 recorded sites were identified within this search area (see *Figure 3.1*), which comprised 18 middens (one of which is associated with axe grinding grooves and one of which is associated with burials at North Head), eight stone artefact scatters (one of which is associated with a Potential Archaeological Deposit [PAD]), three burials (on the beach at North Head and Providence Bay, and at Winda Woppa), one set of axe grinding grooves and one natural mythological (ritual) site at Tomaree Headland.

This search of the local area shows that middens are the main Aboriginal site type recorded in the area, and these are predominantly located on the beach and bays of Port Stephens, and along the estuaries and rivers of the area (including the Myall River).

One midden site (38-5-0148) has been recorded in the eastern portion of the study area, but is not located in the proposed development area (see *Section 3.2.2*). Two other middens (38-5-0076 and 38-5-0147) are located within 300 m to the south of the study area. No other sites are located within 1.5 km.

3.2.2 Previous Local Studies

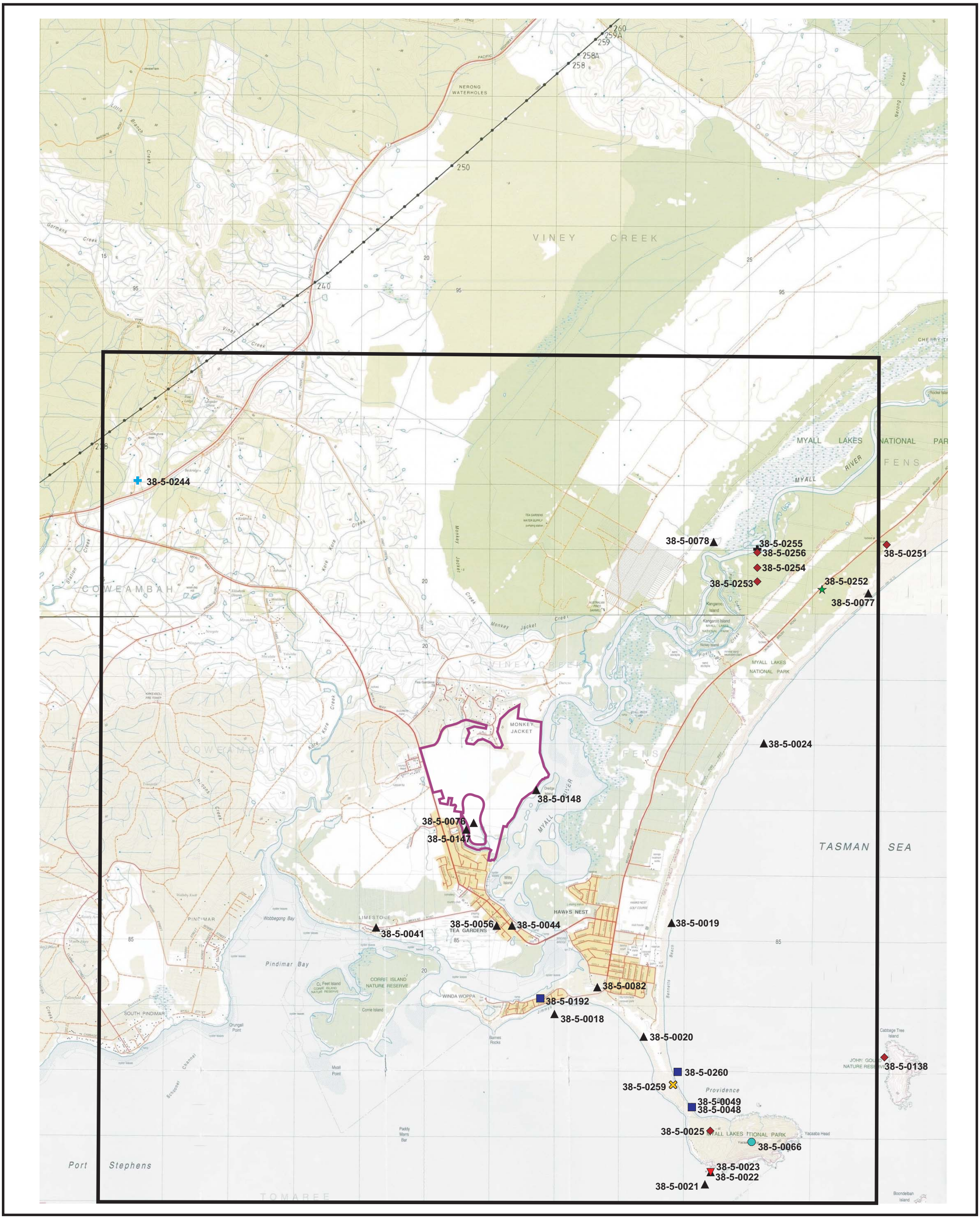
A number of archaeological investigations have been undertaken within and adjacent to the study area. These are outlined in the following pages, to establish a basis on which the predictive model for the study area may be formulated.

Previous Archaeological Work in the Study Area – Site 38-5-0148

The study area has been previously surveyed by Brayshaw (1988), who traversed the entire area on foot, focussing on areas of ground surface exposure, mature trees, and environmental features which may have formed a focus for Aboriginal occupation (refer to *Annex A*). During this survey, Brayshaw located one site, a shell midden comprising four exposures within a 220 m x 40 m strip along the bank of the Myall River opposite the southern part of Dredge Island (AHIMS site 38-5-0148; see *Figure 3.1*).

All of the exposures occurred on sandy elevations vegetated by stands of Swamp Oak, ferns and grasses. No stone artefacts or charcoal was identified within the site.

A number of factors including increasing population pressure on the North Coast has impacted on many sites including shell middens, meaning that the remaining shell middens have become more significant, especially those that by their nature or location mean they are likely to continue to survive. Given



Legend

- Study Area
- Axe Grinding Groove, Midden
- Axe Grinding Grooves
- Burials
- Midden
- Midden, Burials
- Natural Mythogological (Ritual)
- Stone Artefact Scatter
- Stone Artefact Scatter, Non-Human Bone
- Stone Artefact Scatter, Potential Archaeological Deposit
- Search Extent

Figure 3.1

AHIMS Search Results

Client:	Crighton Properties Pty Ltd		
Project:	Environmental Assessment Riverside at Tea Gardens - Archaeology Assessment		
Drawing No:	0043707hv_EA_arch_03		
Date:	07/07/07	Drawing size:	A3
Drawn by:	JD	Reviewed by:	JW
Source:	1:25,000 Topo Port Stephens & The Branch Shts		
Scale:	Refer to Scale Bar		

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the lack of disturbance to this midden, the potential depth of deposit and the range of shell species represented (cockle, oyster, whelk and pipi), Brayshaw assessed the site as having high archaeological significance, and recommended that it be preserved (refer to *Annex A*).

Previous Archaeological Work to the South of the Study Area

The area immediately south of the study area was surveyed by Dallas (1982), who located a disturbed shell midden (AHIMS site 38-5-0076; see *Figure 3.1*) on a sandy elevation above a swamp adjoining the Myall River. The shell species represented were whelk, cockle and oyster. Flaked stone artefacts were also present. Given the shallow deposit and high level of disturbance, the site was assessed as having low archaeological significance. A Consent to Destroy (S.90) permit for this site was issued in 1982, however the permit lapsed and was not finalised until 1994.

The site was reinvestigated by Kinhill Engineers (1994), at which time a new midden exposure was recorded approximately 100 m to the south west (AHIMS site 38-5-0147; see *Figure 3.1*). Kinhill Engineers conducted a program of test excavation (under a S.87 permit) on this new site, and assessed the site as being of moderate to low archaeological significance, with further excavation work unlikely to add to an understanding of the site. Whelk, oyster and some cockle were recovered at this site, as were stone artefacts.

A small area proposed for a caravan park on the southern edge of Tea Gardens was surveyed by Dean-Jones (1989), and no archaeological evidence was found.

Land at the mouth of the Myall River, on the southern edge of Hawks Nest, was surveyed by Byrne (1985). Four occurrences of oyster shell were located over several hundred metres along a vehicle track on the edge of a mangrove swamp, and one stone artefact was located. The site was identified as a short-stay camp with limited extent, depth and shell species, and had been heavily disturbed by the vehicle track. It was assessed as being of low archaeological significance.

Previous Archaeological Work to the West of the Study Area

The area immediately to the west of the study area was surveyed by Silcox (1998). One stone artefact scatter (comprising two artefacts) and one isolated find were located during the survey, and these were both assessed as having low archaeological significance.

Previous Archaeological Work to the North of the Study Area

An area proposed for residential development at Monkey Jacket was surveyed by Rich and Brayshaw (1983), and no archaeological evidence was found.

Summary

The above-mentioned studies demonstrate that the study area and its immediate surroundings have been previously surveyed. The methodologies for these surveys appear to have been adequate, and no sites have been located within the current proposed development area (the midden site 38-5-0148 is located in protected SEPP 14 wetlands and surrounded by a buffer zone).

3.2.3 Regional Archaeological Context

By far the bulk of the archaeological investigations in the Port Stephens catchment have been carried out in relation to development projects. Consequently, the locations of previous studies are generally linked to the primary areas of development, rather than reflecting a cohesive research design. Shell middens are the most common site type along the coast, and tend to occur most frequently in association with beach dunes or estuaries, and to a lesser extent with rock platforms/headlands, particularly in close proximity to fresh water (Sullivan 1982). While shell middens are the most common type of site on the coast, other sites recorded include stone artefact scatters, scarred trees and axe grinding grooves, and burials may be located in soft dune sand either alone or in association with middens.

Sites on the NSW North Coast have been dated predominantly to the last 6,000 years, which corresponds to the time when sea levels rose to their present level (Lampert and Hughes 1974). During the period of lower sea level, the NSW coast would have been located a great distance to the east. Archaeological sites on that ancient coastline would have been submerged below the rising sea levels following the last glacial maximum when sea levels were at their lowest (approximately 18,000 BP).

Most middens on the NSW North Coast date to the last 1,000 years, with many dating to from 300-500 years Before Present (BP) and later (Sullivan 1982:124). However, it is argued that evidence of late Pleistocene occupation in the nearby Hunter region has been identified at a number of sites, namely Warkworth West, Fal Brook and Lemington (AMBS 2002; ERM 2004:15; Koettig 1987; Kuskie 2000). Whilst the representation of Pleistocene sites in the region is limited, it should not be assumed that this apparent paucity of dated sites reflects a lack of human activity. Based on the current models for the peopling of Australia and the evidence from surrounding regions, it seems likely that the Hunter region was initially occupied at some time between 20,000 and 40,000 years ago (ERM 2004:68).

Previous archaeological work undertaken in the region and enthnohistorical information are used as the basis of a series of predictions about the location and content of archaeological sites in the area. The most relevant and useful of these predictions (albeit very general) are as follows (Sullivan 1982):

- beaches, rivers and estuaries were important sources of food, particularly fish and shellfish (especially pipi);
- the exploitation of estuaries was also commonly associated with exploitation of terrestrial resources;
- the use of rocky shorelines was of minor importance;
- short-stay camps commonly occur along beaches and consist of a thin layer of shell (often pipi) and hearthstones, although flaked stone artefacts are rare; and
- longer-stay camps are usually located on the margins of several environmental zones, eg. near the edges of lagoons or estuaries with access to beaches or floodplains, and apart from shell and hearthstones they may also contain bone and flaked stone artefacts.

3.3 PREDICTIVE MODEL OF SITE LOCATION

Based on the archaeological and environmental context outlined above, it is predicted that shell middens are the type of site most likely to be found in the study area, particularly on the eastern boundary adjacent to the Myall River, with its rich resources. Stone artefacts are more likely to be found in association with middens, rather than being represented by individual sites.

Scarred or carved trees may be present in the north eastern corner of the study area in the area of remnant vegetation. Based on the high levels of disturbance that has occurred over the majority of the study area from the pine plantation, no stone arrangements or ceremonial grounds would be likely, and a lack of stone outcrops and cobbles within the study area indicates that stone quarry sites, shelter sites, rock art/engravings and axe grinding grooves will not occur.

Recorded burials in the vicinity indicate that burials are more likely to occur in middens in the soft sand of the beach and the bays of Port Stephens, rather than in the estuaries. There is no indication that burials are more likely to occur in the study area than in any of the surrounding localities.

4 CONSULTATION

Aboriginal consultation is required for any assessment of Aboriginal heritage. The Department of Environment and Climate Change (DECC) has released the Interim Community Consultation Requirements guideline (2004) for Aboriginal consultation in relation to any study that might eventually be used to support an application under Part 6 of the National Parks and Wildlife Act 1974 (ie. Section 90 consents to destroy sites and Section 87 permits to collect/investigate). The interim guideline sets out a process of inviting Aboriginal groups to register interest as a party to consultation (including local press advertisement), seeking responses on proposed assessment methodology, and seeking comment on proposed assessments and recommendations. The interim guideline requires proponents to allow 10 working days for Aboriginal groups to respond to invitations to register, and then 21 days for registered Aboriginal parties to respond to a proposed assessment methodology. An additional ten days are allowed for groups to review a draft report and comment on the results and management recommendations made.

The consultation for the proposed development of the Riverside site has been carried in accordance with the DECC guideline.

Letters requesting advice on Aboriginal organisations to consult and any known heritage issues to be taken into consideration in the area were faxed on 4 May 2007 to:

- The former NSW Department of Environment & Conservation (now DECC);
- Registrar, Aboriginal Land Rights Act 1983 (NSW);
- Great Lakes Council; and
- Karuah Local Aboriginal Land Council (KLALC).

A local press advertisement requesting Aboriginal individuals and groups interested in being consulted on this project to write to ERM, was placed in the Myall Coast Nota newspaper on 10 May 2007. One response to this advertisement was received, from Jan Webb.

DECC identified one additional Aboriginal party to be contacted:

- Guiwain Elder Group.

The Registrar identified one additional Aboriginal party to be contacted:

- Interim Board of Management for Worimi Conservation Lands.

The Interim Board of Management for Worimi Conservation Lands identified one additional Aboriginal party to be contacted:

- Maaiangal Cultural & Heritage.

These parties were contacted about whether they wished to be consulted on this project. In addition, each party was asked to identify any further individuals or groups who would be interested in being consulted regarding this project. Three responses to these letters have been received, from KLALC, Jan Webb and Interim Board of Management for Worimi Conservation Lands. Maaiangal Cultural & Heritage identified the study area as being outside their area of interest.

The three parties that registered an interest were provided with a proposed desktop assessment methodology in June 2007 and a survey methodology in March 2008. Verbal responses to these methodologies were received from KLALC and Jan Webb, each indicating their agreement. Field survey was undertaken in accordance with the agreed methodology on Monday 21 April 2008 with two representatives of the KLALC.

No further Aboriginal parties have been identified through this process. Details of the Aboriginal consultation are provided in *Annex B* and results of the field survey have been detailed in *Chapter 6*.

A search of the National Native Title Tribunal website undertaken on 4 May 2007 and 28 April 2008 failed to reveal any active claimant applications in the study area.

Draft copies of this report were sent to the registered Aboriginal parties, so that they may comment on its content and recommendations. The comments of these parties have been included in *Annex C*.

5 METHODOLOGY

In order to determine the validity of a field survey, it is necessary to describe the fieldwork methodology. This section describes the survey strategy, the criteria used to identify artefacts and the means by which survey coverage was calculated.

5.1 SURVEY STRATEGY

An archaeological survey was undertaken on Monday 21 April 2008. Two representatives of the Karuah Local Aboriginal Land Council, Ron Tisdell and Joshua Simms, and two ERM archaeologists Dr Diana Neuweger and Guadalupe Cincuinnegi conducted the targeted survey.

The survey was designed to target the area of the previously recorded midden (38-5-0148) and attempted to look at areas of archaeological sensitivity and ground exposure.

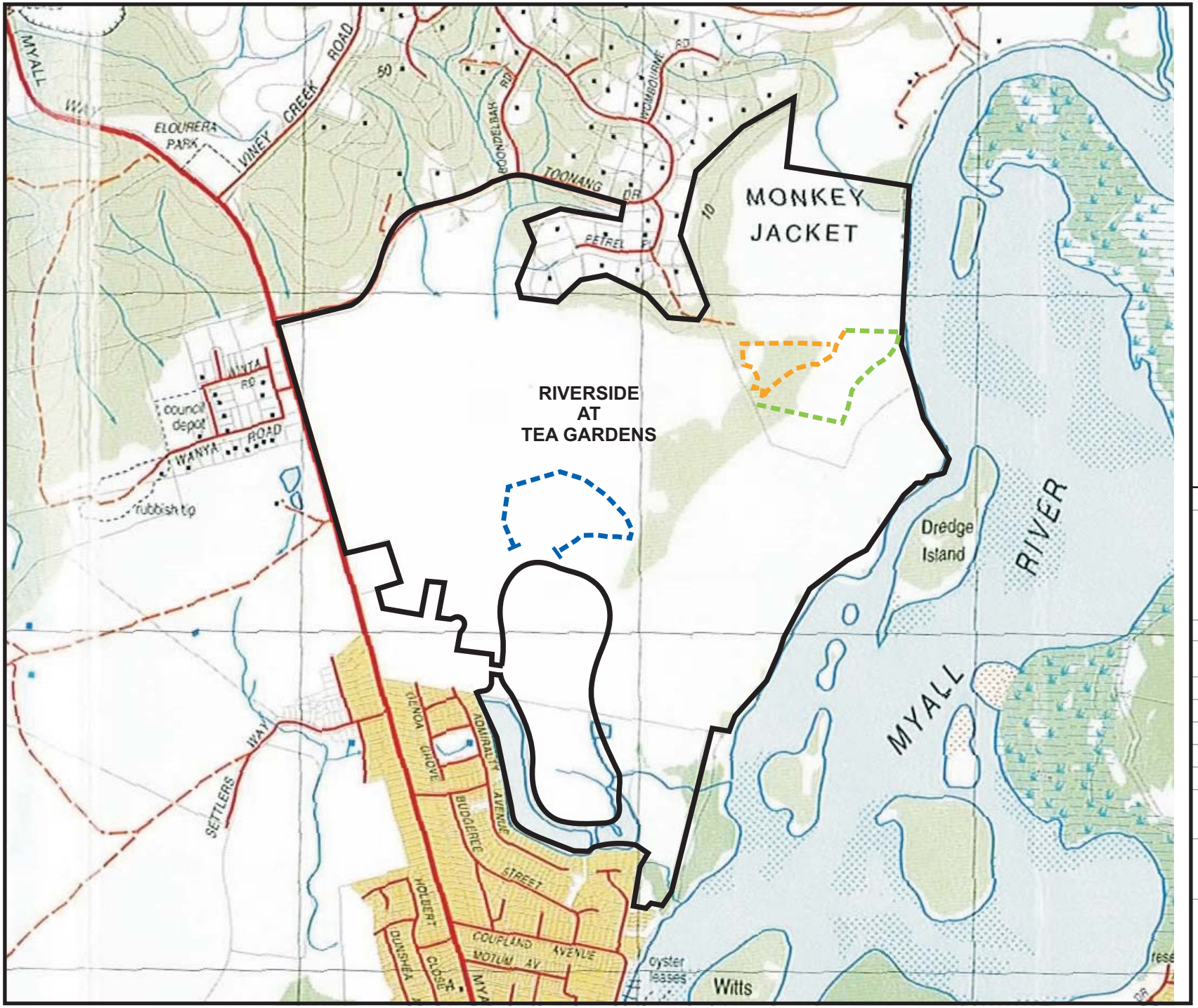
Transect 1 was located within the swamp along the edge of the Myall River within the wetland landscape unit (refer to *Figure 5.1*). Transect 2 adjoined the swamp and followed a low sand dune system in the north east of the study area. Transect 3 was located in the southern part of the study area on flat land, characterised by high grass and scattered native trees.

The visibility in the study area was very low and the areas surrounding the previously recorded midden inaccessible due to inundation.

5.2 SURVEY COVERAGE

In accordance with NSW NPWS (1997:18), the description of survey coverage includes the landform, survey unit area and a quantification of the level of exposure and visibility. The survey units were mapped using a combination of hand-held GPS and visible landmarks.

Visibility refers to the amount of ground upon which artefacts could be sighted and is expressed as a percentage of the survey unit (NSW NPWS 1997:18). The presence of vegetation, leaf litter and other variables can obscure visibility. Exposure is defined as areas in which erosional processes result in the removal of soils and permit the detection of archaeological material that was formerly subsurface. Exposure is also expressed as a percentage of the survey unit (NSW NPWS 1997:18).



Legend

- Riverside at Tea Gardens Site Boundary
- Transect 1
- Transect 2
- Transect 3

Figure 5.1

Survey Locations

Client:	Crighton Properties Pty Ltd		
Project:	Environmental Assessment Riverside at Tea Gardens - Archaeology Assessment		
Drawing No:	0043707hv_EA_river_arch_05		
Date:	08/07/08	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JW
Source:	1:25,000 Topo Series Port Stephens Sheet		
Scale:	Refer to Scale Bar		

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5.3 SURVEY LIMITATIONS

There were several limiting factors that did not allow for complete survey of the development area.

A long period of rain had made the wetland area difficult to traverse, with much of the area being ankle deep (and knee deep in some places) with water. This not only made traversing the area difficult but also removed any possibility of locating Aboriginal archaeology on the ground.

Whilst the remaining areas of the study area were better drained, the vegetation in the north western portion was extremely dense and the southern and central parts were not readily accessible due to the presence of electric fences. A visual inspection was made where possible which confirmed that ground visibility in these areas was close to 0%.

While the access and water issues have limited the survey coverage of the study area, the limited visibility would not have allowed for identification of Aboriginal archaeology, and further survey of the study area is not recommended.

6 SURVEY RESULTS

6.1 SURVEY COVERAGE

The calculation of effective coverage provides a means to describe the proportion of the study area in which it was possible to assess the presence or absence of artefacts. Due to the limited archaeological visibility and exposure, effective coverage was very low at one percent (refer to *Table 6.1*). Of the three landscape types surveyed the sand dune landform had the greatest visibility (5%), although with only 35% exposure the effective coverage was still only 2%.

Table 6.1 Effective Coverage

Transect	Landform	Area (m^2)	Visibility	Exposure	Visible area (m^2)	Area available for detection (m^2)	% Effective coverage
1	Wetland	4405	1%	5%	44.05	2.2	0%
2	Sandune	98850	5%	35%	4942.5	1729.9	2%
3	Flat	150000	3%	25%	4500	1125.0	1%

6.2 MIDDEN SITE – 38-5-0148

Site 38-5-0148 was not relocated during the survey as the wetland areas were inundated and could not be accessed. It was confirmed during the survey that this area is located within the SEPP 14 Wetland and will be protected. As development will not occur within 100m of this site, no further investigations are recommended.

6.3 MIDDEN SITE - RIVERSIDE01

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One additional midden site was recorded during the survey (refer to *Figure 6.1*). The midden is located on a sand dune close to the swamp/wetland area. The midden is currently overgrown with grass and the full extent and nature of the deposit could not be fully determined. The sand in the area of the midden is a pale grey and the midden shows several species of edible shellfish, most predominantly cockle and whelks, as well as pieces of charcoal up to 10cm in size. The midden is not dense and most of what could be seen showed an ephemeral scattering of shell on the surface. The shell is mostly of a small size and appears to be broken as a result of the current land use (cattle grazing).

Photograph 6.1 Location of Midden (Riverside_01) showing extent of grass cover.

Photograph 6.2 Exposure of Midden (Riverside_01)

Photograph 6.3 Detail of the shell in the midden showing a cockle and broken whelk.

The midden is spread along the south east edge of the sand dune ridge with commanding views of the Myall River. The dune system is currently stabilised by non-native grasses. While this is stopping deflation of the dune system and midden, it also obscured an accurate assessment of the midden size. The maximum extent recorded during this survey was 80 metres in length (south westerly to north easterly direction) by 17 metres wide (north westerly to south easterly direction).

There is currently one major threat to the midden due to its location within a cow paddock. The midden is open and exposed to trampling which has the potential to seriously damage and create deflation of the midden and its contents.

In regards to the location of this midden within the development area, the concept plan has been amended to ensure that this site is protected.

6.4 POTENTIAL ARCHAEOLOGICAL DEPOSIT

It is essential to consider the potential for archaeological material to be present in areas of poor visibility and/or in a subsurface context. In relation to the management of the archaeological resource and legislative requirements, the likelihood that subsurface archaeological deposits may be present within an area has implications for any proposed development activity.

In terms of archaeological assessment, not all potential deposits necessarily contribute to our understanding of past human activities. The primary scientific importance of subsurface deposits lies in their potential to provide information that will assist in interpretation of the archaeological record through time and space. For this reason, areas described as potential archaeological deposits should satisfy one or more of the following criteria.

- be likely to contain sufficiently high numbers of artefacts to allow for statistically viable detailed analysis and intra- and inter-site comparison of artefact assemblages;
- exhibit minimal disturbance and a high level of integrity; and/or
- have the potential to contain dateable materials, either in chronological or absolute terms.

As discussed previously, midden material was identified only in areas of exposure within the sand dune and wetland landscape units. Based on the predictive modelling and confirmed by field survey it is likely that a consistent low-density scatter of midden material is likely to occur within the eastern portion of the study area and should be considered as a potential archaeological deposit.

In regards to the proposed development of the study area, these landscape units will be largely protected within the SEPP 14 Wetland and associated buffer zones. The remainder of the study area is proposed for low-density development and has been further considered in *Chapter 8* in regards to ongoing management and mitigation measures.

6.5 IMPACT ASSESSMENT

The midden site 38-5-0148 was not relocated during the current survey due to access limitations and very low visibility (refer to *Chapter 5.3*). This site has been previously recorded (Brayshaw 1988) within the SEPP 14 Wetland and associated buffer zones. No development will occur within 100 metres of this site. Whilst the exact location and context of this site could not be confirmed within the current survey, it was confirmed that this area is within the SEPP 14 Wetland and the large buffer area will ensure that it is not directly impacted.

The newly recorded midden (Riverside_01) is located within the proposed tourist precinct and the concept plan has been amended to ensure that it is protected by a minimum 10 metre buffer on all sides (refer to *Figure 6.2*).

Neither of these middens will be directly impacted by the proposed development, however ancillary impacts may be possible. Alterations to drainage patterns could accelerate erosion of the deposits and greater visitation (on foot and vehicular) may cause damage or erosion.

To address the potential impacts to the SEPP 14 Wetlands, midden sites and associated buffer zones, an Integrated Water Management Strategy has been developed to manage the groundwater and surface water flows. Water management at the site, including the extension of the existing detention lake and the construction of a number of ancillary water quality control ponds to create a 'treatment train' for runoff prior to discharge, together with erosion and sediment control measures, will minimise the potential impact of sedimentation and erosion.

To ensure that indirect impacts do not damage the middens (in particular Riverside_01 which is located within the development area), it is recommended that:

- Riverside_01 is protected on all sides by a minimum 10 metre buffer. No construction/excavation works, including the storage of machinery can impinge on this buffer zone;

- a management plan should be developed in consultation with the local Aboriginal community to ensure the long-term protection of the middens. This management plan should consider the use of fencing, designated walkways and interpretive signage at Riverside_01 as an educational resource; and

- if the current development plan is amended, further subsurface investigation may be required to further assess the significance of the sites.

7 SIGNIFICANCE ASSESSMENT

7.1 ASSESSMENT OF ABORIGINAL ARCHAEOLOGICAL SIGNIFICANCE

Heritage sites, objects and places hold value for communities in many different ways. The nature of those heritage values is an important consideration when deciding how to manage a heritage site, object or place and balance competing land-use options. The many heritage values are summed up in an assessment of "Cultural Significance".

The primary guide to management of heritage places is the Australia ICOMOS Burra Charter 1999. The Burra Charter defines cultural significance as:

Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations.

Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects.

Places may have a range of values for different individuals or groups.

This assessment has attempted to identify heritage objects and sites within the study area and obtain enough information to allow the values of those objects and sites to be determined.

Research and consultation with the Aboriginal community was also conducted to determine whether any heritage value relates specifically to the study area regardless of the archaeological evidence. While it is accepted that the Port Stephens landscape is of significance to Aboriginal people, this study sought to identify whether the study area held specific values either in itself, or as part of a specific local area of particular significance. To date, no information has been received that identifies specific heritage value unrelated to the Aboriginal sites.

Aboriginal heritage sites with archaeological evidence are all of value to the Aboriginal community through the tangible connection they represent to pre-European Aboriginal land use.

Scientific value is assessed according to the research potential of a site. Rarity and representativeness are also related concepts taken into account. Research potential or demonstrated research importance is considered according to the contribution that a heritage site can make to present understanding of human society and the human past. Those heritage sites, objects or places of high scientific significance are those which provide an uncommon opportunity to inform us about the specific age of people in an area, or provide a rare glimpse of artistic endeavour or a rare chronological record of changing life through deep archaeological stratigraphy.

The comparative rarity of a site is a consideration in assessing scientific significance. A certain site type may be "one of a kind" in one region, but very common in another. Artefacts of a particular type may be common in one region, but outside the known distribution in another.

The integrity of a site is also a consideration in determining scientific significance. While disturbance of a topsoil deposit with artefacts does not entirely diminish research value, it may limit the types of questions that may be addressed. A heavily cultivated paddock may be unsuited to addressing research questions of small-scale site structure, but it may still be suitable for answering more general questions of implement distribution in a region and raw material logistics.

The capacity of a site to address research questions is predicated on a definition of what the key research issues are for a region. In the Port Stephens/North Coast area the key research issues centre on the antiquity and content of middens, and to a lesser extent on stone artefact manufacturing technology and raw material sources. While there is a general pattern in Australian archaeology of stone artefact sites concentrated along watercourses, this appears to be less pronounced along the coast. Sites not conforming to this pattern may be of interest for research potential. Well preserved, mounded or stratified midden sites would also be significant for answering research questions.

A number of factors including increasing population pressure on the North Coast has impacted on many sites including shell middens, meaning that the remaining shell middens have become more significant, especially those that by their nature or location mean they are likely to continue to survive.

Given the potential depth of deposit and the range of shell species represented (cockle, oyster, whelk and pipi) within site 38-05-0148, the site is recognised as having high archaeological significance (Brayshaw 1988). Given its location within a protected SEPP 14 wetland it is likely to continue to survive with only minimal disturbance, which further emphasises its significance within the region.

The newly recorded midden site (Riverside_01) is located within a cow paddock and shows signs of disturbance (broken shells on the surface). Given this level of disturbance, and the fact that it is unlikely to survive in its current situation, this midden is considered to have moderate significance only. Further investigations would be required to confirm the extent, depth and contents of this site should development be proposed within 10 metres of its recorded extent.

8 MANAGEMENT MITIGATION MEASUREMENTS

8.1 IMMEDIATE ACTION (RIVERSIDE_01)

The midden needs to be protected from the cattle. A small electric fence (like that around the nearby house) could be used. The area of the visible midden plus a 10 metre buffer should be fenced off so the cattle cannot damage the site.

8.2 OTHER RECOMMENDATIONS (AGREED WITH KARUAH LALC)

The following recommendations are made in light of the predictive modelling, field survey, input of the Aboriginal stakeholders and the relevant legislation protecting Aboriginal heritage in NSW, bearing in mind that the proposed development is being assessed under Part 3A of the EP&A Act:

- Riverside_01 should be protected on all sides by a minimum 10 metre buffer. No construction/excavation works, including the storage of machinery should impinge on this buffer zone;

- a management plan should be developed in consultation with the local Aboriginal community to ensure the long-term protection of the middens. This management plan should consider the use of fencing, designated walkways and interpretive signage at Riverside_01 as an educational resource. No development or excavation works should be undertaken within the tourist precinct until this management plan has been finalised and approved by the Karuah LALC and DECC;

- based on the location of site 38-05-0148 within the protected SEPP 14 Wetland and associated buffer zones, no further protection measures are required;

- while there was limited visibility over the whole site, no further survey work is recommended. However, if the Concept Plan (as shown in *Figure 1.2*) is amended, subsurface investigation may be required to further assess the significance of the recorded sites;

- based on the predictive modelling and confirmed by field survey it is likely that a consistent low-density scatter of midden material is likely to occur within the eastern portion of the study area. This area will be protected within the SEPP 14 Wetland and associated buffer zones and no specific management measures or monitoring is recommended;

- the remainder of the study area has limited potential for additional sites to be recorded and no specific management measures or monitoring is recommended from an archaeological perspective. Following consultation with the local Aboriginal community, monitoring of clearing and initial excavation works has been recommended by the Karuah LALC. This would not be undertaken as an archaeological activity;

- if during clearing or construction works Aboriginal artefacts are recovered a qualified archaeologist should at this time be contacted and the site recorded in consultation with the Aboriginal community. Once recording has occurred and a Care and Control Permit approved under Section 85a of the NP&W Act (if required), any salvage can be undertaken and works (with minimal disruption) can continue;

- a suitable area should be set aside for the possible containment of any cultural heritage material that is uncovered during the construction works. This dedicated 'keeping place' would only be required in the event that material is uncovered and would be under the care and control of the local Aboriginal community; and

- in the event of discovery of skeletal material all works should cease, and the police, relevant local Aboriginal community groups and a suitably experienced archaeologist or physical anthropologist should be contacted to assess the material before determining the correct management action. Works should not resume until the Police and/or DECC have given authority in writing and approved a management plan.

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Annex A

Archaeological Survey at Tea Gardens NSW, Brayshaw 1988

C-1373

ARCHAEOLOGICAL SURVEY AT TEA GARDENS, NSW

by

Helen Brayshaw

February 1988

Prepared for Condux Development Pty Ltd
through Planning Workshop

Brayshaw McDonald Pty Ltd
Consultant Archaeologists
51 Thompson St
DRUMMOYNE 2047 02/8197962

1 INTRODUCTION

A survey has been carried out for archaeological sites within an area adjoining the Myall River which drains into Port Stephens near Tea Gardens. Condux Development Pty Ltd is proposing to develop the area for residential, recreational and tourism purposes with a riverine theme. The environmental impact is being assessed by Planning Workshop, who commissioned the survey.

This is the first stage of the investigation, representing a feasibility study, and the purpose of the archaeological survey was to identify any archaeological deposits existing on the site, and to assess the extent to which such deposits [if any] would be a constraint to development of the site.

Most of the study area, as far as visibility would allow, was found to be free of archaeological sites. Midden deposits, for recording purposes representing one composite site, were identified in four occurrences within a 220x40m strip along the bank of the Myall River adjacent to the southern half of Dredge Island. If it is likely that these deposits will be affected by the proposed development, their content and significance would have to be established by means of subsurface testing. If their significance were found to be high it is very likely that both the National Parks & Wildlife Service and the Karuah Local Aboriginal Land Council would require that they be preserved without further disturbance.

Disturbance could come in the form of greater destructive wave activity resulting from increased traffic of speed boats, and also increased visitation. These factors might also affect Dredge Island, at this point only about 60m from the midden on the shore, in which case it has been recommended that the island also be investigated for archaeological sites.

2 ENVIRONMENTAL SETTING

The study area is within 1km of the township of Tea Gardens on the northern side of Port Stephens. The eastern boundary, over 1.6km long, fronts the Myall River estuary, and the western boundary is along the Tea Gardens - Pacific Highway road. The northern boundary adjoins a Condux semi-rural subdivision currently being developed.

The study area is largely located on Quaternary sands except where the northern perimeter up the lower slopes of a ridge where bedrock is composed of folded and faulted Carboniferous strata, including sandstones, conglomerates, mudstone and interbedded volcanics. Soils appear to be a mixture of sand and clay.

In 1932 Australian Pines and Products Pty Ltd cleared and planted most of the survey area except for a 1200 strip of wetlands adjacent to the Myall River and a small section in the north between a creek and Monkey Jacket. In 1979 large areas of the pine plantation were burned out and it is no longer maintained. The north eastern corner, not planted with pine, contains some large trees. The remainder is covered with secondary regrowth characterised by a very dense understorey which made the area very difficult to traverse and amongst which ground visibility is largely non-existent. Species observed in regenerating areas include include Blackbutt saplings [**Eucalyptus pilularis**], **Banksia serrata**, Bottlebrush, Paperbark [**Melaleuca quinquinervia**], **Hakea sp**, **Acacia sp** and ferns [incl **Pteridium esculentum**].

Mangroves [**Avicennia marina**] fringe the river bank, and in the northern half of the river frontage dense vegetation extends right to the river. Wetlands some 300m wide extend along the southern half of the river frontage and these are covered by dense growths of reeds, swamp grasses and other littoral species including **Sarcocornia quinqueflora.** Opposite Dredge Island stands of **Casuarina glauca** occur on elevated sandy deposits.

3 ARCHAEOLOGICAL CONTEXT

Some archaeological work has been undertaken in the general area of the Myall River and Tea Gardens and it is therefore possible to make predictive statements regarding site location. The predominant site types in the area are coastal and estuarine middens, while carved trees, burials and campsites are also known.

As a result of clearing activities associated with the pine plantation mature trees are confined to the north eastern corner. Scarred trees, the result of the removal of bark or wood for the manufacture of canoes, containers or shelter, could be expected to occur as there is evidence of Aborigines in the area using bark for all these purposes in historic times [Dawson 1830, Ebsworth 1826]. However scarring, or carving, on a tree is unlikely to be of Aboriginal origin if the tree is less than 150 years old.

Burials may occur collectively in burial grounds or individually almost anywhere. They can be in association with middens, and are usually in areas where there are soft sediments with some depth, and are not likely to be visible unless there has been surface disturbance exposing sections.

While surface campsites are known in the region, they are few, dense vegetation inhibiting their visibility. There is little archaeological information about inland land use, as most archaeological investigations have been in coastal areas. A survey of an earlier component of the Condux development on the ridge and south facing hill slopes immediately adjoining the northern boundary of the present study area resulted in the location of no archaeological sites [Rich & Brayshaw 1983].

Sullivan [1982] carried out a computer analysis and assessment of coastal middens which indicated that coastal occupation sites on the north coast of New South Wales tended to be of two kinds:

1. short-stay "dinner-time" camps; these commonly occur along the beaches. They have a thin layer of shell [often pipi] and hearthstones. Flaked artefacts are rare or absent.

2. longer-stay or more frequented campsites; these tend to be

located on the margins of a number of environmental zones, such as near the edges of lagoons with access to beach or floodplain. As well as shell and hearthstones these middens may also contain bone and flaked artefacts.

In the Tea Gardens - Myall River area a number of sites have been recorded. These sites are associated with islands, headlands and beaches around the Port Stephens estuary and along the Myall River. Except for two in the Dark Point area [NPWS Site Nos 38-5-50 and 38-5-77] the beach middens all appear to be "dinner-time" camps.

In the Tea Gardens township sites 38-5-56 and 38-5-44 are estuarine middens one of which contains stone artefacts. Both now grossly disturbed, they are located on rises above swamps adjoining the Myall River. Another midden [38-5-76], located by Dallas [1982] some 400m south of the present study area, was also situated on a sandy elevation above the swamp. Although containing stone artefacts as well as shell, they were very few, and the site, which had been disturbed by vehicle traffic and erosion, is a "dinner-time" camp, as are those within the township.

Site 38-5-78 was located about 3.5km north of the study area by Villiers [1981] during her survey of the Tea Gardens - Hawks Nest water supply augmentation scheme. A midden consisting of a light scatter of fragmentary **Crassostrea** and **Ostrea** shells with some stone flakes, this site probably also represented a "dinner-time" camp. The midden was located at the base of a ridge of sandstone, some 600m from a swamp west of the Myall River near Kangaroo Island. The site was already grossly disturbed and in 1982 the National Parks & Wildlife Service issued the Public Works Department with consent to its destruction.

The Dark Point headland has a site complex [38-5-52] which has been investigated by Dyall [1977]. Behind the headland is a series of dunes which drops away to low country which is marshy in places. The Myall River is 3km to the west. The site complex, located within the dunes, includes an extensive artefact "workshop" and faunal evidence of 15 species of fish, and shellfish, as well as dog, wallaby and small marsupials. The

evidence indicates exploitation of rocky coast, beach, estuarine/mudflat and swamp areas. The contents of the nearby middens 38-5-50 and 38-5-77 point to the use of similar resource zones. The Dark Point area is obviously a major camping place.

North along the Myall River, some 9.5km beyond the study area, site 38-5-73 was recorded by Dyall at Chinaman's Knob. Here a low sand ridge rises above the swampy marshes and adjoins a rocky outcrop which Dyall commented was the only such outcrop between Port Stephens and the Broadwater along the Myall River. The site comprises a surface scatter of shells and a range of stone artefacts on a 180m strip of sand between 30 and 40m from the river bank. Beach and rock platform shellfish were brought inland 2.5km; oysters may have come from the Myall River. This would have been another camping place.

Thus within the Tea Gardens - Myall River area there appears to have been a number of focal points for campsites: at the Dark Point Headland and associated dunes, near rocky outcrops and on sandy elevations above the low-lying swamps. The larger campsites [rather than "dinner-time" sites] are associated with distinctive landscape features.

From the foregoing it is apparent that scarred or carved trees could be encountered only in the north eastern corner of the study area; that middens were likely to be encountered near the river but, given the absence of distinctive landscape features, they would probably be smaller "dinner-time" camps rather than large longer duration campsites; burials could be present in soft sandy deposits wherever they occur, but would be unlikely to be exposed except accidentally by erosion or during excavation.

4 THE SURVEY

4.1 Procedure

The NSW National Parks & Wildlife Service Register of Sites, associated documents, and archaeological survey reports on the area and the region were inspected prior to the field survey. This was to enable site prediction within the study area and to provide a basis for assessment of any sites found.

The survey was performed by archaeologists Helen Brayshaw and David Crew. The Port Stephens 1:25,000 map was used in the field.

All but 200m of the river frontage was traversed on foot, the section omitted being south of the creek in the north eastern corner, over which the pine plantation had extended: it was therefore covered in very dense vegetation and was known to have been disturbed. Samples of wetland back from the river were traversed, as were sections of the plantation beyond the wetland towards the hillslopes, and the apparently less disturbed north eastern corner.

Everywhere ground exposure was minimal due to vegetation cover, but where encountered it was investigated for midden material and stone artefacts; environmental features which might form the focus for occupation were looked for, as were mature trees which might bear signs of Aboriginal carving or scarring.

4.2 Aboriginal Consultation

The land falls within the area cared for by the Karuah Local Aboriginal Land Council. Sites within this area have contemporary significance for local Aborigines in terms of an identifiable connection with prehistoric occupation and as future Aboriginal education resources.

Prior to the survey being undertaken Ms Colleen Perry, Coordinator of the Karuah LALC, was informed of the proposed development and associated archaeological survey. Unfortunately no representative of the Council was free to participate in the

survey. Ms Perry has been informed of the results, and expressed the view that if the proposed development was likely to affect the midden deposits, they should be investigated further and, if found to be significant, preserved without further disturbance.

A copy of the archaeological report should be forwarded to her for the information of Council members.

4.3 Results

Shell midden deposits were identified in four occurrences within a 220x40m strip along the bank of the Myall River adjacent to the southern half of Dredge Island. Separated by intervals of less than 30m, they can be classified for recording purposes as one site.

All occur on sandy elevations vegetated by stands of swamp oak, ferns and grasses. At locations 1-3 the shells were evident on the slope around these elevations, on the river side and also away from the river. At location 3 compacted shells right at the water's edge are being eroded away by wave action. Occasional areas of visibility occurred on top of the elevations and away from the edges, for example towards the rear of locations 2 and 3, and in a burrow at location 1. At location 4 the shells were only visible in the centre of the elevation within a clearing surrounded by oaks, at a number of small exposures apparently created by animals.

The food sources occurring at all four locations are those most commonly found on Aboriginal middens on this section of the coast: pipi [**Plebidonax deltoides**], cockle [**Anadara trapezia**], whelk [**Pyrazus ebeninus**] and drift or mud oyster [**Ostrea** sp]. The habitat of all of these species is sand and mud flats and amongst mangroves, so all could have been obtained from the Myall River estuary, close to the midden deposits. Access could have been along the river bank or by canoe.

Location 1
Position: 15m from HWM, SW of Dredge Island
Dimensions: 24[NS]x12[EW]x0.3m
Edible species observed: Drift Oyster 30%
Cockle 60%
Whelk 5%
Pipi 5%
Maximum shell density: 600 fragments/m^2
Matrix: Yellow sand

Location 2
Position: 20m N of location 1
Dimensions: 25[NS]x35[EW]x0.2m
Edible species observed: Drift Oyster 20%
Cockle 75%
Whelk 5%
Maximum shell density: 750 fragments/m^2
Matrix: Yellow/grey sand

Location 3
Position: 20m N of location 2
Dimensions: 63[NS]x37[EW]x0.7m
Edible species observed: Drift Oyster 30%
Cockle 65%
Whelk 5%
Maximum shell density: 120 fragments/m^2 [not including very tiny fragments - shell less dense and much more fragmented than at locations 1 and 2]
Matrix: Yellow/grey sand

Location 4
Position: 15m N of location 3
Dimensions: approx 60[NS]x35[EW]x0.5m
Edible species observed: Drift Oyster 30%
Cockle 65%
Whelk 5%
Maximum shell density: 120 fragments/m^2 [much less fragmented than at location 3]
Matrix: Grey sand

No stone artefacts were identified at any of the locations, nor was any charcoal observed. The sandy deposits were generally yellow with only slight grey coloration except for the northernmost location 4 where the sand was noticably greyer. The shells themselves appeared fresh, with little indication of corrosion or structural disintegration, although fragmentation was apparent, especially at location 3.

4.4 Discussion

The records for most of the midden sites known in the Tea Gardens area are minimal. However useful comparison can be made with a site comprised of four occurrences of shell midden exposed along a vehicle track at Hawks Nest, which was evaluated by Byrne [1985]. They were in a sand matrix noticably darker than the adjacent surface, but appeared to contain no charcoal. Nor was there any evidence of any food type other than oyster. Only one stone artefact was located: a flaked piece of a dark-grey siliceous material. The depth of deposit appeared to be no more than 10cm. Shell densities were recorded as between 400 and 1200 fragments per square metre. Byrne concluded that the site represented a series of "dinner-time" occupations, particularly in view of the single food type represented and the absence of numbers of stone artefacts.

While the deposits opposite Dredge Island contained several species of shellfish, they are the types most commonly occurring in middens and all are available in the immediate vicinity. No bones of fish or other sources of food were observed. No stone artefacts were identified, and the deposits appeared to contain no charcoal, even the darker matrix of location 4. The deposits cover a similar area but they are deeper - 30cm as opposed to 10cm at Hawks Nest.

Surface assessment therefore suggests that the midden deposits located during this investigation more closely resemble the "dinner-time" camps represented by Byrne's Hawks Nest site than the larger campsites represented by Dyall's sites at Dark Point and Chinaman's Knob.

However, in view of the undisturbed nature of the midden, the presence of several species, the apparent depth of the deposits and the dark colour of the deposit at location 4, only a very

small area of which was exposed, it is suggested that the site does have potential for greater significance, both scientific and to Aborigines, than that at Hawks Nest. Surface assessment is insufficient to determine the status of the deposits; spade probing would be required at all locations with conversion to test excavation in the case of stratification becoming apparent and additional cultural material such as hearths and faunal or human bones being encountered.

Because so many of the middens in the Tea Gardens area have been disturbed or even destroyed, a site which has not been disturbed should be given high priority for investigation or preservation.

5 RECOMMENDATIONS

The shell midden was the only archaeological site identified within the study area, and it provides the only archaeological constraint to the proposed development. The following recommendations for management of the midden are made on the basis of legal requirements regarding the protection of relics within the state and discussion with the Coordinator of the Karuah Local Aboriginal Land Council.

It is understood by the consultant that the midden occurs within a section of the river frontage protected by State Environmental Planning Policy No 14, which relates to wetlands, and therefore development of the actual site is unlikely. However, the overall proposed development for residential, recreation and tourism based on the river will involve much greater public use of the land and the waterway. The midden site could be exposed to indirect effects of the development, for example:

* the site is likely to be subjected to much greater visitation than at present;
* alterations to drainage patterns may accelerate erosion of the deposits;
* the increased use of motorised watercraft, in particular speed boats, would accelerate erosion of the deposits.

It is suggested therefore that:

1 If the site is considered to be at risk of either direct or indirect impact from the proposed development, the developer should make an application for Consent to Destroy from the National Parks & Wildlife Service in order that the site can be assessed, by means of spade probing or if necessary test excavation, to determine its cultural and scientific significance.

Subsurface testing would enable determination of site formation processes, including whether the site was originally one large deposit since separated by erosion, and at the same time stabilisation requirements could be assessed. Significance should be assessed on the basis of comparison with other sites in the region.

Even if the scientific significance of the site is assessed after further investigation as being minimal, the site will have very good educational value. As such it could be incorporated within the development with a sign designating it as an Aboriginal site and an important element of local cultural heritage. Advice as to the appropriate wording should be sought from the National Parks & Wildlife Service.

2 In the event of this significance warranting preservation of the site consideration would have to be given to the maintenance of low visitation levels, speed restrictions on water traffic, and/or the erection of physical barriers to protect the site.

Suggested management procedures include:

a] jetties could be constructed to attract boats away from the site and guide visitation to less sensitive areas in a controlled manner. At present, being the only dry land elevated above the swamp and mangroves, the midden is at risk to casual beaching of boats for picnics and fishing.

b] if preservation by stabilisation is required on part or all of the site, it could be covered with vegetation bearing material which facilitates rapid growth without interfering with the deposit, such as "Environmat, or any other material regarded as suitable by the National Parks & Wildlife Service.

c] the Shire Council could arrange for the stabilising to be monitored on a routine and regular basis, perhaps once a year, by a Council representative, suitably qualified to assess environmental impact, together with a representative of the Local Aboriginal Land Council, with concomitant reporting to the National Parks & Wildlife Service.

3 Since Dredge Island is as little as 60m from the mainland it too is likely to be indirectly impacted upon by the development. If this is the case it should be investigated for archaeological sites.

4 The Karuah Local Aboriginal Land Council should be invited to participate in any further investigations, either of the midden site or of Dredge Island.

Under the provisions of the National Parks & Wildlife Act of 1974 [as amended] it is illegal to damage, deface or destroy a relic without written permission of the Director. Such consent must be sought in relation to this site if the development proposed is likely to affect the midden deposits. Applications for consent should be directed to the Regional Archaeologist in the Central Region Office of NPWS at Parramatta.

Should any other relics be uncovered during the course of development, the National Parks & Wildlife Service should be informed. This may apply particularly to burials, which may occur any where in coastal sandy areas.

* Five copies of this report should be forwarded to

Ms Bronwyn Conyers,
Regional Archaeologist,
National Parks & Wildlife Service,
PO Box 95,
PARRAMATTA, 2150.

* One copy of this report should be forwarded to

Ms Colleen Perry,
Coordinator,
Karuah Local Aboriginal Land Council,
12 Mustons Rd ,
KARUAH, 2324.

6 REFERENCES

Byrne D. 1985 Archaeological survey at Hawks Nest, NSW. Report to Department of Local Government and Lands.

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Fig 1: Location Map

Newcastle 1:250,000

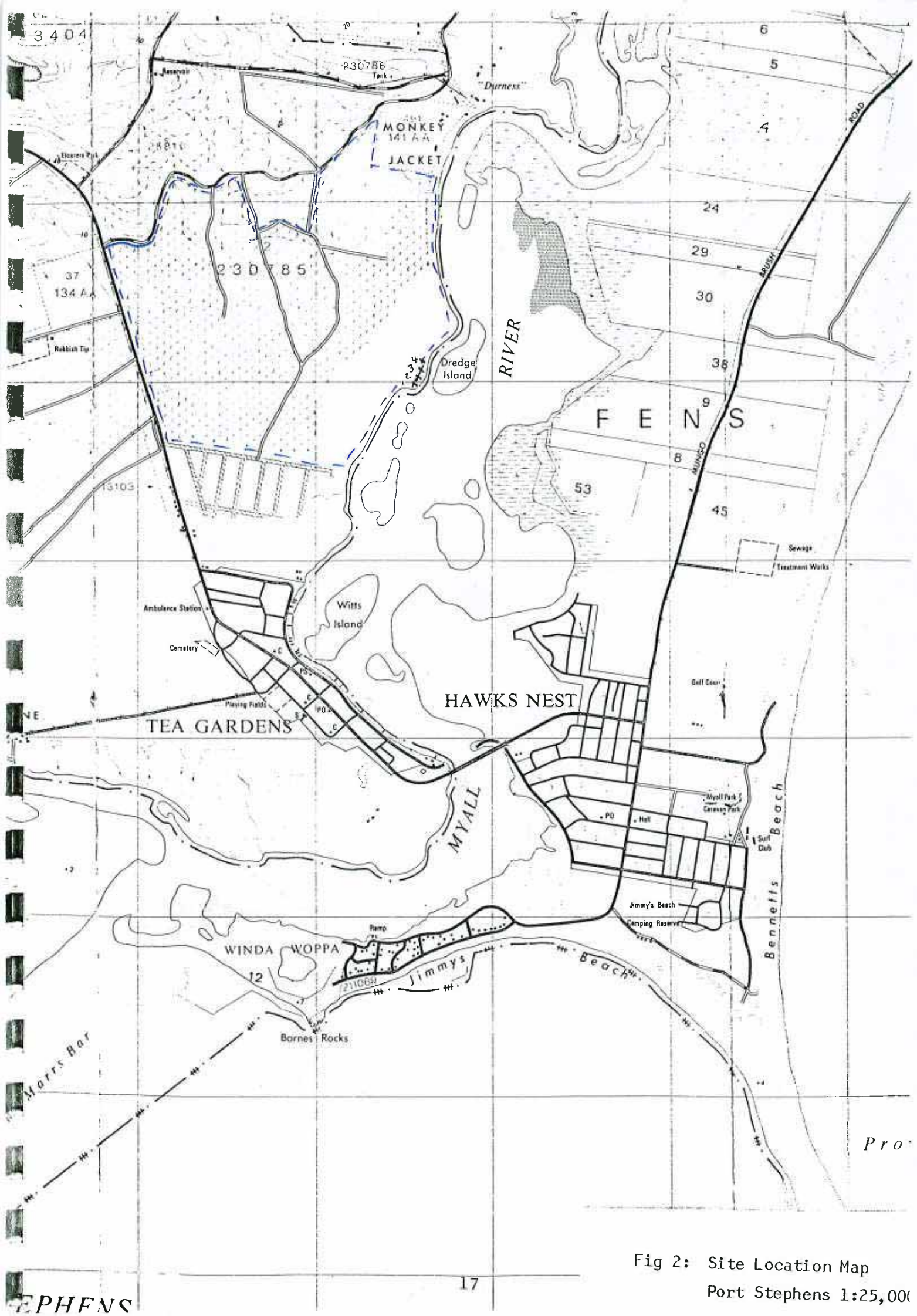


Fig 2: Site Location Map
Port Stephens 1:25,000

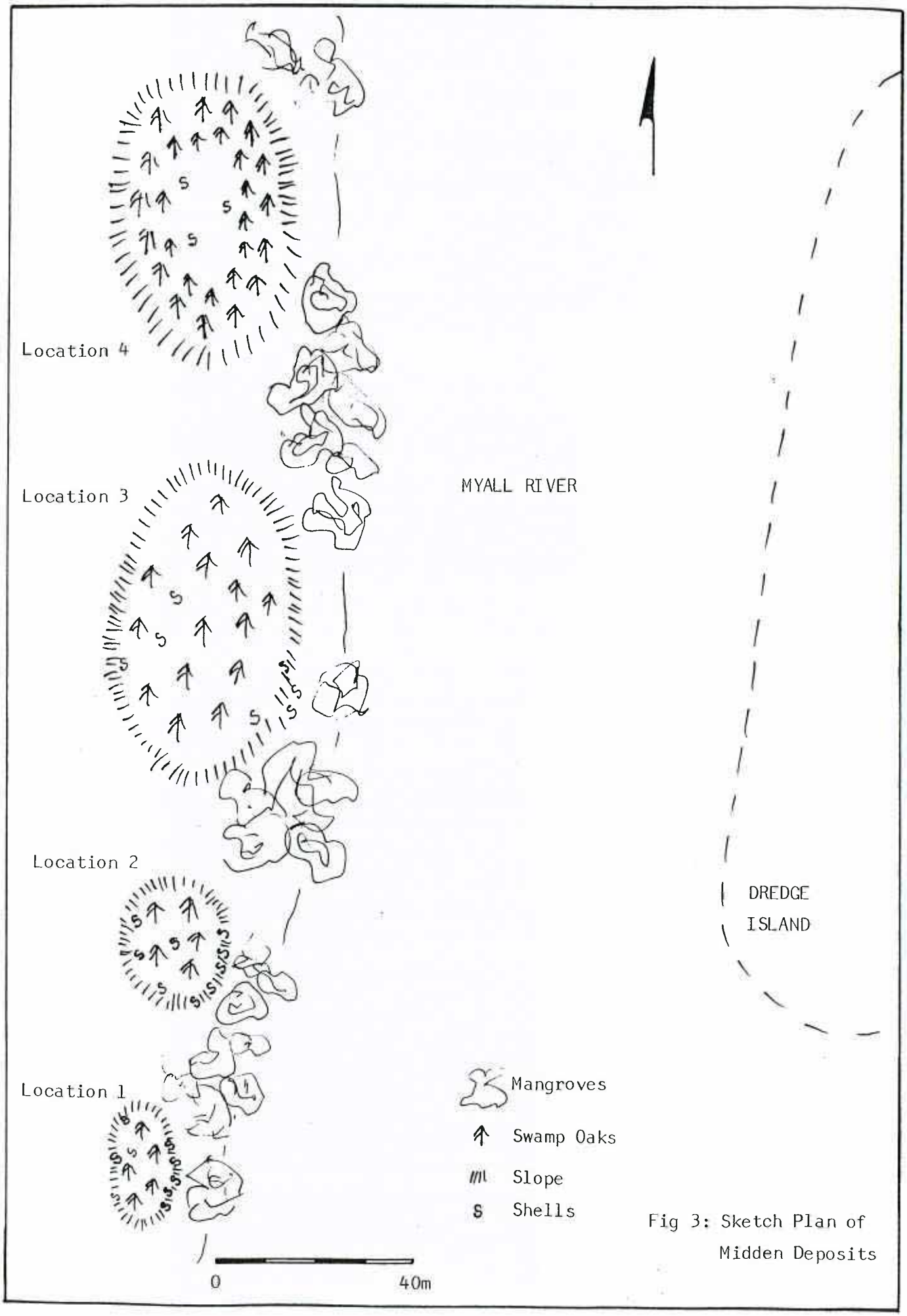
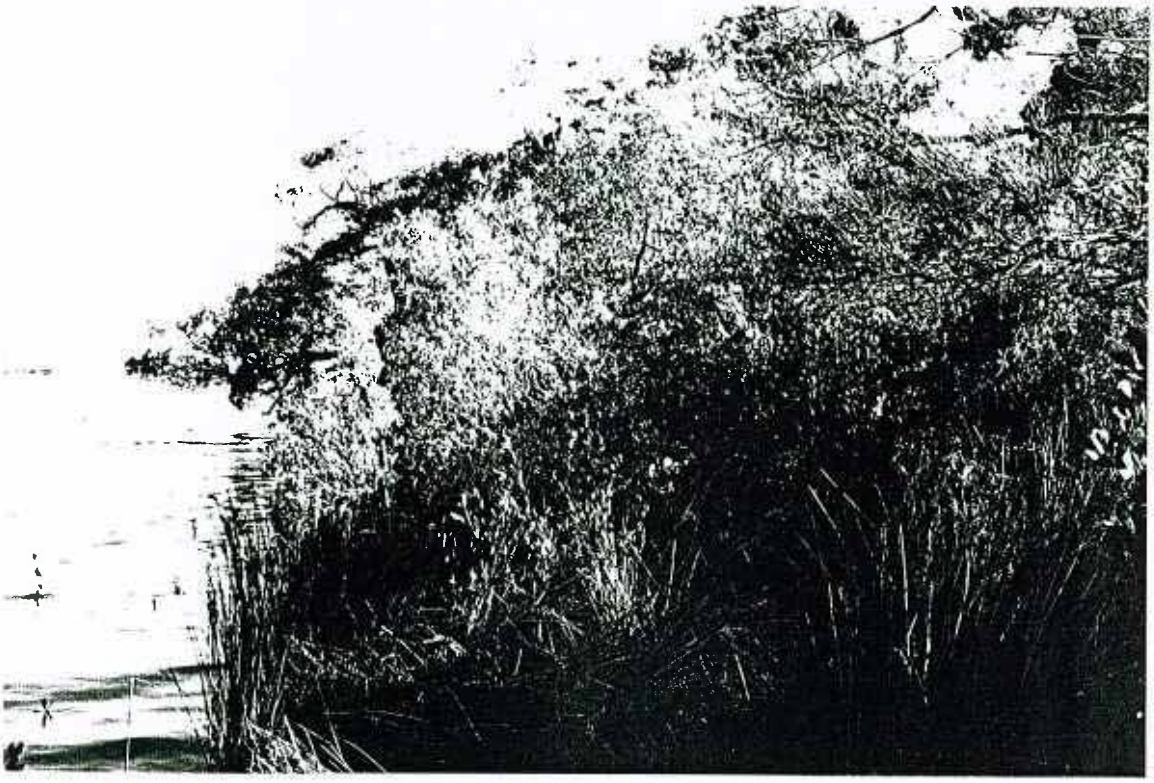


Fig 3: Sketch Plan of Midden Deposits

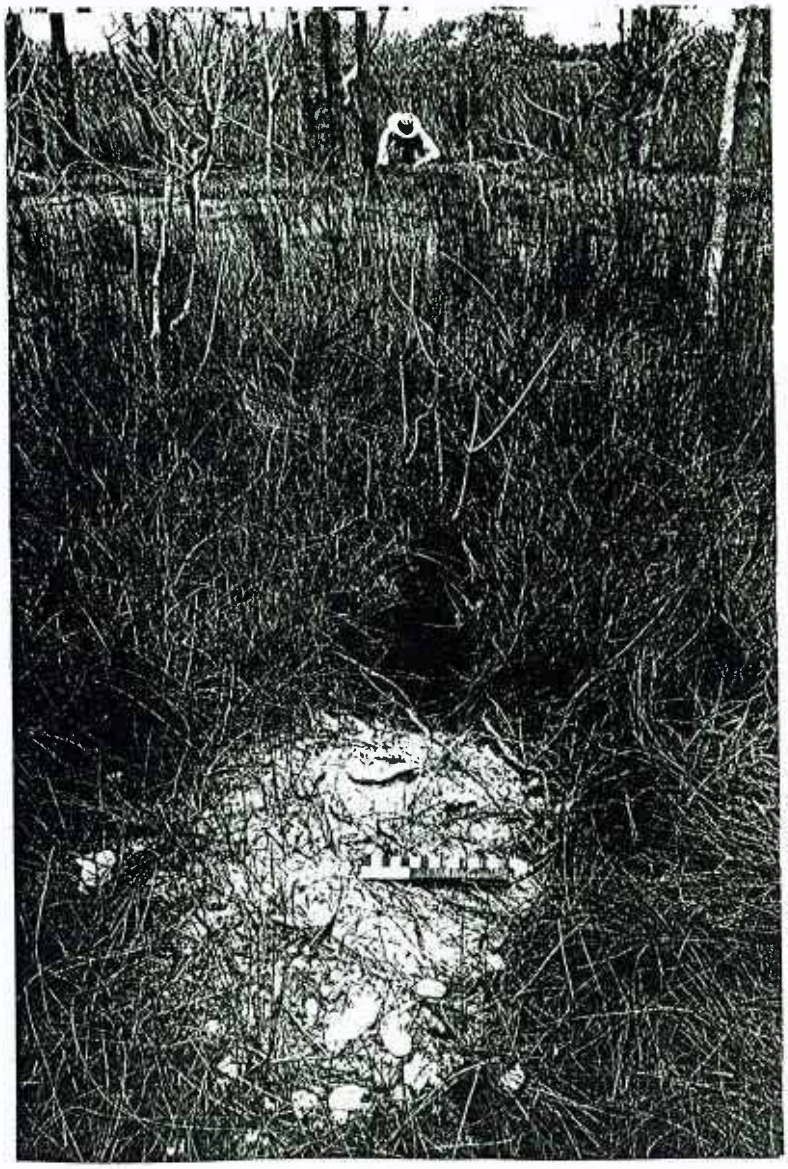
Pl.1: View over wetlands towards ridge north of study area.

Pl.2: View north towards Monkey Jacket from near Location 4.



Pl.3: South of Monkey Jacket dense vegetation continues to the water's edge.

Pl.4: Shell Midden - Location 1, camera facing south.

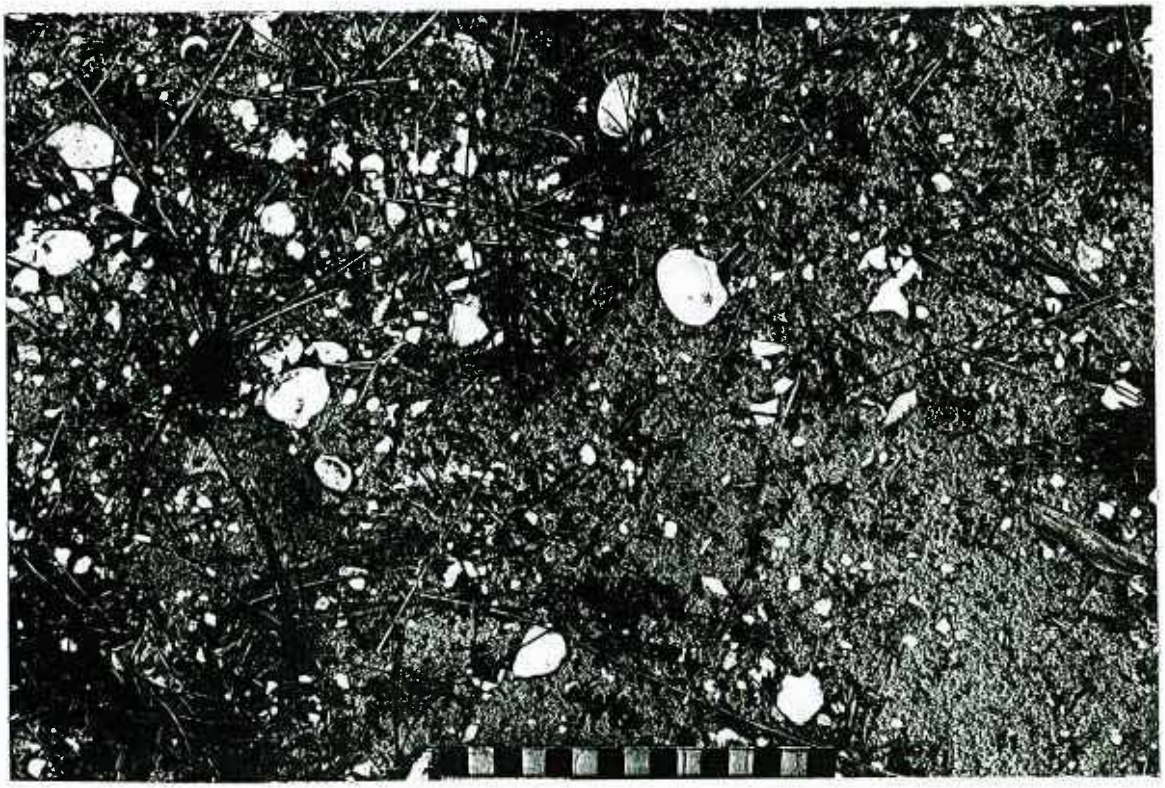


Pl.5: Location 1 shells exposed 30cm deep in burrow, camera facing east.

Pl.6: Shell Midden - Location 2, camera facing north.

Pl.7: Location 2 - detail.

Pl.8: View south east from Location 3 - Dredge Island on left.



Pl.9: Location 3 - detail.

Pl.10: Shell Midden - Location 4, view south east of grassy area surrounded by Swamp Oaks.

Pl.11: Location 4 - small shell exposure.

Annex B

Consultation Log

Table B.1 Consultation Stage 1: Advisory Requests

Date	Organisation/group/individual	Contact Name	Details
04-May-07	Myall Coast Nota	N/A	Ad to appear on Thursday 10th May 2007, given response date of 24 May 2007. Response from Jan Webb.
04-May-07	Native Title Services	N/A	Search of NNTT website of Great Lakes LGA shows 9 non-claimant application (one of which was for the Forster LALC and was full-approved), and one claimant application, which is active. This was for Mrs Mirinda Avery-Slater and Ors, but it is for the area of Forster-Tuncurry.
04-May-07	DECC	Brendan Diacono	Email requesting groups to consult. Letter received 15/05/07 identifying 1 Aboriginal party who may be interested in being consulted.
04-May-07	Registrar of Aboriginal Owners	Megan Mebberson/Adam Black	Email requesting groups to consult. Email received 10/5/07 with list of two Local Aboriginal Land Councils (Worimi and Karuah) and Ms Jackie Henderson. As the area is only within the Karuah LALC area, no further consultation was undertaken with Worimi LALC.
04-May-07	Great Lakes Council	Alex Caras	Email requesting groups to consult. Email received 7/5/07 with list of four Local Aboriginal Land Councils (Worimi, Purfleet-Taree, Karuah and Forster). As the area is only within the Karuah LALC area, no further consultation was undertaken with the other three LALCs. Email also suggested checking for cultural values in the Local Environmental Study for the Myall River Downs opposite, however this did not identify any relevant cultural values.
04-May-07	Karuah LALC	N/A	Email requesting groups to consult.
10-May-07	Interim Board of Management for Worimi Conservation Lands	Jackie Henderson	Email requesting groups to consult.
16-May-07	Guiwain Elder Group	N/A	Letter requesting groups to consult. (NB. In a previous job, ERM tried to post this group a letter to the address given by DECC but it came back marked Return To Sender. Looked on whitepages, yellowpages, blackpages, ORAC and google but could not find any mention of them so posted to the address given by DECC.)
24-May-07	Guiwain Elder Group	N/A	Letter requesting groups to consult returned to sender as "wrong box number".
07-Jun-07	Maaiangal Cultural & Heritage	N/A	Phone call to see whether they are interested in being consulted.
15-Jun-07	Maaiangal Cultural & Heritage	N/A	Phone call to see whether they are interested in being consulted. They said that the study area is not within their area of interest.

Table B.2 Consultation Stage 1: Aboriginal Group Registrations Received

Date	Organisation/group/individual	Contact Name	Details
15-May-07	Karuah LALC	Priscilla Mason	Email expressing interesting in being consulted on the project.
18-May-07	N/A	Jan Webb	Fax in response to newspaper article, expressing interesting in being consulted on the project.
07-Jun-07	Interim Board of Management for Worimi Conservation Lands	Jackie Henderson	Email with list of two Local Aboriginal Land Councils (Worimi and Karuah) and Maaiangal Cultural & Heritage. As the area is only within the Karuah LALC area, no further consultation was undertaken with Worimi LALC.

Table B.3 Consultation Stage 2: Briefing and Desktop Methodology Advice Sent

Date	Organisation/group/individual	Contact Name	Details
14-Jun-07	Karuah LALC	Priscilla Mason	Email of proposed methodology with response date of 5 July 2007. Rang and left message, and emailed, on 23/07/2007 to see if they had any further comments.
14-Jun-07	N/A	Jan Webb	Fax of proposed methodology with response date of 5 July 2007. Rang 23/07/2007 to see if she had a response, but she said she hadn't received it, so I resent it and confirmed that it had arrived.
14-Jun-07	Interim Board of Management for Worimi Conservation Lands	Jackie Henderson	Email of proposed methodology with response date of 5 July 2007.

Table B.4 Consultation Stage 2: Aboriginal Comments Received

Date	Organisation/group/individual	Contact Name	Details
15-Jun-07	Hunter region Aboriginal heritage officer	Steve Braerton	Phone call saying Jackie Henderson had been in touch with him about my recent correspondence. He said I should contact Karuah LALC and DECC in Coffs Harbour, which we had already done.
25-Jul-07	N/A	Jan Webb	Jan said she was happy with the methodology and that the midden wouldn't be disturbed. She said that she was a member of the Land Council and knew that they were also aware of the midden and that it wouldn't be disturbed.
25-Jul-07	Karuah LALC	Priscilla Mason	Priscilla said they were happy with that methodology, as the midden material wasn't to be disturbed.

Table B.5 Consultation Stage 2: Briefing and Survey Methodology Advice Sent

Date	Organisation/group/individual	Contact Name	Details
18-Mar-08	KLALC	Margaret Wright-Wilson	Spoke to Margaret and gave her a very brief background on the history of the project and the requirement for an updated field survey and assessment. KLAC only opened Tuesday and Wednesday so I will ensure that the methodology is emailed before Tuesday. Confirmed email address.
18-Mar-08	N/a	Jan Webb	Spoke to Jan and informed her that the project was ongoing and that DECC had requested further survey worked as the original survey was 20 years old. Jan indicated that she may be able to attend the survey. If not she would still like to review the draft report. She is in contact with the LALC in the event that she is unable to attend the survey due to work commitments. Noted new postal address.
18-Mar-08	Interim Board of Management for Worimi Conservation Lands	Jackie Henderson	Left message and contact details for Jackie.
20/03/2008	Interim Board of Management for Worimi Conservation Lands	Jackie Henderson	Called Jackie. She has passed on the ERM contacts details to the liaison officer but as yet have not heard from them. Will send the proposed methodology to Jackie and she will pass it on. Noted new postal address.
20/03/2008	Karuah LALC	Margaret Wright-Wilson	Email of proposed methodology with response date of 5 July 2007. Rang and left message, and emailed, on 23/07/2007 to see if they had any further comments.
20/03/2008	N/A	Jan Webb	Fax of proposed methodology with response date of 5 July 2007. Rang 23/07/2007 to see if she had a response, but she said she hadn't received it, so I resent it and confirmed that it had arrived.
20/03/2008	Interim Board of Management for Worimi Conservation Lands	Jackie Henderson	Email of proposed methodology with response date of 5 July 2007.

Table B.6 Consultation Stage 2: Aboriginal Comments Received

Date	Organisation/group/individual	Contact Name	Details
8/04/2008	KLAC	Margaret Wright-Wilson	Phoned Margaret to see if they had any comments on the proposed methodology. They will not be able to respond until next Tuesday 15 April 2008 as she has not been able to get anyone in to the office until then.
15/04/2008	KLALC	Margaret Wright-Wilson	Phoned Margaret to see if they had any comments and to confirm survey details. Priscilla will give me a call to organise the fieldwork for next week.
16/04/2008	KLALC	Priscilla Mason	Phoned Priscilla. Two people from the LALC will attend the survey next week. I will send her all of the meeting details and she will pass it on. Any day next week is fine. Told her that it is expected to take one day, however if it requires more we will continue until it is complete.
17/04/2008		Priscilla Mason	Sent email confirming survey for Monday 21/04/08 at 9.30am.
18/04/2008	KLALC	Priscilla Mason	Phoned Priscilla to confirm that she received the survey details.
18/04/2008	N/a	Jan Webb	Phoned Jan to see if she had any comments on the proposed methodology and to confirm the surveys date/time. Jan did not receive the methodology but would like to attend the survey. Confirmed details.
18/04/2008	Interim Board of Management for Worimi Conservation Lands	Jackie Henderson	Left message and contact details for Jackie. Confirmed that LALC and Jan Webb would be undertaking the survey on Monday and that she could call me to confirm the details if they wanted to attend. If not, I will send draft copies of the report for their review and comment.

Table B.7 Consultation Stage 3: Draft Report Sent

Date	Organisation/group/individual	Contact Name	Details
31/07/2008	Karuah LALC	Priscilla Mason	Posted hardcopy of draft report requesting feedback within two weeks.
31/07/2008	N/A	Jan Webb	Posted hardcopy of draft report requesting feedback within two weeks.
31/07/2008	Interim Board of Management for Worimi Conservation Lands	Jackie Henderson	Posted hardcopy of draft report requesting feedback within two weeks.

Table B.8 Consultation Stage 3: Aboriginal Comments Received

Date	Organisation/group/individual	Contact Name	Details
5/08/2008	KLAC	Margaret Wright-Wilson	Response received via fax (as attached). KLALC agrees with the recommendations although they would like to see more thorough investigation of known sites if the concept plan is amended. They also recommended that a keeping place is set aside.
5/08/2008	DECC Cultural and Heritage Division Northern	Lennie Anderson	Response received via email (draft report forwarded to DECC for comment by Jackie Henderson).

Table B.9 Consultation Stage 3: Follow up on Aboriginal Comments Received

Date	Organisation/group/individual	Contact Name	Details
20/08/2008	KLAC	Margaret Wright-Wilson	Spoke to Margaret to clarify their recommendations. KLALC agree with the recommendations contained in the report including the provision of a minimum 10m buffer around the midden site, the preparation of a management plan prior to development commencing in the tourist precinct. KLALC also request the monitoring of all excavations works within the development area. In addition to the original recommendations, as requested by KLALC, the developer will set aside an area for the containment of any cultural material if it is uncovered during the monitoring works. It is also recognised that further surface/sub surface investigations may be required if the concept plan is amended to further assess the significance of the recorded sites. No further surveys are recommended by the KLALC in regards to the current proposal.
22/08/2008	DECC Cultural and Heritage Division Northern	Lennie Anderson	Spoke to Lennie to clarify the recommendations provided by DECC. Confirmed that KLALC agree with the recommendations contained in the report and the developer will set aside an area for the containment of any cultural material if it is uncovered during the monitoring works, as recommended. DECC indicated that the recommended 10m buffer and management plan as agreed with the KLALC would be sufficient to protect the recorded site. As the concept plan provides a large buffer to the SEPP14 wetland and does not include any marinas or other shoreline activities, the need for a management plan to minimise impact on inter-tidal aquatic habitat and coastal processes is not a requirement. This was followed up by email to confirm that follow up consultation had been undertaken and that the KLALC was happy with the recommendations contained in the report.

Annex C

Consultation Responses

Karuah Local Aboriginal Land Council
ABN 17 304 066 465

Ph: (02) 49 975733
Fax: (02) 49 975750
Email: klalc@optusnet.com.au

PO Box 30
16 Mustons Rd
KARUAH NSW 2324

Environmental Resources Management Australia
Referred to: Ref. No.
Date Received 07 AUG 2008
Checked By: Date:

Environmental Resources Management Australia
53 Bonville Avenue (PO Box 71)
Thornton NSW 2322

August 5, 2008

Dear Joanne

Re: Riverside Aboriginal Cultural Heritage Assessment at Tea Gardens

We agree with the recommendations in the survey report however we also feel that there should be a more thorough investigation of the known areas. This should include mapping and monitoring and would require extensive surveying. We recommend that Karuah Local Aboriginal Land Council be involved in further surface surveys.

Further to our recommendation and area should be set aside as a keeping place for community assessment of any artefacts.

Yours faithfully

M Wright-Wilson.

Margaret Wright-Wilson
For Karuah Local Aboriginal Land Council

FAXED

Joanne Woodhouse

From: Anderson Lennie [Lennie.Anderson@environment.nsw.gov.au]
Sent: Tuesday, 5 August 2008 1:06 PM
To: Joanne Woodhouse
Cc: Dunn Ciaron; Naden Hilton; klalc@optusnet.com.au; beatle4864@bigpond.com
Subject: Draft Report Aboriginal Heritage Assessment at Tea Gardens NSW REF: 0043707 ARCH_LO2 WCL.DOC

Dear Joanne

After reviewing the documentation (as offered) and in the realisation of the recommendations put forward I would like to offer these subject matters from Culture and Heritage Division (Northern).

They are:

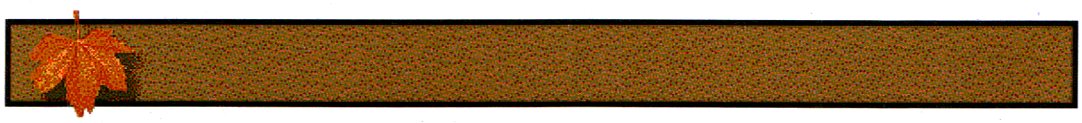
- The recommendation to conduct a Management Plan which will minimise impact on inter-tidal aquatic habitat and existing Coastal processes.
- The Karuah Land Council has identified a number of areas within the development (as well as adjacent areas) which are of particular Cultural significance. Protective "buffer zones" were consequently identified and must be constructed under the direction of the Karuah LALC
- A suitable area is set aside for the containment of any Cultural Material that is uncovered/discovered, so as to maintain spiritual contact. This could be a dedicated "Keeping Place" that would be under care and control of the Aboriginal Community.
- Culture and Heritage Division (Northern) can assist the community in the CCHMP and provide "Incident Response" formats.
- In recognition of the physical aspects as noted in this study, CHD would also consider it applicable to view an "Intellectual and Spiritual" Property Rights Report or Cultural Heritage Report that has been undertaken by the Aboriginal Community (Karuah LALC) before any further processes are undertaken.

Hoping this information has been of help to this proposal, and please call the nominated Office or my mobile 0429-605-309 if I can be of any further assistance

Regards

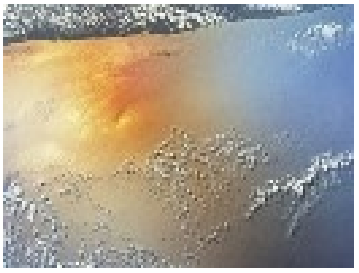
Lennie Anderson
Aboriginal Liaison Officer
Cultural and Heritage Division Northern

Phone 4984 8257
Fax 4981 5913



ERM consulting services worldwide **www.erm.com**

Environmental Resources Management Australia
53 Bonville Ave
Thornton NSW 2322
Telephone (02) 4964 2150
Facsimile (02) 4964 2152



Volume 3B: Servicing Strategy

SERVICING STRATEGY

for

THE PROPOSED RIVERSIDE DEVELOPMENT AND IMMEDIATE ENVIRONS

LOTS 1, 10, 19, 30 & 38 in DP 270100

RIVERSIDE AT TEA GARDENS

PREPARED BY

TATTERSALL SURVEYORS PTY LTD

DEVELOPMENT CONSULTANTS

July 2008

DEVELOPMENT CONSULTANTS IN ENGINEERING, SURVEYING AND PLANNING

Tattersall Surveyors Pty Limited ABN 41 003 509 215

2 Bourke Street, RAYMOND TERRACE 2324 **All mail to**: PO Box 54

Telephone: (02) 4987 1500 **Fax**: (02) 4987 1733 **Email**: attat@hotkey.net.au

DX 21403 RAYMOND TERRACE

TABLE of CONTENTS

INTRODUCTION ***3***

THE PROPOSAL ***3***

SITE DESCRIPTION ***4***

LAND OWNERSHIP ***6***

ADJOINING DEVELOPMENT ***6***

RETICULATION OF SEWER SERVICES ***7***

RETICULATION OF WATER SERVICES ***8***

RETICULATION OF ELECTRICAL AND COMMUNICATION SERVICES ***9***

CONCLUSION ***9***

Appendices

Appendix A – Development Plan

Appendix B – Certificates of Title

Appendix C – Reticulated Vacuum Sewer Servicing Plan

Appendix D – Reticulated Water Servicing Plan

Appendix E – Reticulated Electrical Servicing Plan

Appendix F – Communications Servicing Plan

Appendix G – Typical Footpath Service Allocations

Appendix H – Correspondence with MidCoast Water

INTRODUCTION

The Proposal

Crighton Properties has engaged Tattersall Surveyors Pty Ltd to undertake the development of an appropriate and coordinated servicing strategy for Riverside and adjoining environs. The servicing strategy has been prepared in consultation with the appropriate Services Agencies and includes:-

- MidCoast Water for Water & Sewer Reticulation.
- Country Energy for Electrical Reticulation.
- Telstra for Communications.

Natural Gas is not available and has not been pursued.

This Servicing Strategy has been prepared to consider a holistic approach for the provision of essential services to the area of north Tea Gardens and to be a lead document for the reticulation of major services to other adjoining areas as well as to the future potential major development sites of North Shearwater, Hawks Nest North, Myall River Downs and the partly serviced Tea Gardens Industrial Park.

A copy of the overall Servicing Strategy Project Site is contained within Appendicies C, D and E. Note that Riverside is highlighted and adjoining parcels/future development projects are indicated.

Great Lakes Council has prepared a Tea Gardens & Hawks Nest Conservation & Development Strategy as a strategic document to direct the decision making for the development of identified areas. Riverside is one of the identified areas for development and as it is adjoining the current extents of Tea Gardens is a pivotal development for the reticulation of essential services to most other potential developments to the north, east and west of the site.

As part of the Conservation & Development Strategy, the provision of essential reticulated services is provided through the Riverside project and as can be seen when

viewing the attached plans, the intent of the C&DS is adequately addressed. It is to be noted that in discussions with MidCoast Water, other more appropriate servicing for Hawks Nest North are also considered. Recent correspondence with MidCoast Water is attached in Appendix H.

Site Description

The Riverside Project contains land that is generally to the east of Myall Street, north of Myall Quays Boulevarde and Shoreline Drive, south of Toonang Drive and adjoins the Myall River. Lot 19 is generally south of Shoreline Drive and willcontain parts of the first stage of the development.

The land is generally flat in nature and cleared of any significant vegetation. The proposed Development Plan has evolved to produce a particular footprint that seeks to achieve a balanced outcome within the constraints of the site and the various legislative, planning and operational aspects that can be legitimately achieved.

The site constraints with the land being of a generally flat nature have contributed to MidCoast Water undertaking the construction and commissioning of a state of the art Vacuum Sewer Pumping Station. This type of infrastructure is only becoming a viable option and for this site, an ideal technology that has significant environmental positive outcomes.

Tattersall Surveyors has prepared a servicing strategy for the roll out of the reticulated sewer servicing for all lands within the catchment that this critical infrastructure facility can legitimately service. These plans, included in Appendix C, have yet to be approved by MidCoast Water but their development has provided MidCoast Water the opportunity to commence the introduction of sewer services to the adjoining Tea Gardens Industrial Park.

Areas to the southern side of the Riverside development site are already serviced by a reticulated gravity sewer system and reticulated water supply. Redundancies in the water supply have been developed to assist MidCoast Water in guaranteeing the

provision of its services to other areas within Tea Gardens and this has provided a higher level of supply for MidCoast Water customers.

Reticulated water supplies are available to the current Commercial Area and in part these services are being utilised to service the proposed development. Extensions to the reticulated water system are indicated in Appendix D. Note that with the reticulated water, MidCoast Water is going to provide a second supply to Hawks Nest via the North Shearwater, Riverside and the Hawks Nest North developments. Currently MidCoast Water are somewhat exposed if the single pipe water supply over the Singing Bridge to Hawks Nest is disrupted.

Country Energy is currently proposing to relocate and significantly upgrade its electrical supply network. A relocated Substation is under consideration and its new location is indicated. Existing overhead and underground services have been identified and indicated. Appendix E contains relevant details.

Photograph 1 – Typical Landform to the north of the Shopping Centre

Land Ownership

Lots 19, 30 and 38 DP 270100 are owned by Crighton Properties Pty. Limited, Lot 1 is owned by the Myall Quays Community Association and Lot 10 is owned by Geoff Cox, Managing Director, Crighton Properties. Copies of the Titles are contained in *Appendix B.* Adjoining lands that contain the MidCoast Water Vacuum Sewer Pump Station are owned by Myall River Downs Pty Ltd and this Company is under the Crighton Properties umbrella.

Adjoining Development

Photograph 2 – Commercial/Retail Centre on Myall Quays Boulevarde

All of the existing Development that has either development approval or is constructed in the vicinity of the Shopping Centre or the most northern extremities of Stages 7 and 8 are adequately serviced by reticulated services from existing trunk infrastructure. Parts

of the servicing of these areas will be appropriately extended to support the servicing of the new areas.

Reticulation of Sewer Services

Appendix C contains plans for the reticulation of the Vacuum Sewer system. The overall system currently envisages a roll out of 10 vacuum lines. Three (3) of these lines are to be directed towards Riverside, the Tea Gardens Industrial Park (currently under design) and North Shearwater. Other vacuum lines are being rolled out to accommodate the already approved Hermitage Retirement Village. A Sewer Rising Main servicing MidCoast Water's Bore Fields situated on land to the north of Lot 10 DP 270100 is being accommodated within the Riverside development.

This type of vacuum system has significant environmental advantages over the usual gravity service. Typical advantages are:-

1. Less pumping stations and this means less potential for environmental discharges.
2. Less pumping stations requiring long term maintenance.
3. Significantly less long term groundwater infiltration as the system uses welded plastic PE pipes.
4. Significantly less access chamber infiltration from stormwater as the system uses less access chambers. In some cases there is up to 500m between access chambers on the trunk mains.
5. Higher pipe depths so that the water table will be intercepted less often.

Disadvantages of the system only relate to the location of the services into the front of the dwellings, generally the footpath, and for Greenfield developments, this presents an additional service that needs to be accommodated. Access to valve chambers on a 24 hour basis is one of the requirements of the service. A typical footpath allocation has been prepared and is included in Appendix G.

Riverside would have required the provision of at least eight conventional pumping or lifting stations and this service has been completely replaced by one coordinated

system. A significant reduction in infrastructure costs and future maintenance costs that are inherent with these services has been negated.

The commissioning of the Vacuum Sewer Pumping Station creates the situation of a hugely underutilised facility. The approval of the Riverside development options will enable this facility to commence an appropriate servicing regime and as it has a significant reduction in overall environmental impact, the utilisation of the facility needs to commence without undue delay.

Reticulation of Water Services

Appendix D contains a proposed reorganisation of major water supply services from the existing dual supplies in Myall Street to a triple pipe supply via North Shearwater. This third supply will also be potentially extended to Hawks Nest North via a connection point at the northern parts of the Riverside project.

In addition to the reticulation of potable water, the Riverside Planning Group are currently investigating the potential with MidCoast Water for the reticulation of “grey water” to all new residences within Riverside and areas to the north and west. This “third pipe solution” has the potential to marginally reduce the trunk main sizing and future demands on the potable water supply from the bore fields to the north of Tea Gardens.

Redundancies within the system for reticulated water have been designed to accommodate MidCoast Water requirements and the introduction of this third water main will have significant advantages to all existing clients in the current Tea Gardens/Hawks Nest supply area.

MidCoast Water has, in anticipation of the imminent extension of development options for the north of Tea Gardens, recently completed the upgrading and augmentation of potable water storages at the Viney Creek Road Reservoirs. An additional 8.1ML reservoir has been recently commissioned and will provide sufficient capacity for the future immediate (~10 – 15 years) potable water requirements from the various potential developments.

MidCoast Water has a secure coastal bore water supply that has a known supply capacity far in excess of the requirements of the currently considered potential developments at Riverside, Myall River Downs to the west of Riverside, North Shearwater to the north of Riverside and Hawks Nest North.

Reticulation of Electrical and Communication Services

Electrical (refer Appendix E) and Communications (Appendix F) are considered to be merely an extension of existing services. Crighton Properties has already provided Country Energy with proposed layouts so that they can commence designs for the accommodating of the major new linkages from the existing overhead supplies.

Again these services are providing redundancies to the provision of services which will significantly help in the reduction of brown outs that are of continuing concern in Tea Gardens. Country Energy are also relocating their main supply substation further west along Viney Creek Road and are proposing major upgrading of the facility as well as the incorporation of an adjoining Maintenance Service Depot.

Communication upgrades has already seen Telstra provide additional services to Tea Gardens. Telstra have provided “fibre to the node” for The Hermitage and have offered via its “Smart Communities” program, the provision of services to the other parts of Riverside.

Exiting infrastructure includes fibre-optic technology and this is available along Myall Street.

CONCLUSION

This Servicing Strategy provides for the logical and practical understanding for the provision of essential services for all future residents of Riverside and other adjoining developments. The redundancies that are created are providing high level future resident satisfaction and Service Agency support. The new technology of a Vacuum Sewer service has significant environmental attributes including:-

- Dramatic reduction in Sewer Pumping Station Facilities (cost/environmental discharges.
- Reduce excavations and therefore less groundwater interceptions.
- Negligible wet weather impacts on the infrastructure.

This Pumping Station has been commissioned in 2007 and now provides services to The Hermitage (another Crighton development activity) and the service mains will be extended and made available to provide services for the initial lots made developable in Riverside.

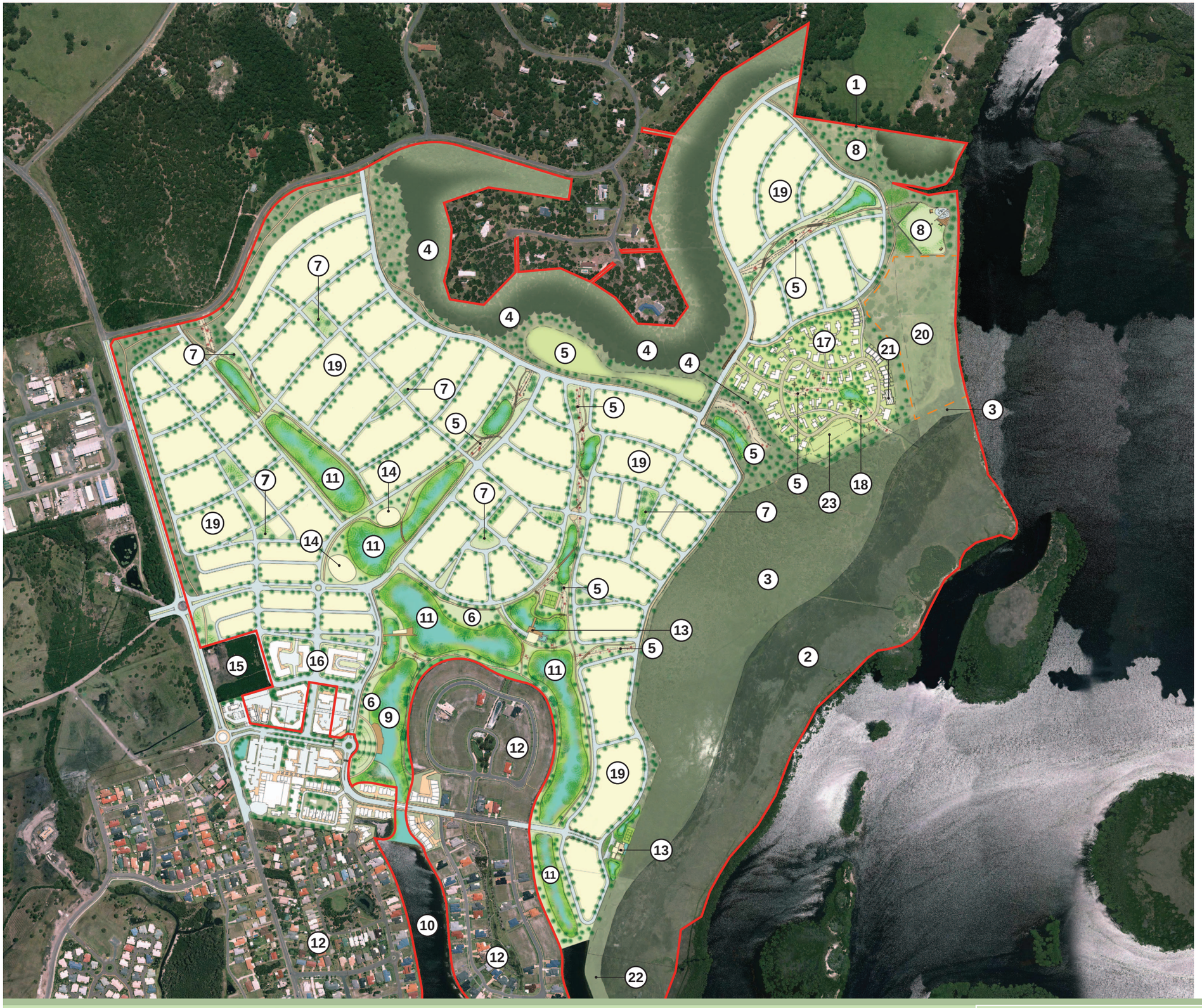
MidCoast Water has also provided sufficient spare capacity with the augmentation of the potable water storages at the Viney Creek Road Reservoirs to ensure that development is not inhibited by any lack of supply capacity.

Other services like the third water main, communications and electrical reticulation will be provided as part of a coordinated process that is appropriately timed in conjunction with developer needs and requirements.

Due to the holistic approach for the provision of services to all areas of the Strategy, undue demands on Supply Authorities is not considered to be excessive and as the Agencies have been historically engaged at all times with the provision of their services for other already produced developments, this good working relationship is a feature of the Crighton Properties operations.

Appendix A:

Development Application Plan



Item	Description
1	Extent of concept plan area 'Riverside' at Tea Gardens.
2	Existing 7(a) wetland zone.
3	Existing 7(b) buffer zone.
4	Wildlife movement corridor.
5	Water management & open space corridors.
6	Community parks incorporating walking/cycle ways, BBQs, children's play area equipment.
7	Community pocket parks.
8	Myall foreshore park.
9	Extended lake area for water detention & water quality management (2.0 Ha).
10	Existing detention and water quality lake.
11	New fresh water water quality management & detention ponds.
12	Existing residential development.
13	Precinct community facilities.
14	Future precinct community facilities.
15	Site area currently owned by Great Lakes Council.
16	Extension of existing commercial precinct. Waiver received (Dept. of Planning).
17	Low density tourist residential lodgings.
18	Conference & community facilities, associated low rise town house accommodation
19	Proposed residential lot development to be developed under community title.
20	Future development site
21	Existing house
22	DCP buffer
23	Location of known midden & buffer

Land Use Legend

Total Site	Ha	%
Open Space		
- Wetlands (zoned 7a)	28.4	12.4
- Buffer Zones (zoned 7b)	20.6	9.0
- Additional Conservation Buffer	1.4	0.6
- Wildlife Corridors	27.3	11.9
- Myall Foreshore Park	5.6	2.4
- Drainage Corridors, Ponds & Large Parks	35.1	15.4
- Pocket Parks	2.6	1.1
- Existing detention & water quality lake	6.7	2.9
Total	**127.7 Ha**	**55.7%**
Built Upon Area		
- Residential (including roads & community facilities)	83.6	36.5
- Tourist/Residential (Lodgings)	8.4	3.7
- Future Development Site	5.0	2.2
- Commercial/Retail	4.3	1.9
Total	**101.3 Ha**	**44.3%**
Total	229.0 Ha	**100%**

Riverside
Tea Gardens Australia

DRAWING TITLE
CONCEPT PLAN

0m 500m

APPLICATION
Part 3a Submission to N.S.W D.O.P

DATE	SCALE	DRAWING No.	REVISION
June 08	**1:4000 @ A1**	**R.C. -03**	**F**

CRIGHTON PROPERTIES

Appendix B:

Copy of Certificate of Title

ACS SEARCH PTY LTD

PO Box A1155, Sydney South NSW 1235. Phone: 02 9267 9728 Fax: 02 9267 9226

http://acssearch.urbispro.com.au

Note: Information contained in this document is provided by GlobalX Information Services Pty Ltd (ABN 99 073 436 414)
www.globalx.com.au an approved broker.

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 1/270100

SEARCH DATE	TIME	EDITION NO	DATE
10/7/2008	2:58 PM	11	18/7/2005

LAND

THE COMMUNITY PROPERTY WITHIN LOT 1 IN COMMUNITY PLAN DP270100
AT TEA GARDENS
LOCAL GOVERNMENT AREA GREAT LAKES
PARISH OF COWEAMBAH COUNTY OF GLOUCESTER
TITLE DIAGRAM DP270100

FIRST SCHEDULE

COMMUNITY ASSOCIATION DP270100
ADDRESS FOR SERVICE OF NOTICES:
C/- MONTEATH & POWYS STRATA MANAGEMENT PTY. LTD
25 BOLTON STREET
NEWCASTLE NSW 2300

SECOND SCHEDULE (20 NOTIFICATIONS)

---

1 RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
2 ATTENTION IS DIRECTED TO THE MANAGEMENT STATEMENT OF THE COMMUNITY SCHEME FILED WITH THE COMMUNITY PLAN
- 5851594 AMENDMENT TO MANAGEMENT STATEMENT. BY LAWS 4.14(C) AND 3.3.5,3.3.6,3.3.7 AND 3.3.8HAVE BEEN REPEALED. NEW BY LAWS 4.14(D)(E)(F),3.3.5(2), 3.3.6(2), 3.3.7(2), 3.3.8(2), 5.3.1, 5.3.2, 5.3.3 AND 5.3.4 ADDED
- 6010962 AMENDMENT TO MANAGEMENT STATEMENT BY LAWS 4.14 (D) & (E) REPEALED. NEW BY LAWS NO 4.14 (G) AND (H) ADDED SEE ANNEXURE 'B' OF THE MANAGEMENT STATEMENT
- 6346634 AMENDMENT TO MANAGEMENT STATEMENT, BY-LAWS 2.1.10 AND 4.16.7 ADDED. SEE ANNEXURE "D" OF THE MANAGEMENT STATEMENT
- 8537409 AMENDMENT TO MANAGEMENT STATEMENT BY-LAW 6.1 ADDED BY-LAW 3.3.5(2) TO 3.3.8(2)REPEALED AND REPLACED WITH BY-LAWS 3.3.5(3) TO 3.3.8(3) INCL SEE ANNEXURE "E" OF THE MANAGEMENT STATEMENT
- AA893519 AMENDMENT TO MANAGEMENT STATEMENT. BY-LAW 5.2.9 ADDED - SEE ANNEXURE 'F'.

3 LAND EXCLUDES MINERALS WITHIN THE PART(S) SHOWN DESIGNATED (B) IN THE TITLE DIAGRAM - SEE CROWN GRANT
4 BK 864 NO 856 LAND EXCLUDES MINERALS WITHIN THE PART SHOWN DESIGNATED (A) IN THE TITLE DIAGRAM
5 DP855274 EASEMENT FOR SERVICES AND DRAINAGE 3.8 WIDE AND

END OF PAGE 1 - CONTINUED OVER

FOLIO: 1/270100 PAGE 2

SECOND SCHEDULE (20 NOTIFICATIONS) (CONTINUED)

		VARIABLE AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
6	DP855274	EASEMENT FOR ACCESS 3.8 WIDE AND VARIABLE AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
7	DP855274	EASEMENT TO DRAIN SEWAGE 3 WIDE AND VARIABLE AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
8	DP855274	EASEMENT FOR ELECTRICITY TRANSMISSION LINES 3.8 WIDE AND VARIABLE AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
9	DP270100	EASEMENT TO DRAIN SEWAGE 3 WIDE AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
10	DP270100	EASEMENT TO DRAIN WATER VARIABLE WIDTH AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
11	3157802	NOTICE OF CONVERSION - PROPERTY NOW INCLUDES LOT 7 DP270100
12	DP270100	EASEMENT TO DRAIN SEWAGE 3 METRE(S) WIDE AND VARIABLE AFFECTING THE PART(S) SHOWN SO BURDENED IN DP270100
13	DP270100	EASEMENT TO DRAIN SEWAGE OVER EXISTING LINE OF PIPES AFFECTING THE PART(S) SHOWN SO BURDENED IN DP270100
14	9852322	NOTICE OF CONVERSION - PROPERTY NOW INCLUDES LOTS 16 AND 21 IN DP270100
15	DP270100	EASEMENT TO DRAIN WATER VARIABLE WIDTH (DOC. 4) AFFECTING THE PART(S) SHOWN SO BURDENED IN THE TITLE DIAGRAM
16	DP738450	RESTRICTION(S) ON THE USE OF LAND AFFECTING THE PART(S) SHOWN SO BURDENED IN THE TITLE DIAGRAM
17	DP786548	RESTRICTION(S) ON THE USE OF LAND AFFECTING THE PART(S) SHOWN SO BURDENED IN THE TITLE DIAGRAM
18	DP270100	EASEMENT TO DRAIN WATER VARIABLE WIDTH (DOC. 5) AFFECTING THE PART(S) SHOWN SO BURDENED IN THE TITLE DIAGRAM
19	DP270100	EASEMENT TO DRAIN WATER 3 METRE(S) WIDE (DOC. 5) APPURTENANT TO THE PART(S) OF THE LAND ABOVE DESCRIBED SHOWN SO BURDENED IN THE TITLE DIAGRAM
20	AB527646	LOTS 10 & 32 DP270100 HAVE BEEN SEVERED FROM SCHEME AND ARE NO LONGER COMPRISED WITHIN THIS COMMUNITY SCHEME

NOTATIONS

DP285341 NOTE: NEIGHBOURHOOD PLAN DP285341 REGISTERED 22/3/1996 SUBDIVIDES LOT 2

DP270100 NOTE: COMMUNITY PLAN OF SUBDIVISION - SUBDIVIDES LOT 4 INTO LOTS 6-9. REGISTERED 2-6-1997

DP285432 NOTE: NEIGHBOURHOOD PLAN DP285432 - REGISTERED 2-6-1997 SUBDIVIDES LOT 6

END OF PAGE 2 - CONTINUED OVER

FOLIO: 1/270100 PAGE 3

NOTATIONS (CONTINUED)

3808403 NOTE: DP270100 CUMMUNITY PLAN OF SUBDIVISION REGISTERED 19-2-1998 SUBDIVIDES LOT 5 INTO LOTS 10-11
DP270100 NOTE: DP270100 REGISTERED 1/7/1999 SUBDIVIDES LOT 9 INTO LOTS 12-14 DP270100
DP270100 NOTE: LOT 12 SEVERED FROM THE COMMUNITY SCHEME
DP285585 NOTE: PLAN OF SUBDIVISION DP285585 REGISTERED 18.8.1999 SUBDIVIDED LOT 13 INTO LOTS 1-26 IN DP285585
DP280001 NOTE: PRECINCT PLAN DP280001 REGISTERED 17.6.2002 SUBDIVIDES LOT 15 INTO LOTS 1-38
NOTE: DP270100 REGISTERED 17.6.2002 SUBDIVIDES LOTS 3, 8, 11 AND 14 INTO LOTS 15 - 19
DP270100 NOTE: REGISTERED 28.8.2002 - SUBDIVIDES LOT 17 INTO LOTS 20-22
DP270100 NOTE: AA95671 SECOND SCHEDULE NOTIFICATIONS 15-19 ADDED AFTER CONVERSION OF LOTS 16 & 21 TO ASSOCIATION PROPERTY
DP270100 NOTE: REGISTERED 21-6-2004. SUBDIVIDES LOT 22 INTO LOTS 23-25 IN DP270100.
DP270100 NOTE: REGISTERED 5-7-2004. SUBDIVIDES LOTS 18 AND 25 INTO LOTS 26-31 IN DP270100.
DP270100 NOTE: REGISTERED 6-7-2004. SUBDIVIDES LOT 31 INTO LOTS 32-34 IN DP270100.
DP280002 NOTE: REGISTERED 6-7-2004. SUBDIVIDES LOT 33 INTO LOTS 1-41 IN PRECINCT PLAN DP280002.
DP270100 NOTE: LOT 10 & LOT 32 SEVERED FROM THE COMMUNITY SCHEME
DP270100 NOTE: REGISTERED 27/8/2007 COMMUNITY PLAN OF SUBDIVISION - SUBDIVIDES LOT 34 INTO LOTS 35-36 IN DP270100
DP270100 NOTE: DP270100.REGISTERED 18.9.2007 SUBDIVIDES LOT 36 INTO LOTS 37-38 IN DP270100.
UNREGISTERED DEALINGS: DP270100 DP270561.

*** END OF SEARCH ***

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LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 10/270100

SEARCH DATE	TIME	EDITION NO	DATE
2/7/2008	10:51 AM	3	13/7/2005

LAND

LOT 10 IN COMMUNITY PLAN DP270100
AT TEA GARDENS
LOCAL GOVERNMENT AREA GREAT LAKES
PARISH OF COWEAMBAH COUNTY OF GLOUCESTER
TITLE DIAGRAM DP270100

FIRST SCHEDULE

GEOFFREY JOHN COX (T 5333813)

SECOND SCHEDULE (8 NOTIFICATIONS)

1 RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
2 INTERESTS RECORDED ON REGISTER FOLIO 1/270100
3 BK 864 NO 856 LAND EXCLUDES MINERALS WITHIN THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
4 DP738450 RESTRICTION(S) ON THE USE OF LAND AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
5 DP786548 RESTRICTION(S) ON THE USE OF LAND AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
6 5333814 MORTGAGE TO STATE BANK OF NEW SOUTH WALES LIMITED
7 AB527646 THIS LOT DOES NOT FORM PART OF A COMMUNITY SCHEME
* 8 DP1118863 EASEMENT FOR ACCESS OVER TRACK IN USE APPURTENANT TO THE LAND ABOVE DESCRIBED

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

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LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 19/270100

SEARCH DATE	TIME	EDITION NO	DATE
10/7/2008	2:54 PM	1	17/6/2002

LAND

LOT 19 IN COMMUNITY PLAN DP270100
AT TEA GARDENS
LOCAL GOVERNMENT AREA GREAT LAKES
PARISH OF COWEAMBAH COUNTY OF GLOUCESTER
TITLE DIAGRAM DP270100

FIRST SCHEDULE

CRIGHTON PROPERTIES PTY. LIMITED

SECOND SCHEDULE (6 NOTIFICATIONS)

---

1 RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
2 INTERESTS RECORDED ON REGISTER FOLIO 1/270100
3 ATTENTION IS DIRECTED TO THE MANAGEMENT STATEMENT OF THE COMMUNITY SCHEME FILED WITH THE COMMUNITY PLAN
4 LAND EXCLUDES MINERALS WITHIN THE PART(S) SHOWN DESIGNATED (B) IN THE TITLE DIAGRAM - SEE CROWN GRANT
5 BK 864 NO 856 LAND EXCLUDES MINERALS WITHIN THE PART(S) SHOWN DESIGNATED (A) IN THE TITLE DIAGRAM
6 5413147 MORTGAGE TO AUSTRALIA AND NEW ZEALAND BANKING GROUP LIMITED

NOTATIONS

NOTE: THE CERTIFICATE OF TITLE FOR THIS FOLIO OF THE REGISTER DOES NOT INCLUDE SECURITY FEATURES INCLUDED ON COMPUTERISED CERTIFICATES OF TITLE ISSUED FROM 4TH JANUARY, 2004. IT IS RECOMMENDED THAT STRINGENT PROCESSES ARE ADOPTED IN VERIFYING THE IDENTITY OF THE PERSON(S) CLAIMING A RIGHT TO DEAL WITH THE LAND COMPRISED IN THIS FOLIO.
UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

Tattersall Surveyors Pty Ltd PRINTED ON 10/7/2008

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LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 30/270100

SEARCH DATE	TIME	EDITION NO	DATE
10/7/2008	2:58 PM	2	5/7/2004

LAND

LOT 30 IN COMMUNITY PLAN DP270100
AT TEA GARDENS
LOCAL GOVERNMENT AREA GREAT LAKES
PARISH OF COWEAMBAH COUNTY OF GLOUCESTER
TITLE DIAGRAM DP270100

FIRST SCHEDULE

CRIGHTON PROPERTIES PTY LIMITED

SECOND SCHEDULE (11 NOTIFICATIONS)

---

1 RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
2 INTERESTS RECORDED ON REGISTER FOLIO 1/270100
3 ATTENTION IS DIRECTED TO THE MANAGEMENT STATEMENT OF THE COMMUNITY SCHEME FILED WITH THE COMMUNITY PLAN
4 THE LAND ABOVE DESCRIBED IS LIMITED IN STRATUM IN THE MANNER DESCRIBED IN DP270100 (SHEETS 21 & 22)
5 BK 864 NO 856 LAND EXCLUDES MINERALS
6 DP738450 RESTRICTION(S) ON THE USE OF LAND
7 DP786548 RESTRICTION(S) ON THE USE OF LAND
8 DP270100 EASEMENT FOR WATER SUPPLY 3 METRE(S) WIDE,4 METRES WIDE AND VARIABLE AFFECTING THE PART(S) SHOWN SO BURDENED IN THE TITLE DIAGRAM (DOC.4)
9 DP270100 EASEMENT FOR TRANSMISSION 1 METRE WIDE, 4 METRES WIDE & VARIABLE AFFECTING THE PART(S) SHOWN SO BURDENED IN THE TITLE DIAGRAM (DOC.4)
10 AA682643 MORTGAGE TO AUSTRALIA AND NEW ZEALAND BANKING GROUP LIMITED OF THE PART FORMERLY IN 25/270100
11 DP270100 EASEMENT TO DRAIN WATER VARIABLE WIDTH REFERRED TO AND NUMBERED (4) IN THE S.88B INSTRUMENT AFFECTING THE WHOLE OF THE LAND ABOVE DESCRIBED (DOC.7)

NOTATIONS

UNREGISTERED DEALINGS: DP270561 DP280012.

*** END OF SEARCH ***

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LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 38/270100

SEARCH DATE	TIME	EDITION NO	DATE
2/7/2008	10:51 AM	3	16/2/2008

LAND

LOT 38 IN COMMUNITY PLAN DP270100
AT TEA GARDENS
LOCAL GOVERNMENT AREA GREAT LAKES
PARISH OF COWEAMBAH COUNTY OF GLOUCESTER
TITLE DIAGRAM DP270100

FIRST SCHEDULE

CRIGHTON PROPERTIES PTY LIMITED

SECOND SCHEDULE (11 NOTIFICATIONS)

1 RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
2 INTERESTS RECORDED ON REGISTER FOLIO 1/270100
3 ATTENTION IS DIRECTED TO THE MANAGEMENT STATEMENT OF THE COMMUNITY SCHEME FILED WITH THE COMMUNITY PLAN
4 BK 864 NO 856 LAND EXCLUDES MINERALS
5 DP738450 EASEMENT TO DRAIN WATER 6 METRE(S) WIDE AFFECTING THE PART(S) SHOWN SO BURDENED IN THE TITLE DIAGRAM
6 DP738450 RESTRICTION(S) ON THE USE OF LAND
7 DP786548 RESTRICTION(S) ON THE USE OF LAND
8 DP270100 EASEMENT TO DRAIN WATER VARIABLE WIDTH AFFECTING THE WHOLE OF THE LAND ABOVE DESCRIBED (DOC.8)
9 DP270100 RIGHT OF ACCESS 6.5 METRE(S) WIDE APPURTENANT TO THE PART SHOWN SO BENEFITED IN THE TITLE DIAGRAM (DOC.9)
10 DP1118863 EASEMENT FOR ACCESS OVER TRACK IN USE AFFECTING THE PART(S) SHOWN SO BURDENED IN DP1118863
11 AD771287 MORTGAGE TO AUSTRALIA AND NEW ZEALAND BANKING GROUP LIMITED

NOTATIONS

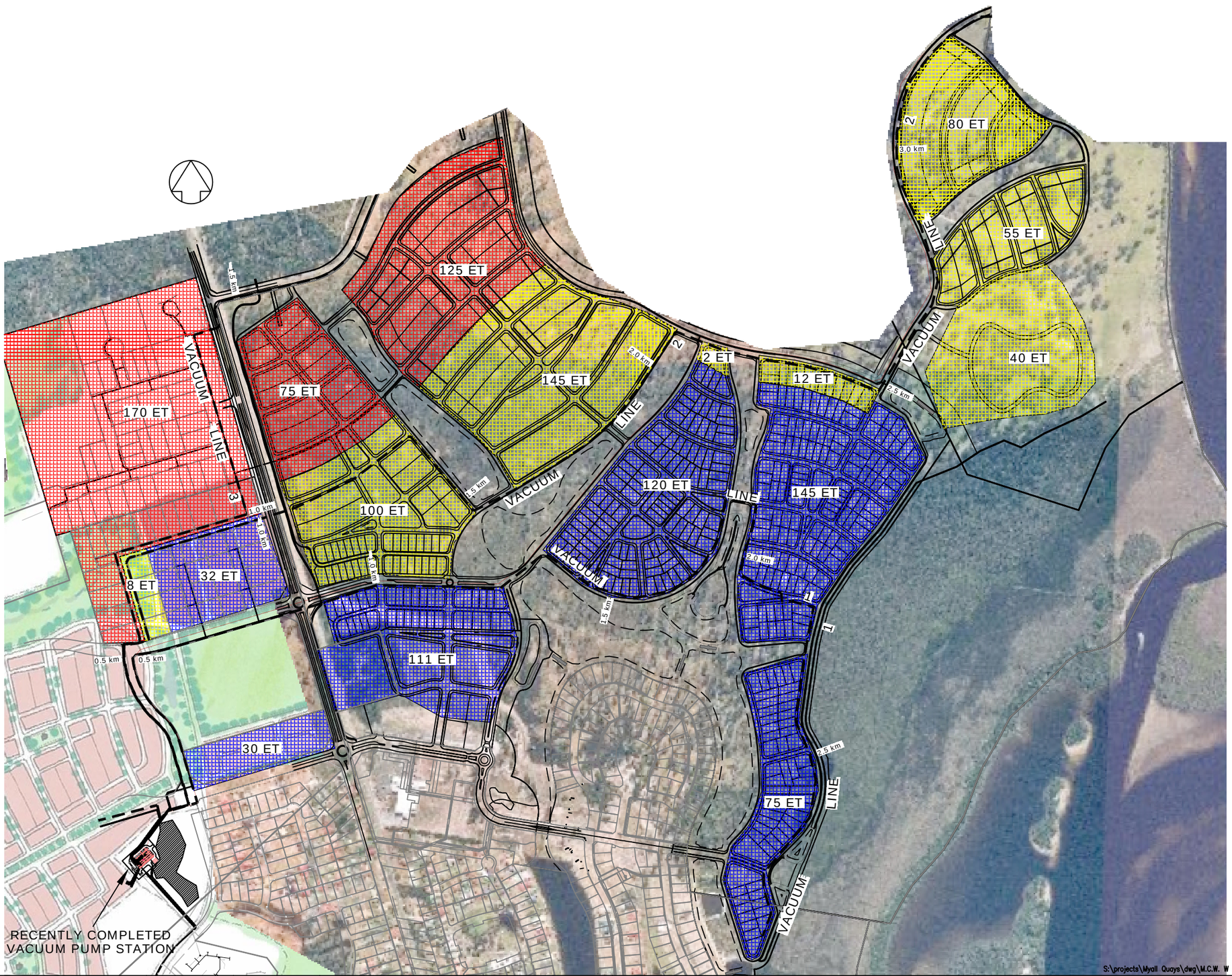
UNREGISTERED DEALINGS: DP270100 DP280012.

*** END OF SEARCH ***

Appendix C:

Reticulated Vacuum Sewer Servicing Strategy

	VACUUM LINE	CAPACITY	ET TAKEUP	AVAILABLE CAPACITY	INDICITIVE MAIN LENGTH
	1	675	512	163	2.9km
	2	675	550	125	3.9km
	3	675	575	100	3.1km



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REV.	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED	DATE
D	Revised Layout & ET Count	DWK	DWK			
C	North Shearwater Main Removed	AV	AV	G.H.*	R.L.*	15/09/07*
B	Revised Layout	AV	AV	-	-	13/07/07*
A	Original Issue to M.C.W.	DWK	DWK	-	-	22/03/07*

FILE No.: 910370 | DRAWN:
SHEET 1 OF 2 | CHECKED:
DATE: | PASSED:

SCALE:
HORIZONTAL: 1:4000
PLOT SCALE: 1:2
SHEET SIZE: A1

Local Government Area
GREAT LAKES

HORIZONTAL
CO-ORDINATE SYSTEM:
MARKS ADOPTED:
EAST: NORTH:

MIDCOAST WATER PROJECT ASSET No.
.....

VERTICAL
DATUM:
B.M. ADOPTED:
RL:

PLOT FILE/DWG No.: 20600220

Plotted 11:13 07/08/08

TATTERSALL SURVEYORS
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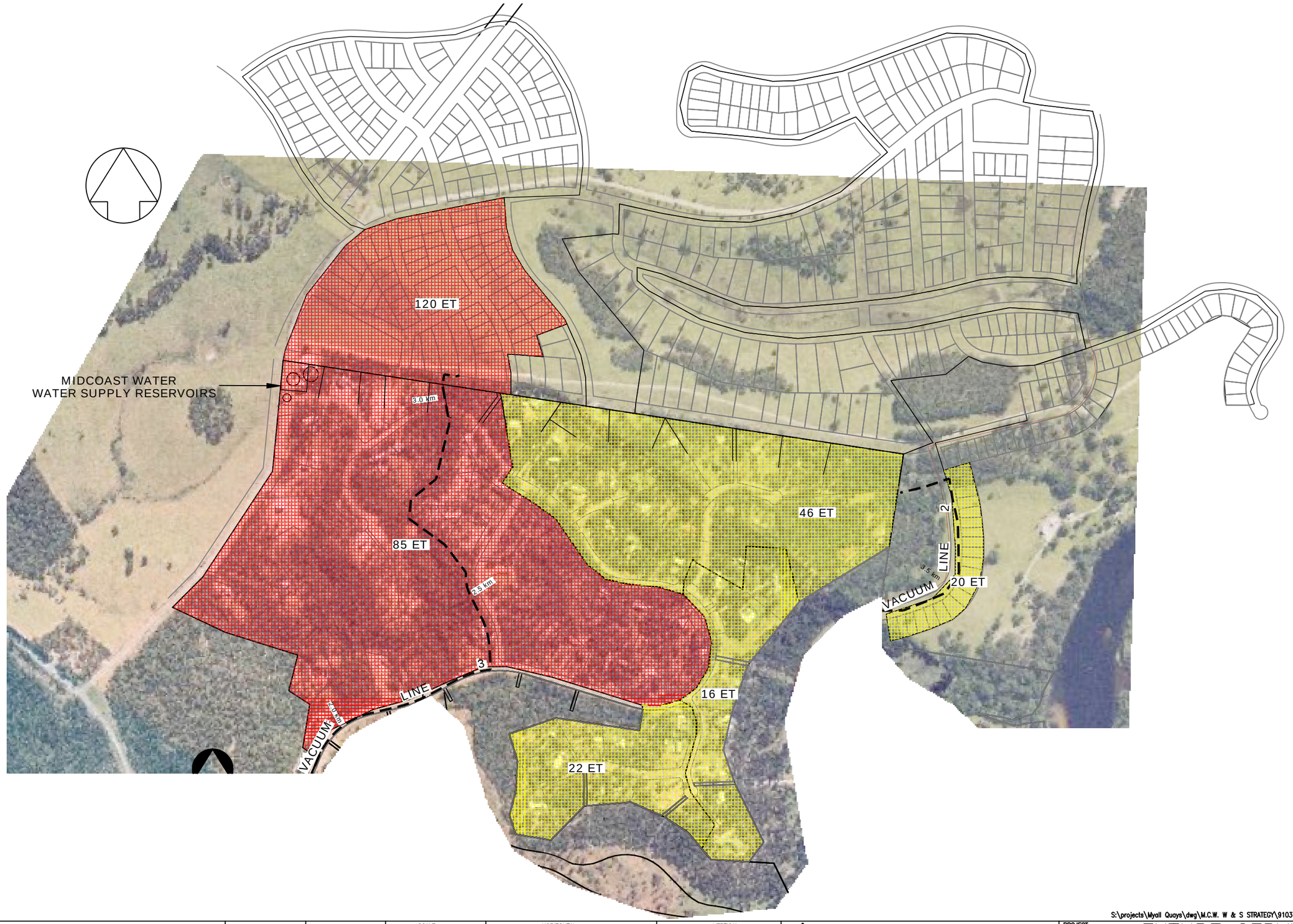
2 Bourke St. Box 54
RAYMOND TERRACE 2324
Phone (02) 49871500
DX 21403 RAYMOND TERRACE
Email: attat@hotkey.net.au

PROJECT

FUTURE SERVICING OF TEA GARDENS RIVERSIDE

VACUUM SEWER SERVICING STRATEGY

	VACUUM LINE	CAPACITY	ET TAKEUP	AVAILABLE CAPACITY	INDICITIVE MAIN LENGTH
	1	675	512	163	2.9km
	2	675	550	125	3.9km
	3	675	575	100	3.1km



S:\projects\Myall Quays\dwg\M.C.W. W & S STRATEGY\910370–myall quays (riverside) w & s strategy.dwg

AMENDMENTS:

REV.	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED	DATE
D	Revised Layout & ET Count	DWK	DWK			
C	North Shearwater Main Removed	AV	AV	G.H.*	B.L.*	13/07/07*
B	Revised Layout	AV	AV	-	-	13/07/07*
A	Preliminary Issue	AV	AV	-	-	22/03/07*

FILE No.: 910370
SHEET 2 OF 2
DATE:
DRAWN:
CHECKED:
PASSED:

SCALE:
HORIZONTAL: 1:4000
PLOT SCALE: 1:2
SHEET SIZE: A1
Local Government Area
GREAT LAKES

HORIZONTAL
CO–ORDINATE SYSTEM:
MARKS ADOPTED:
EAST: NORTH:
MIDCOAST WATER PROJECT ASSET No.
.....

VERTICAL
DATUM:
B.M. ADOPTED:
R.L.:
PLOT FILE/DWG No.: 20600222
Plotted 11:16 07/08/08

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Email: attat@hotkey.net.au

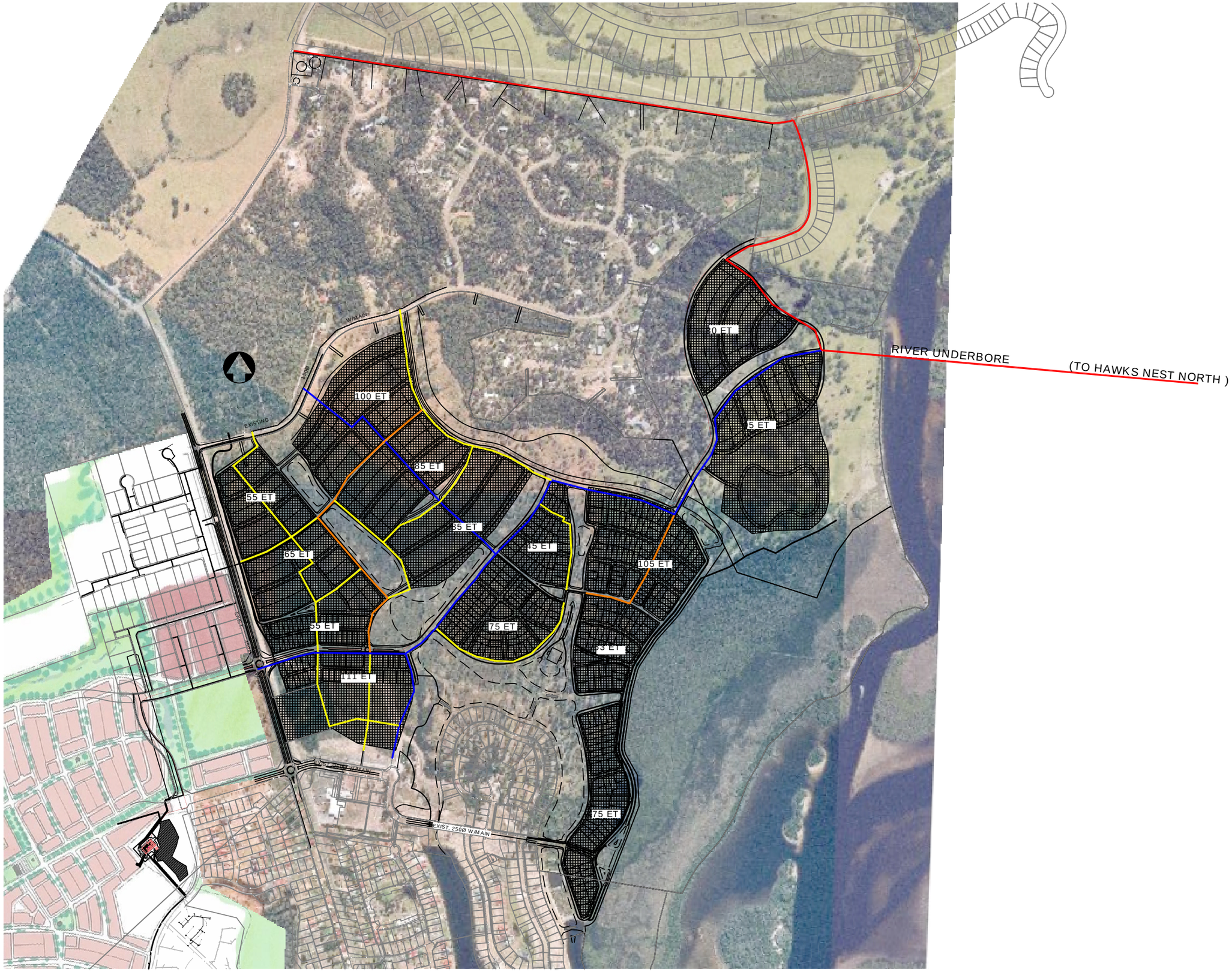
PROJECT

FUTURE SERVICING OF TEA GARDENS SHEARWATER ESTATE & DURNESS STATION

VACUUM SEWER SERVICING STRATEGY

Appendix D:

Reticulated Water Servicing Strategy



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AMENDMENTS:

REV.	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED	DATE
C	Revised Layout & ET Count	DWK	DWK			
B	Revised Layout	AV	AV	G.H.*	B.L.*	13/07/07*
A	Original Issue to M.C.W.	DWK	DWK	-	-	22/03/07*

FILE No.: 910370
SHEET 1 OF 1
DATE:

DRAWN:
CHECKED:
PASSED:

SCALE:
HORIZONTAL: 1:5000
PLOT SCALE: 1:2
SHEET SIZE: A1
Local Government Area
GREAT LAKES

HORIZONTAL
CO-ORDINATE SYSTEM:
MARKS ADOPTED:
EAST: NORTH:
MIDCOAST WATER PROJECT ASSET No.
.....

VERTICAL
DATUM:
B.M. ADOPTED:
RL:
PLOT FILE/DWG No.: 20600198
Plotted 11:04 07/08/08

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PROJECT

FUTURE SERVICING OF TEA GARDENS RIVERSIDE
WATER SERVICING STRATEGY

Appendix E:

Reticulated Electrical Servicing Strategy

PROPOSED MAINTENANCE SERVICE DEPOT

EXISTING COUNTRY ENERGY SUBSTATION (TO BE RELOCATED)

EXISTING INDUSTRIAL AREA

UPGRADED RELOCATED COUNTRY ENERGY SUBSTATION

PROPOSED MYALL RIVER DOWNS ESTATE

PROPOSED INDUSTRIAL AREA

EXISTING

FUTURE

SHEARWATER

NORTH

SHEARWATER

ESTATE

ESTATE

EXISTING COMMERCIAL AREA

EXISTING

RESIDENTIAL

ESTATE

RIVERSIDE ESTATE

	STAGE
	1
	2
	3

EXISTING OVERHEAD POWER

EXISTING UNDERGROUND POWER

PROPOSED 11KV TRUNK UNDERGROUND POWER

PROPOSED KIOSK

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised Layout	DWK	DWK			
A	Original Issue	AV	AV	G.H.	B.L.	13/07/07*

* Denote the original signature and date when revision was issued.

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DX 21403 RAYMOND TERRACE

FUTURE SERVICING OF TEA GARDENS RIVERSIDE ELECTRICAL SERVICING STRATEGY

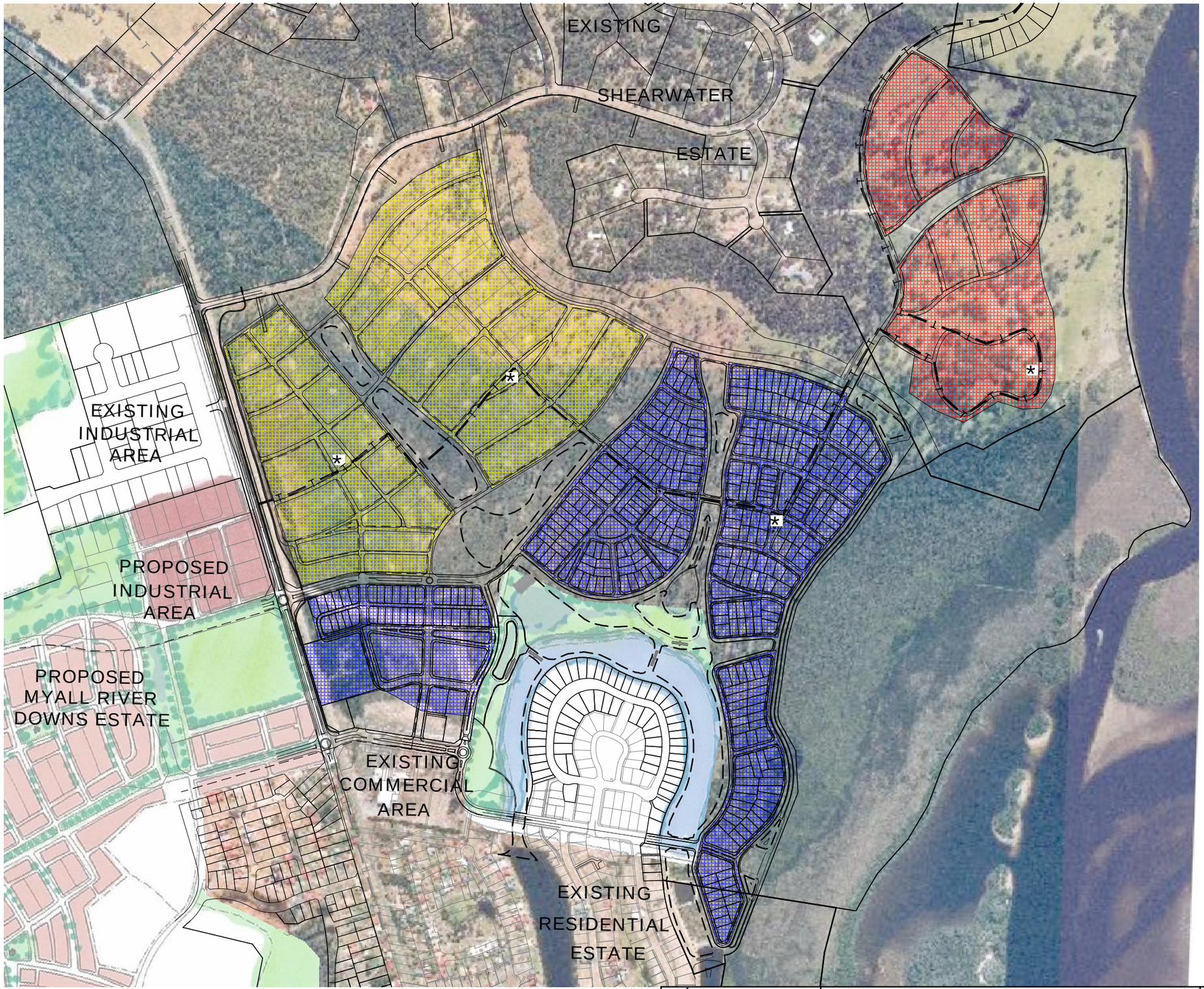
COUNCIL: GREAT LAKES	REFERENCE: 20700087
PARISH: COWEAMABH	SHEET SIZE: A1
SCALE: 1: 4000	SHEET No.: 1
DATE : Plotted 11:43 07/08/08	

CLIENT: CRIGHTON PROPERTIES PTY LTD | JOB No.: 910370 | COMPUTER FILE : S:\projects\Myall Quays\dwg\M.C.W. W & S STRATEGY\910370-myall quays (riverside) elec strategy.dwg

Xref: 920428 - Boundary Xref [920428 - Boundary Xref.dwg] Xref: 201478 - Stg 8 Bdy [201478 - Stg 8 Bdy.dwg] Xref: Shearwater Boundaries xref [Shearwater Boundaries xref.dwg] Xref: INDUSTRIAL AREA XREF [INDUSTRIAL AREA XREF.dwg] Xref: 910370 - BDY [910370 - BDY.dwg] Xref: 202400-ComSite [202400-ComSite.dwg] Xref: Stg 9 [Stg 9.dwg]

Appendix F:

Communications Servicing Strategy



RIVERSIDE ESTATE

STAGE
1
2
3

EXISTING OPTICAL FIBRE CABLE

PROPOSED OPTICAL FIBRE CABLE

PROPOSED COMMUNICATION CABLE

PROPOSED COMMUNICATION NODE FACILITY *

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised Layout	DWK	DWK			
A	Original Issue	AV	AV	G.H.	B.L.	13/07/07*

* Denote the original signature and date when revision was issued.

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DX 21403 RAYMOND TERRACE

FUTURE SERVICING OF TEA GARDENS RIVERSIDE COMMUNICATIONS SERVICING STRATEGY

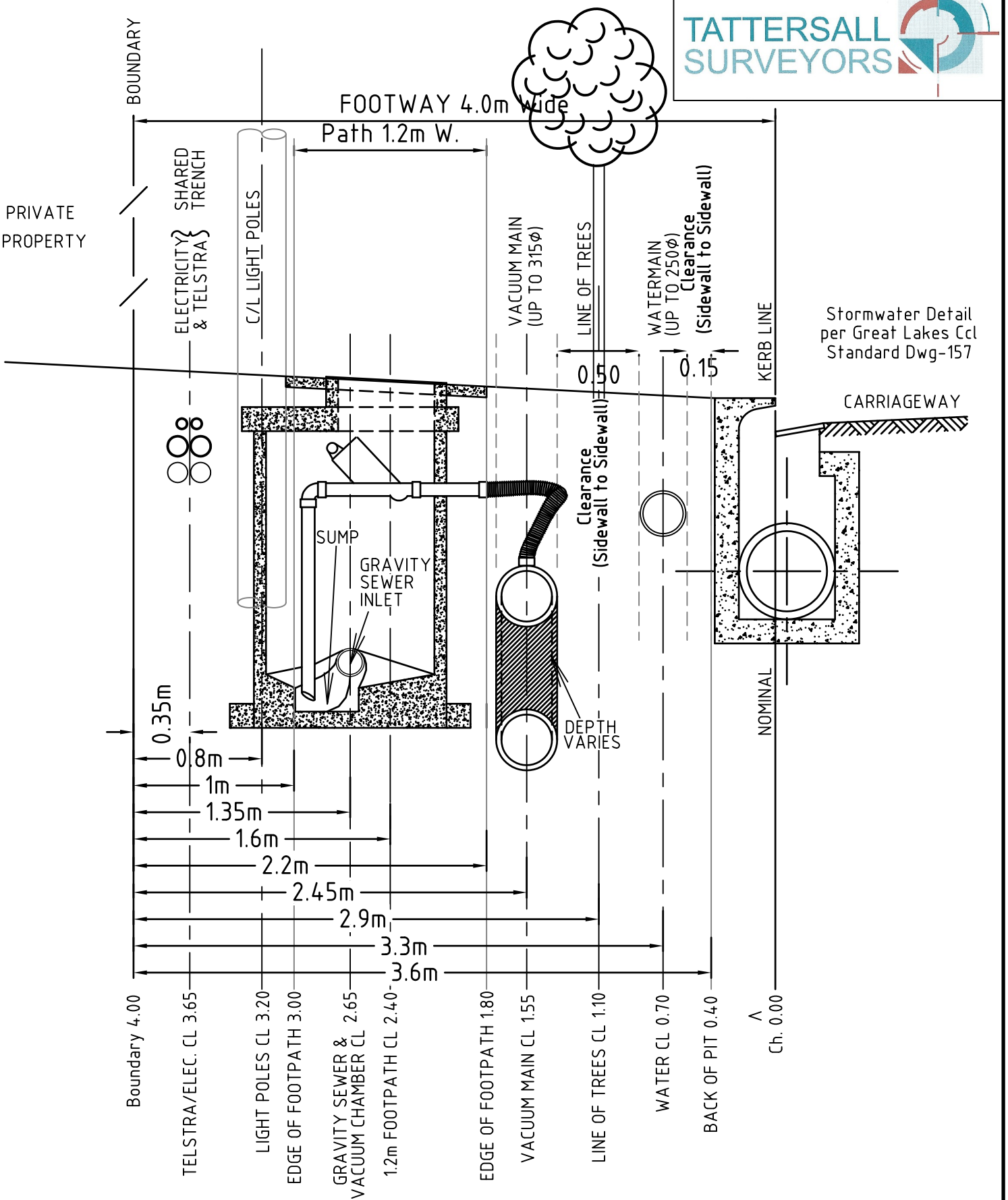
COUNCIL: GREAT LAKES	REFERENCE: 20700088
PARISH: COWEAMABH	SHEET SIZE: A1
SCALE: 1:4000	SHEET No.: 1
DATE : Plotted 11:42 07/08/08	

CLIENT: CRIGHTON PROPERTIES PTY LTD | JOB No.: 910370 | COMPUTER FILE : S:\projects\Myall Quays\dwg\M.C.W. W & S STRATEGY\910370-myall quays (riverside) elec strategy.dwg

Xref: 920428 - Boundary Xref (920428 - Boundary Xref.dwg) Xref: 201478 - Stg 8 Bdy (201478 - Stg 8 Bdy.dwg) Xref: Shearwater Boundaries xref (Shearwater Boundaries xref.dwg) Xref: INDUSTRIAL AREA XREF (INDUSTRIAL AREA XREF.dwg) Xref: 910370 - BDY (910370 - BDY.dwg) Xref: 202400-ComSite (202400-ComSite.dwg) Xref: Stg 9 (Stg 9.dwg)

Appendix G:

Typical Footpath Service Allocations



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DX 21403 RAYMOND TERRACE

PROJECT:
PROPOSED TYPICAL FOOTWAY
SERVICES ALLOCATIONS
TEA GARDENS
(4.0 METRE FOOTWAYS)

CLIENT : CRIGHTON PROPERTIES PTY LTD

REF: 201479

COUNCIL: GREAT LAKES

DATE : Plotted 17:39 03/07/08

S:\projects\Myall River Downs\920428\dwg\Prop 4.0 Footway Allocations-Tea Gardens Take 2.dwg

Appendix H:

Correspondence with MidCoast Water

MIDCOAST WATER
ABN 33 274 464 218

Forster Office:
16 Breese Parade
Locked Bag 4000
Forster NSW 2428
Ph: (02) 6591 7543
Fax: (02) 6591 7555

23 April 2008
Ref: 178424

Tattersall Surveyors
PO Box 54
Raymond Terrace NSW 2324

Attn: Mr Bob Lander

RE: RIVERSIDE DEVELOPMENT – TEA GARDENS

Dear Bob,

In reply to your email of 21 April 2008 regarding a MidCoast Water response to the "issues paper" and "adequacy test" applied by the Department of Planning for the Riverside Application at Tea Gardens. MidCoast Water makes the following comments:

MidCoast Water requires the preparation of Water Supply & Sewerage Strategies to demonstrate how the proposed development can be provided with reticulated water and sewer services in accordance with our requirements, these strategies are to nominate any required extensions or upgrades to MidCoast Water infrastructure. In the absence of such strategies, MidCoast Water can only confirm that the Riverside development is proposed on land identified as future service area within our current servicing strategies.

As detailed in the MidCoast Water Sewerage Servicing Strategy (January 2003) the Hawks Nest Waste Water Treatment Plant (WWTP) is upgradeable to 16,000 Equivalent Population (EP) for the ultimate development of Tea Gardens/Hawks Nest, including North Hawks Nest. The ultimate development case includes an allocation of 960 Equivalent Tenements (ET) for the Riverside (Myall Quays) development. The ultimate loads from infill development within Tea Gardens/Hawks Nest as well as the known future growth areas were allocated within this existing strategy and are summarised below, note that the existing strategy does not include the connection of the North Port Stevens villages. Refer Doc: EKA-061/7, Appendix A: Table A2 for full details of load allocations.

	Existing Peak Load (2003)		Fully Developed Peak Load	
	ET	EP	ET	EP
Hawks Nest	1292	4245	1558	5724
Tea Gardens	862	2444	1174	3830
North Hawks Nest	0		400	1000
Myall Quays (Riverside)	0		960	2592
Myall River Downs	0		800	2160
Shearwater & Industrial	0		320	672
TOTALS	**2154**	**6689**	**5212**	**15978**

Under the existing Sewerage Servicing Strategy, MidCoast Water can only confirm that there is sufficient capacity in the Hawks Nest WWTP to cater for up to 960 ET within the Riverside development. The Equivalent Tenement allocation includes commercial & non-residential components in the total allocation.

MidCoast Water requires the preparation of an Integrated Water Cycle Management plan (IWCM) for the site. This plan would consider the water cycle and identify appropriate measures and end uses for the water resources available. One of the areas expected to be investigated is the use of reticulated recycled water for non-potable uses within residential premises. This investigation may identify alternate sources for effluent disposal that could relieve pressures on the WWTP and yield additional capacity within the WWTP. In the absence of an accepted IWCM, MidCoast Water is unable to make any comment "as to whether services for the use of reclaimed water will be provided".

Please contact me should you have any questions or to discuss the progression of an Integrated Water Cycle Management plan for the proposed development.

Yours faithfully

DAVID MCKELLAR
Development Engineer

Volume 3B: Review of s93 and s94 Requirements

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Review of s93 and s94 requirements – Crighton Properties

19 March 2007
Reference 22554
Revision 2

Document Control

Document ID: O:\PROJECTS\URBAN_DEVELOPMENT\22554-CRIGHTON PROPERTIES\DRAFT REPORT\CRIGHTON_S94_FINAL.DOC

Rev No	Date	Revision Details	Typist	Author	Verifier	Approver
0	5 July 2006	Review of Section 94 Requirements	MM	MM	DB	DB
1	19 March 2007	Review of Section 94 Requirements	MM	MM	DB	DB

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Table of Contents

Section		Page
Executive summary		***1***
1. Introduction		***2***
1.1	Purpose and structure of report	2
1.2	Local government context	2
1.3	Context of Crighton Holdings	3
2. Legislative background		***4***
2.1	The NSW contributions system	4
2.2	Providing facilities for growth	4
2.3	Section 94	5
2.4	Planning agreements	5
2.5	Fixed levies	6
2.6	Works in kind and material public benefit	6
2.7	Great Lakes Section 94 Policies	6
3. Urban development analysis		***7***
3.1	Introduction	7
3.2	Council strategic planning initiatives	7
3.3	Potential growth and development	7
3.4	Population share	9
4. Assessment of facility demand		***10***
4.1	Introduction	10
4.2	Planning standards for facility provision	10
4.3	Community facilities	11
4.4	Open space	13
4.5	Traffic management facilities	16
4.6	Other facilities	17
5. Options for facility provision		***19***
5.1	Introduction	19
5.2	Methods of facility provision	19
5.3	Facilities proposed by Crighton Properties	19
5.4	Land dedication and embellishment	19
5.5	Material public benefits	20
5.6	Principles for establishment of a planning agreement	21
6. Potential project commitments		***22***
6.1	Introduction	22
6.2	Discussions with Great Lakes Council	22
6.3	Preferred planning agreement conditions	22
6.4	Summary of potential project commitments	22
7. References		***23***
Appendix A		
Execution of planning agreements		
Appendix B		
Open space facilities at Tea Gardens/Hawks Nest		

Executive summary

This report examines the development of urban expansion lands at Tea Gardens that are proposed for development by Crighton Properties. It has been prepared to provide background on future human service and infrastructure provision, and to outline key works that could be provided by Crighton to cater to future demands of this urban development.

The development of these properties will take place over a number of years and will deliver a wide variety of benefits to the local area. The development will also create a range of demands for various public services and facilities for which the Great Lakes Council may be responsible.

Approval of the development concepts for the subject properties will be under the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979*. The Department of Planning will be the consent authority and will consider the issues surrounding the demand through the consent process.

Crighton is a pivotal landholder in the area and moves towards developing their holdings, it is essential that there is common ground between Crighton and the Great Lakes Council in the provision of facilities. There are opportunities for the development of the subject lands to provide a range of facilities and services that will cater to the immediate demands of these land as well as the demands of external residents. As Crighton Properties development will have a major influence on expansion of the Tea Gardens/Hawks Nest, the opportunity is presented to provide a lead role in provision of facilities. The key issue is the extent to which that provision should reasonably be made in the context of the Council's longer term plans for the area.

There is an obvious benefit in providing for residents of the development, however, the question of what should be provided and when needs to be investigated and discussed with key authorities. It is envisaged that a Planning Agreement will provide the foundation for the provision of human services and other urban infrastructure in the Tea Gardens/Hawks Nest Area. This report is intended to initiate that process.

The purpose of this report is to therefore identify the issues surrounding the development of the Crighton lands and to identify the manner in which the demands of the future population of these sites can be satisfied. This has necessarily required an assessment of the Council's current strategic planning processes as well as the existing Development Contributions Plans ("CPs") that have been prepared under section 94 of the EP&A Act. An examination of the options that are available to Crighton for provision of facilities and their possible costs are also highlighted.

The concluding sections of this report outline the principles upon which a Planning Agreement might be based. It is considered that such an agreement will be the optimum method of delivery of the services and facilities.

1. Introduction

1.1 Purpose and structure of report

This report has been prepared on behalf of Crighton Properties ("Crighton") to assess human services and infrastructure provision in the Tea Gardens/Hawks Nest area. The Crighton holdings are extensive and there will be a need to provide a range of services and facilities to service the future population of these lands. While some of these are likely to be provided by the Great Lakes Shire Council, ("the Council") there is wide scope for Crighton to provide those services in conjunction with, or in the place of, the Council. This will have the benefit of allowing the facilities to be provided in a timely fashion and to mesh with the Council's intended of facilities. The report specifically addresses the facilities that may be provided via sections 93 and 94 of the *Environmental Planning and Assessment Act* ("*EP&A Act"*).

Delivery of required human services and infrastructure can be undertaken by various means including direct provision, joint development, land dedication or monetary contributions. The purpose of this report is to examine typical levels of provision of such infrastructure services in a greenfield situation to inform decision-making on provision and staging. This will provide the basis for the preparation of a Planning Agreement.

The structure of this report is as follows:

- ***Section 1*** (this section) provides an introduction to the review and sets out the context of the Crighton holdings
- ***Section 2*** outlines the legislative background to the NSW development contributions system including the requirements for planning agreements and section 94 contributions
- ***Section 3*** assesses the existing Council policies with respect to the long term development of the Tea Gardens/Hawks Nest area and details the extent to which the Crighton lands will contribute to that development. It specifically reviews population forecasts for the area as this will be the fundamental basis upon which human services and infrastructure provision should be measured
- ***Section 4*** provides an outline of the likely extent of demand for the human services and infrastructure outlined in Section 3. This includes a review of typical levels of provision in greenfield and urban situations that are applied across NSW.
- ***Section 5*** details the potential options for Crighton in delivering facilities to service the future population of the holdings as well as that of Tea Gardens/Hawks Nest. This includes the legal mechanisms that might be used to facilitate such provision including the principles that may be used in negotiating a planning agreement.
- ***Section 6*** outlines potential "commitments" for human services and infrastructure provision that might be used as part of the 3A process. This is intended as a draft outline that could be used to facilitate dialogue with relevant authorities.

1.2 Local government context

The Great Lakes Shire Council is the relevant planning authority for the area and the key provider of some baseline human services and infrastructure. The Great Lakes local government area ("LGA") stretches from Port Stephens in the south to Hallidays Point in the north. It is geographically diverse with a dispersed population. While development occurred gradually up to the 1980's, there has been a population surge with a large influx of retirees as well as the ubiquitous "seachangers". The outcome is a significantly older population profile than the rest of the state.

The trend for the future is likely to continue in a similar vein although housing affordability in Sydney and, to a lesser extent, Newcastle may drive families to areas such as Great Lakes. The key influence in those trends will be the availability of both housing and employment.

The ability of the Council's to respond to change will be a function of their financial position and planning approach to provision of land for housing and employment. It is often difficult for local government to react quickly to change as there are many political and financial implications in taking action. However, there is opportunity for Crighton to assist in the process of facility provision that may assist in "filling the gap". Flexibility in provision of facilities that will be delivered over the 20 year life of the Crighton development must be a key consideration to allow both Crighton and the Council to reconsider facility planning in light of possible changes to demand and the funding of facilities.

1.3 Context of Crighton Holdings

Crighton Properties landholdings include the Myall River Downs and Riverside at Tea Gardens Development. The extent of the development sites is such that future expansion in Tea Gardens will primarily occur within these sites and will have a significant influence on the development of Tea Gardens/Hawks Nest.

The Riverside at Tea Gardens Estate ("Riverside") is currently being developed and comprises a range of residential, retail/commercial, recreation and tourist development including over 240 completed residential lots. In 2002 Crighton Properties began the process of seeking approval to develop a substantial portion of Riverside for residential and tourist purposes. Following the introduction of State Environmental Planning Policy (SEPP) 71 – Coastal Protection the process of developing a master plan began. The Riverside at Tea Gardens site is currently zoned 2(f) Mixed Commercial Residential (ERM, 2006c).

The Myall River Downs site ("Myall River") is currently zoned 1(a) Rural, 7(a) Wetlands and Littoral Rainforests and 7(a1) Environment Protection. A Local Environmental Study has been prepared recommending a substantial portion of the Myall River Downs site be zoned 1(a) Rural to enable urban/residential development. Formal adoption by Great Lakes Council of the LES findings has been delayed pending the outcome of the Tea Gardens/Hawks Nest Housing Strategy and preparation of a concept plan for the site.

Given the role of the Crighton development in expansion of the Tea Gardens/Hawks Nest area, the opportunity is presented to provide a lead role in provision of facilities. The key issue is the extent to which that provision should reasonably be made in the context of the Council's longer term plans for the area. There is an obvious benefit in providing for residents of the development, however, the question of the type of facilities and their timing should be considered carefully. This report is intended to initiate that process.

2. Legislative background

2.1 The NSW contributions system

Legislation requiring a contribution towards the provision of public infrastructure was first codified as Section 94 (s94) when the *EP&A Act* was introduced in 1979. Section 94 of the *EP&A Act* enables consent authorities to levy contributions on developers towards the cost of providing local public infrastructure and facilities required as a result of development. Contributions can only be sought by councils where there is an adopted contributions plan in place.

Recent planning reforms have widened the ambit of the contributions system to include new provisions under Section 93 and Section 94A of the *EP&A Act,* which provide greater flexibility as to the means of levying a contribution. The amendments provide for the following methods of funding local infrastructure by a consent authority through:

- Section 94 contributions
- Section 94A levy
- Planning Agreements

The various methods of funding local infrastructure are collectively known as the development contributions system. Each component of the system has its own regulations and approaches which bears on any possible option for provision of facilities (either by direct provision, monetary contributions or through planning agreements). The important considerations in relation to the development of the Crighton properties are briefly discussed below.

This discussion draws on the Department of Planning *Development Contribution Practice Notes* ("the *Practice Notes*") which have been prepared pursuant to clause 25B(2) and clause 26(1) of the *EP&A Regulation*.

2.2 Providing facilities for growth

The funding of public infrastructure has changed substantially over the last 40 years, moving from traditional sources such as Commonwealth, State and local government budget allocations to a mix of sources ranging from public private partnerships (PPP) to developer charges and user pays charges.

Section 94 of the EP&A Act has traditionally been the principal method enabling councils to levy contributions for public amenities and services required as a consequence of development. The widening of the contributions system allows for a range of innovative approaches to the provision of facilities and negotiation of planning agreements.

Providing facilities to cater to growth is bound by a relatively strict set of regulations concerning the methods that a Council must employ. Traditionally, the process is undertaken under the provision of Section 94 which involves the identification of the relationship between expected development and demand which typically have required an assessment of:

- The make-up, spatial distribution and timing of growth that will be encountered in the catchment area(s) in the planning horizon (**growth and development**)
- The current levels of provision of public amenities and services in the catchment, and the needs of the future residents in this catchment (**nexus/demand identification**)

However, these approaches are largely now confined to Section 94 contributions plans as flat rate levies and planning agreements do not need to have the same close bond to nexus as a Section 94 contribution. Growth and development and nexus/demand identification are important considerations as they can limit the power that the Council has in imposing contributions.

The Minister, when determining an application under Part 3A of the *EP&A Act*, must have regard to any contributions plan that is in place pursuant to section 94D. He may also have regard to any planning agreement that is being negotiated.

2.3 Section 94

Section 94 is the exclusive source of power for a Council to impose a condition requiring land dedication or monetary contributions, and this power must be specifically authorised by a duly adopted section 94 contributions plan ("CP"). This is an important consideration since a Council wishing to impose such conditions outside section 94 is acting out of power unless these are done under the auspices of a planning agreement.

Section 94 contributions are based on two key concepts:

- *Reasonableness* in terms of nexus (the connection between development and demand created) and apportionment (the share borne by future development)
- *Accountability* both public and financial

A Section 94 contribution can be satisfied by:

- Dedication of land
- A monetary contribution
- Material public benefit
- A combination of some or all of the above

In the case of the Minister being the consent authority, the provisions of any section 94 CP must be taken into account but the Minister is not bound by the CP.

2.4 Planning agreements

Provisions for planning agreements have been codified under section 93 of the *EP&A Act*. Planning agreements are intended to be voluntary and can be entered into as part of the rezoning or development approval process. A consent authority cannot coerce an applicant into a planning agreement nor can it require a planning agreement to be entered into as a condition of consent (unless an offer to enter into an agreement is made by an applicant).

Planning agreements may be directed towards achieving the following:

- Meeting the demands created by development for new public infrastructure, amenities and services
- Securing off-site planning benefits for the wider community
- Compensating for loss of or damage to a public amenity, service, resource or asset by development through replacement, substitution, repair or regeneration
- Meeting the recurrent costs of facilities and services

A planning agreement may provide for a monetary contribution, land dedication, or material public benefit towards a public purpose (which is widely defined). A planning agreement may also wholly or partly exclude the application of Section 94 or Section 94A of the *EP&A Act*. There are specific requirements and steps that are codified under the *EP&A Act* for the negotiation and execution of planning agreements. Further details are provided in the DoP Practice Notes presented in Appendix A.

2.5 Fixed levies

The final plank in the contributions system is the "fixed rate" levy plan. A Council can impose a fixed levy of 1% if a s94A contributions plan is in place. In most cases, these plans are not used as they do not raise significant funds. They are unlikely to be an issue for the Crighton holdings.

2.6 Works in kind and material public benefit

An applicant can satisfy development obligations by various means. These include:

- Undertaking "works in kind" (WIK). WIK is where a work that is identified in a section 94 or 94A plan is constructed/completed by the applicant
- Providing a "material public benefit" (MPB). MPB may include a wide variety of things but it cannot be the dedication of land or a monetary contribution (unless these are part of a planning agreement)

Planning agreements can be structured such that MPBs are provided by the applicant over a number of stages and in various locations. However, they must have some relationship to the subject development.

2.7 Great Lakes Section 94 Policies

The Council has in place a "LGA wide" section 94 CP (*Great Lakes Wide Section 94 Contributions Plan*) and a specific CP for the Tea Gardens/Hawks Nest area (*Tea Gardens & Hawks Nest Section 94 Contributions Plan*). These provide details of the various facilities that the Council intends to provide to cater for population growth.

The LGA wide CP includes provision for the following public facilities:

- Library facilities
- Rural Fire Fighting facilities
- Administrative building

This CP has an effective life to 2009/2010.

The Tea Gardens/Hawks Nest Plan includes provision for the following:

- Open space, such as parks, playing fields and courts
- Cycleways
- Community facilities such as libraries and community centres
- Surf life saving facilities
- Upgrading the road network to accommodate increases in traffic

This CP has an effective life 2010/2011.

The development of the Crighton holdings will occur over a period of around 20 years and, consequently, the CP's as they currently stand do not provide an adequate basis for delivery of the facilities required to cater to the demand generated by the future growth of the Tea Gardens/Hawks Nest. However, they do provide some relevant benchmarks for future planning of facilities.

Whilst the Council will doubtless amend the CP's, the key issue for the approval process of the Crighton lands is defining the facilities that will be required so that the Minister, when approving the 3A applications, can be confident that any project commitments by Crighton are appropriate and reasonable.

3. Urban development analysis

3.1 Introduction

An assessment of the likely scale and type of population growth is a key first step in defining the likely future requirements for human services and infrastructure. An analysis of the nature, staging and demographics of urban development will allow definition of facility needs over a defined period of growth.

A comparison of existing and required facility types will allow for identification of facilities required due to urban expansion and types of facilities that may be needed to fill any "gaps". The expected population growth can be linked to particular developments, or development types, such that the appropriate site for facilities may be linked to development scenarios and funding can be sought from specific developers to fund all facilities.

3.2 Council strategic planning initiatives

In 2003 the Great Lakes Council adopted the *Tea Gardens/Hawks Nest Conservation and Development Strategy* ("the *Conservation and Development Strategy*"). This identified opportunities for conservation and development based on the existing condition of the study area, biophysical features and planning policies.

In 2006, the Council placed on exhibition an initial draft *Tea Gardens/Hawks Nest Housing Strategy* ("the *Housing Strategy*"). That draft *Housing Strategy* addresses issues such as dwelling types, dwelling densities and lot yields. A second draft of the *Housing Strategy* is currently on exhibition and it is likely that adoption of this will occur some time in 2007. This largely builds on the *Conservation and Development Strategy*.

Council has also identified that the area beyond the Tea Gardens ridge (known as the "North Shearwater Precinct") to the north-west of Tea Gardens is capable of urban development, subject to further investigations. Council has identified that the North Shearwater precinct has potential for rural residential, urban and tourist uses subject to road and infrastructure links being provided through the adjoining Riverside and capacity being available at the North Hawks Nest wastewater treatment plant for the disposal of effluent from this area (Parsons Brinckerhoff, 2003).

3.3 Potential growth and development

3.3.1 Great Lakes Local Government Area

The Great Lakes LGA had a total population in 2001 of 31,384 persons. The Estimated Resident Population (ERP) based on "Enumerated Population" for the Great Lakes LGA in 2005 (preliminary) is 34,695 (Great Lakes Council, 2007).

According to the Department of Planning (Transport and Data Centre, 2004) projections, the population of the Great Lakes LGA will grow by 18,000 persons by 2031 an increase of over 50%. By 2031, the LGA population will be one of the oldest in NSW with a median age of 58 years.

However, the Department's figures appear somewhat at odds with those in the Council's planning strategies (see below). Nevertheless, the LGA will experience substantial growth which will require a significant investment in provision of human services and infrastructure.

3.3.2 Tea Gardens/Hawks Nest growth and development

The total population of the Tea Gardens/Hawks Nest area in 2001 was 2,545 persons (Great Lakes Council, 2007). The ERM report (2006b) provide an estimated population for Tea

Gardens and Hawks Nest of around 3,200 persons (April 2006) based on Great Lakes Census Summary Information and analysis of sales and Council records.

Table 3.1 Estimated existing population: Tea Gardens and Hawks Nest

Location		Persons	Total
Existing 2001 Population[1]	Tea Gardens	1,372[3]	2,545[3]
	Hawks Nest	1,173[3]	
Estimated Population Growth (2001-2006)[2]	Tea Gardens	500	1,872
	Hawks Nest	155	1,328
Estimated 2006 population[4]			3,200

Notes:

1. *Based on Great Lakes Population 2001 Census Summary Information, produced by the Community Services Branch Great Lakes Council.*
2. *Based on analysis of sales and Council records.*
3. *Estimate different to summary information provided on Council's web site accessed 6 July 2006 by Connell Wagner.*

The population of Tea Gardens/Hawks Nest is generally older than other centres in the Great Lakes area. A large proportion of residents in the Tea Gardens/Hawks Nest area are over 50.

The Council made population forecasts in 2003 and 2005 for the Tea Gardens/Hawks Nest area which estimated the total population in 2011 of 4,123 and 2016 of 4,755 a growth rate of around 4%. The projected population of Tea Gardens/Hawks Nest under the draft housing strategy was between 7,450 (low), 8,600 (medium) and 9,750 (high) by 2031. This represents between 41% and 54% of the Department of Planning forecast for the entire LGA.

3.3.3 Crighton development

Myall River Downs has the potential to create approximately 1,500 dwelling sites with the potential to house around 3,228 persons while the Riverside site has potential for creation of approximately 990 dwellings with the potential to house around 2,142 persons. Together with other approvals, the total population that could be housed in the Crighton holdings is approximately 5,782 persons (refer Table 3.2). The net residential densities used in this table are based on the Housing Strategy rate of 13 dwellings per hectare.

Table 3.2 Predicted population: Crighton Holdings

Location	Development Type	Dwellings	Occupancy Rate	Total Persons
Riverside	Residential (medium density)	40	1.3	52
	Residential (standard residential)	759	2.2	1670
	Moorings Precinct – lodges	51	2.2	112
	Moorings Precinct – houses	140	2.2	308
	Sub Total	990		2,142

Location	Development Type	Dwellings	Occupancy Rate	Total Persons
Myall River Downs (Proposed Rezoning)	Residential (medium density)	63	1.3	82
	Residential (low density)	1204	2.2	2,649
	Residential north-west (medium density)	6	1.3	8
	Residential north-west (low density)	108	2.2	238
	Transition – west (units)	75	1.3	98
	Transition – west (lodges)	104	1.3	135
	8 lot residential subdivision	8	2.2	18
	Sub Total	1,568		3,228
The Hermitage		281	1.3	365
Tea Gardens Grange		36	1.3	47
Total		**2,875**		**5,782**

Source: ERM, 2006b

3.3.4 Other development

Other growth will occur in Tea Gardens within the North Shearwater Estate and as infill development within existing residential estates. Estimates taken from ERM (2006b) are provided in Table 3.3.

Table 3.3 Other population growth in Tea Gardens/Hawks Nest

Location	Dwellings	Rate	Persons	Total Persons
North Shearwater	300	2.2	660	660
Infill Tea Gardens				
Houses	100	2.2	220	
Units	140	1.3	182	402
Total Additional Sundry				1,062

Note: these figures do not include proposed "Myall Way" Precinct.

3.4 Population share

3.4.1 Crighton population share

If the total population represented in Tables 3.2 and 3.3 are added to the 2006 population (3,200), the total population capacity represented would total 10,044 persons which marginally exceeds the Housing Strategy high forecast figures (9,750). For the purposes of this report, the total population capacity of the Tea Gardens/Hawks Nest area is assumed to be 10,000.

The Crighton holdings would represent around 85% of the future population growth while it would represent around 57% of the total population at capacity (ie existing plus future population).

4. Assessment of facility demand

4.1 Introduction

Demand for human services and other urban infrastructure is a function of population growth. As Crighton is a pivotal landholder in the area and moves towards developing their holdings, it is essential that there is common ground between Crighton and the Great Lakes Council in the provision of facilities. It is envisaged that a Planning Agreement will provide the foundation for the provision of human services and other urban infrastructure in the Tea Gardens/Hawks Nest Area as a section 94 contributions plan will be complicated by the possible provision of facilities by Crighton.

This section explores the issues concerned with identifying the facilities required to cater to population demand identified in the previous section.

4.2 Planning standards for facility provision

4.2.1 Background issues

The population thresholds or numerical standards that are used by local government and human service agencies in their planning of services often nominate the threshold at which the population requires and can sustain the provision of a service. These are usually expressed as a ratio between population numbers and facility/service provision. However, only some agencies use standards or thresholds in their planning, and then only to provide an initial guide to potential facilities for further investigation.

Standards or thresholds are only ever seen as a starting point for planning, and must be supplemented by reference to the characteristics of the population and particular circumstances of need. Many agencies do not use standards at all, but rely instead on a range of practical measures and assessment of needs in the local area.

Some general principles for the development of human services and facilities have been defined in new release areas in the Sydney region such as the North West and South West Sectors (Elton, 2003). The key issues raised in this work include:

- There is a need to plan for flexibility in facilities to enable responsiveness to needs and life cycle changes as they emerge. Facilities should be multi-purpose and capable of delivering a range of services, rather than designated for single uses or specific target groups that may quickly become outdated.
- Human services need to be provided in more innovative and integrated ways that address the gaps and overlaps among facility types when they are provided as separate facilities
- Facilities need to be provided in a resource efficient manner which encourages joint, shared or multiple use of resources
- Human services are commonly considered in two categories: baseline or core services and district or threshold services:
  - Core services are those which are required by most new residents from the outset of settlement to meet their local everyday neighbourhood needs and include neighbourhood shops and community centres, childcare centre, facilities for various ages, parks and playgrounds
  - District level services are more specialist services for specific segments of the population which operate on a broader district catchment. They will vary according to the particular characteristics and needs of the population.

These principles can be used as the basis for the assessment of the required facilities in the area.

4.2.2 Defining demand

The Department of Planning *Development Contribution Practice Notes* indicate that the demand for facilities may be determined by:

- Estimating the future population
- Estimating demographics of the population
- Assessing the possible staging of development
- Identifying existing human services and facilities used by the current population
- Predicting the future needs based on an evaluation of the above
- Apportioning demand between existing and future development (DIPNR, 2005)

The assessment of facility demand in this way permits a clear understanding of facility requirements that may then be used to identify the level of provision of facilities and their timing.

Predicted facility demand requires an assessment of the make-up, spatial distribution and timing of growth and the current levels of provision. The existing level of facility provision is an important consideration in the estimation of the demand for future facility provision since augmentation or embellishment of existing facilities and provision of new facilities can cater for additional demand.

Importantly, the *Practice Notes* make the point that the imposition of any section 94 must be reasonable and should not be used to make up for past deficiencies. Thus, any estimation of demand must consider the existing level of provision and future demand must be tempered by what might reasonably be required based upon that consideration.

This is not to suggest that a planning agreement cannot make up for past deficiencies. However, should such an approach be adopted there must be other trade offs to ensure that, overall, the contribution to local facilities is reasonable.

In relation to the future demand for facilities that might reasonably be considered for the Tea Gardens/Hawks Nest area, the following facility types are considered relevant:

- Community and cultural facilities
- Open space (structured and unstructured)
- Roads and traffic management facilities
- Cycleways/walkways
- Bushfire fighting facilities

Issues associated with the future provision for these facilities are outlined below.

4.3 Community facilities

4.3.1 Planning for community facilities

Various planning standards have been used by agencies to make provision for baseline community facility needs. Table 4.1 outlines standards used by a variety of agencies including local government.

Key issues associated with planning for community facilities include:

- Human services and community facilities should be clustered together or co-located to provide opportunities for shared and efficient use of resources

- They should be located in places where people already have cause to congregate, rather than on stand alone sites, for reasons of safety, accessibility and convenience. Shopping centres and schools are recognised as the key places where people tend to congregate within a neighbourhood
- The trend in local government is that fewer but larger community facilities are now being built as larger facilities have been found to be more versatile
- The planning of childcare services has become more complex in recent years with the increasing role of the private sector in childcare

Population thresholds outlined in Table 4.1 are unlikely to be exceeded in the Tea Gardens/Hawks Nest area in the immediate future, however, it is noted that the current level of provision in the area is relatively high compared with these standards albeit there may be some capacity issues with the existing facilities. The facilities have also been traditionally provided in Hawks Nest which will have little population growth in the future.

Table 4.1 Community facilities: provision standards [1.]

Facility/Target Population	Standard	Floorspace Requirements[2.]	Existing Provision Levels
Long day care	1 place per 11 children 0-4 years[3.]	3,000 sq m site with building of 300-400 sq metres for 60 place facility	Existing 29 person centre
Youth and Community Centre	1 per 20,000 persons or 1 per 3,000 13-19 year olds	300-400 sq m	Nil
Community Centre	1 per7,000-10,000 persons[4.]	600-800 sq m	Existing
Library[5.]	District: 1 per 30,000 persons Branch: 1 per 5,000 persons Resources: 1 item per 2.5 person[6.]	1000 sq m 600-700 sq m	Existing
Seniors	1 per 30,000 persons	1000-2000 sq m	Existing community centre

Notes:

1. *Standards derived from Blacktown, Baulkham, Campbelltown City Councils, Department of Planning, and various other statutory authorities*
2. *Floorspace requirements based on modest facility only.*
3. *Where private facilities are provided this may be relaxed to 1:20. Typically, 60 place centre required for population of 7,000.*
4. *Current Department of Community Service standard.*
5. *Library standards typically predicated on persons including workers.*
6. *State Library Current standard*

There are no set standards for shopping facilities although a standard of 2 square metres per person for retail is often used as a guide for centre planning. The day to day shopping and service needs of the Tea Gardens and Hawks Nest population are currently serviced by local neighbourhood shopping centres in each of the centres. For more specialist commercial services and shopping, residents currently travel to. According to Ibecon (2000) there is a significant level of net escape spending out of Tea Gardens and Great Lakes in all retail categories to Raymond Terrace, Newcastle and other fringe areas. Population projections

indicate a substantial deficiency of shop floorspace and long-term planning should consider a large-scale retail facility of up to 11-14,000m^2, depending on the take up rate of population.

4.3.2 Future facility provision and timing

Planning for a population of around 10,000 persons will clearly require a range of facilities for various target groups as identified in Table 4.1. The key issue is the timing of the provision and the type of facility that is required as various thresholds are met.

The demographic profile of the area is likely to be older although there is also likely to be a proportion of younger families. It is also likely that Tea Gardens will have a proportionally "younger" population; although, there will also be substantial growth in older age categories in this area as well (Parsons Brinckerhoff, 2006).

The existing preschool is able to accommodate growth until at least approximately 2011 due to the higher than average component of aged people although provision of additional child care services may need to be considered given that Tea Gardens is beginning to attract young families. A child care has been approved by Council within the site that will attribute valuable child care places for parents with young children.

The existing community centre and library in Hawks Nest are not considered to be of adequate capacity. As most population growth will occur in Tea Gardens Council considers it desirable to provide a new community centre to cater for the existing and future residents (Great Lakes Council, 2003). According to Great Lakes Council (2003) all community facilities at Tea Gardens/Hawks Nest are expected to be used to capacity by 2011. Notwithstanding the foregoing, four clubhouses are proposed as part of the Masterplan for Riverside at Tea Gardens. The clubhouses will contain function/meeting rooms that may be utilised by the community for their purposes.

The need to provide for a variety of needs and the extent of population growth argues for a facility that can function as multi-use. The growing population of Tea Gardens is creating the need for additional facilities and the expansion of facilities in Hawks Nest is clearly not the intention of the Council.

Consequently, the future development of the Tea Gardens area is likely to create demand for another community facility within this area that ideally should be multi use. There will also be demand created for library services and, to a lesser extent, child care facilities.

The proposed centre in the Riverside development presents an opportunity to make provision for the population of the Crighton development as well as cater to the needs of the wider Tea Gardens area. Crighton Properties have proposed a number of facilities for use by residents of Riverside at Tea Gardens and Myall River Downs as well as facilities provided within The Hermitage and Tea Gardens Grange Retirement Village specifically aimed towards seniors. While some of the facilities can be used by the wider community, the nature of the retirement villages is that they are essentially self-contained and residents will not have a significant impact on facilities required by the broader community.

4.4 Open space

4.4.1 Open space planning standards

Standards for open space represent community expectations in terms of provision of open space and the recreation demands arising from growth. An assessment of previous research on recreation demand indicates the following trends:

- Of structured activities, the national data suggests that the highest participation growth is expected in swimming, aerobics and golf
- Informal and unstructured use of parks and reserves will assume greater importance with a wider sector of the community
- Organised sports will continue to be important although only for a proportion of the community
- Swimming will be a primary activity participated in by those using developed facilities
- Indoor activities (aerobics, gym based-training, basketball, indoor cricket) are estimated to have lower participation rates although these sports are popular

However, the aging of the population will suppress demand for more active pastimes that are traditionally associated with young participants. Informal activities, particularly walking and driving for pleasure, walking the dog, fishing and picnics/bbq's are expected to be more popular than more structured activities such as organised sports.

A variety of facilities are necessary to satisfy needs and demands of the community as recreation preferences (thus, demand) are a function of age and the ability to pay. The typical range of facilities required by various age groups is presented in Table 4.2.

Increasing residential densities and the cost of land require open space to respond to the needs of individual communities by providing varied recreational opportunities or settings (Commonwealth Government Department of Housing and Regional Development, 1995).

Table 4.3 indicates open space planning standards that have previously been used by government organisations in NSW. Whilst the standards are not intended to be prescriptive, they are based on a substantial based of research into optimum levels of provision to permit a reasonable level of access to open space facilities by a new population.

Table 4.2 Major needs of target groups (baseline facilities)

Group	Major Needs	Typical Facilities	Leisure Activities
Children (0-12 years)	Small parks within walking distance of home with play equipment. Formal playing fields. Areas for informal sporting activities. Corridors linking open spaces. Large natural and parkland areas.	Parks/playgrounds; Cricket/football ground; Tennis; Bicycle paths; Swimming facilities.	Walking for pleasure; Visiting friends; Going to movies; Going to beach.
Youth (13-19 years)	Formal playing fields. Areas for informal sporting and leisure activities. Large natural and parkland areas.	Cricket/football; Tennis; Swimming facilities; Skateboard park; Indoor facilities.	Walking for pleasure; Jogging; Visiting friends; Going to beach; Going to clubs/movies.

Group	Major Needs	Typical Facilities	Leisure Activities
Adults (20-60 years)	Formal playing fields. Areas for informal sporting activities. Large natural and parkland areas.	Cricket/football; Tennis; Swimming facilities; Indoor facilities; Golf facilities.	Walking for pleasure; Playing active sports; Jogging; Going to gym.
Seniors (60+)	Walking paths. Areas for informal sporting activities. Large natural and parkland areas.	Tennis; Swimming facilities; Bowling greens; Golf facilities.	Walking for pleasure; Playing tennis/golf.

Source: Connell Wagner, 2006

Table 4.3 Comparison of normative provision of structured recreation facilities

Facility	AWDC	NCDC	DOP
Football (all codes)	1:2,500-3,000	1:1,000	1:1,000
Soccer	Combined football	Combined football	Combined football 1:2,500
Hockey	1:3,500	1:3,000	Combined football
Cricket	1:2,200-3,000	2:2,200	1:4,000
Tennis courts	1:1,000	1:1,500	1:1,000
Netball courts	1:1,000	1:1,000	1:2,000
Golf course	1:25,000	N/A	1:25,000
Swimming pool	1:25,000	N/A	1:50,000

Source: Albury Wodonga Development Corporation (AWDC), National Capital Development Corporation (NCDC) and Department of Planning (DoP)

4.4.2 Future facility provision and timing

Great Lakes Council has not necessarily followed the above standards in the current CP. In the past the Council has adopted a ratio of 28.3m^2 per person (or 2.83 hectares per thousand people) as a planning standard. While this is a dated planning standard, the Council has typically applied that standard ratio in the following ratios:

- Small parks at about 25% (around 7 square metres per person)
- Large parks without structured facilities at about 30% (around 8.5 square metres per person)
- Structured facilities such as courts (eg tennis, basketball, netball) at about 15% (about 4.25 square metres per person)
- Structured facilities such as playing fields at about 30% (around 8.5 square metres per person)

The Council standards equate to a provision rate of around 1.53 hectares of unstructured open space and 1.3 hectares of structured open space per thousand population. This is not typically the ratio used by planning authorities as structured open space requires more land. However, it

is noted that the higher rate of provision of local parklands may be more appropriate for the ageing population.

According to Great Lakes Council (2003) Tea Gardens/Hawks Nest offer good opportunities for cycleways for recreation and road access. The current lack of cycleways in the area provides an opportunity to consider proposed cycleways within Crighton Properties development as a facility available to the wider community. There is the potential for paths within Crighton Properties land to be extended to provide access to the CBD. In recognising the need for cycleways Council has developed a policy on cycleways in the LGA.

Council considers that existing open space areas met community needs in 1996. The Council appears to have the view that there is sufficient space in the large parks, courts and fields to expand facilities. Further, the Council's position appears to be that future open space requirements will be met by acquiring land for small parks in newly developing areas and embellishing all open space facilities (Great Lakes Council, 2003).

Open space facilities at Tea Gardens/Hawks Nest are presented in the tables in Appendix B. There is an existing structured sports facility at Hawks Nest which includes a number of sports fields. Although this caters to existing demand for such facilities, there is likely to be longer term demand to another such facility. It would appear that making provision within the Crighton lands would offer the opportunity to cater to this longer term needs.

Based on the current Council levels of open space provision, the future population growth of around 6,800 persons in the Tea Gardens/Hawks Nest area will create demand for around 8 hectares of structured open space and 10 hectares of unstructured open space. A portion of the demand will be met by the provision of facilities such as tennis courts and recreation areas throughout the development.

ERM (2006) recommend that Crighton Properties provide 6.4 hectares of land for structured open space, as the proposed Myall River Downs Sporting Complex site is ideally located to serve the needs of the majority of the future population. However, it is considered inappropriate for North Shearwater, Tea Gardens Infill and Hawks Nest to provide their allocation on site as this would result in scattering of recreation facilities that would be more costly and inefficient to use and maintain. Cash in lieu of land dedication therefore recommended for these sites. These monies could be used embellishment of existing facilities and the proposed Sporting Complex.

Structured open space in the form of the recreation fields proposed by Crighton Properties is consistent with the intention of Council in establishing structured open space areas and would provide almost 6 hectares. The recreation fields will provide for some residents external to the locality as people visit the area for retail/commercial/medical reasons. Inclusion of small (<0.5 ha) unstructured parks within 500m of all new houses in Crighton Properties development will meet the general objectives of Council.

4.5 Traffic management facilities

Population and employment growth creates the need for various improvements to roads including intersection upgrades to permit greater movements, improved road signage and traffic control as well as traffic management measures especially in and around main centres.

The population likely to occur in the future will be spread spatially across the LGA. Where road improvements are required for a development consideration is typically given to the following:

- Developers are to contribute to the cost of road improvements which arise from the development
- The level of contribution required is proportional to the need for improvements which are a direct result of the development
- The minimum level of contribution is assessed on the basis of maintaining the existing level of service on the adjacent road network
- Where road improvements have already been planned, the contribution is adjusted in order to advance the works schedule and coincide with the completion of the development (RTA, 2002)

The Council has indicated that a substantial portion of the population in Tea Gardens/Hawks Nest leaves the catchment on a daily basis, presumably for travel to work, shopping or other destinations accessible via the Pacific Highway (Great Lakes Council, 2003). According to Great Lakes Council (2003) Myall Way will have insufficient carriageway width to accommodate the expected increase in traffic and Myall Street may need to be upgraded.

In determining contributions for traffic management the existing flow of vehicular traffic and nature of daily commuting from the LGA must be considered. Many of the residents that relocate to the area will be seniors and will be less likely to commute on a daily basis. Additionally the home office area provided in Myall River Downs and Riverside at Tea Gardens will not result in an increase in commuter traffic as the intention is that the residents will operate home businesses which would travel demand.

Therefore, demand for traffic management facilities and the consequent requirements for facilities needs to consider the potential population profile and particularly identify traffic generation rates that is appropriate to the future distribution of travel demand. In particular, travel demand at peak period should be taken into account in setting the parameters for addressing traffic management needs.

An assessment of the proposed internal traffic network (in accordance with acceptable standards) will be necessary (ERM, 2006c). A traffic impact study for the future expansion of Tea Gardens/Hawks Nest will provide consideration of future network requirements to allow for reasonable contributions to be levied in respect of the proposed development.

The purpose of the traffic impact study is to determine an appropriate apportionment of growth in vehicle movement to Crighton Properties development. Key issues in relation to a traffic assessment of Tea Gardens/Hawks Nest include:

- Capacity of the road network generally and intersections specifically to cope with additional demand
- Existing traffic volume and nature
- Background traffic growth
- Expected increase in traffic as a result of future development
- Portion of demand on road network attributable to Crighton Properties development

This will enable various facilities to be identified and costed.

4.6 Other facilities

There will be a range of other facilities for which demand will be created including:

- Bushfire management
- Surf lifesaving
- Police and Emergency Services
- Cultural, entertainment and leisure facilities

- Health Services
- Welfare and Support Services
- Public Transport
- Places of Worship

These will be provided by the Council, other levels of government or the private sector. It is envisaged that appropriate investigations will be carried out before they are proposed and there may be opportunity for space or facilities to be provided within the Crighton development. Such facilities would be subject to separate negotiation and potential exists for inclusion of the facilities in a planning agreement.

5. Options for facility provision

5.1 Introduction

Crighton will be providing a range of facilities to cater to future demand. While The Hermitage and Grange Retirement Village are essentially "self-contained" facilities (as are the proposed tourist developments), other demand will need to be addressed.

Given the scale of the development of the Crighton holdings this demand can be met by a combination of methods that will be subject to later agreement. The purpose of this section is to outline the options for such provision.

5.2 Methods of facility provision

As noted previously, a Section 94 contribution can be satisfied by:

- Dedication of land
- A monetary contribution
- Material public benefit (MPB)
- A combination of some or all of the above

In the assessment of demand, consideration also must be made to the facilities that may be provided within a development that may satisfy demand such that external demand is reduced. This is an important consideration in terms of whether any contribution sought is reasonable.

The following briefly sets out the facilities currently proposed by Crighton.

5.3 Facilities proposed by Crighton Properties

The proposed Hermitage retirement village is expected to be completed by 2011 and will include the following:

- Indoor swimming pool
- Four link bowling green
- 2 tennis courts
- several community buildings for the use of its residents
- Generous parks and open space

Facilities provided within The Hermitage retirement village will cater for the needs of the residents of the village. As facility provision will generally be sufficient for residents within the village the potential exists for recognition of reduced facility demand on the wider community created by the development.

5.4 Land dedication and embellishment

Land is typically required to provide for open space as well as relevant community facilities. The Crighton development has potential to provide a range of open space facilities including:

- ***Local open space*** – typically local parks providing for low key recreation needs
- ***District open space*** – a large facility that could include sports grounds and similar structured facilities
- ***Environmental open space*** – areas of land that are zoned for conservation and/or environmental protection

There is also the potential to embellish this open space to provide for demand on an immediate and ongoing basis (especially where demand may be incremental). The Council has indicated in the CP that additional sports facilities are not required for some time and it would appear they are concerned

to be maintaining a large facility where there is low demand. However, as noted previously, the opportunity to provide this facility while early planning for the development of the holdings are under way should not be missed. There may be potential for either maintenance payments to be made or, alternatively, for the maintenance to be undertaken on the Council's behalf for a set period. This process could include immediate dedication to the Council or dedication after a set period.

The local open space can be planned, embellished and dedicated on an ongoing basis and it would be surprising if the Council would have trouble with this proposition.

The environmental open space could provide for demand for walking trails and interpretive facilities subject to agreement with the relevant authorities. Consideration must be given to the ongoing maintenance and management of environmental space.

5.5 Material public benefits

A MPB may be offered as a means of partial or full settlement of a section 94 contribution. A MPB could be:

- A work in kind (WIK). This is undertaking a work that is specifically listed in the works schedule of a CP for which a monetary contribution would normally be sought
- The provision of other public amenities or services that may or may not exist in the area and that is not included in a development contributions plan

The list of facilities that may be offered as a MPB is not limited and would be subject to agreement. Such facilities would include:

- Street lighting and planting not otherwise required by the development
- Footpath and footbridges in open space or other areas
- Road pavement, kerb and gutter and kerb ramp construction in existing streets
- Construction of cycleways (both in Crighton properties holdings and in the wider locality)
- Stormwater management facilities beyond Crighton properties holdings
- Construction of community facilities such as a multi-purpose facility, library or child care centre
- Streetscape embellishment such as paving, seats and information boards
- Road network improvements (including traffic calming)
- Access to community facilities in Crighton development for the wider community (including community buildings and structured and unstructured recreation)
- Ongoing management of environmentally sensitive land, such as wetland areas
- Ongoing bushfire management
- Ongoing management of recreational fields and community facilities
- Proposed structured multi-use sports field may be amended/expanded to provide for walking path or senior activities (such as bowls, croquet or similar)
- Proposed structured multi-use sports field may be amended/expanded to provide for younger residents in the form of baseball and hockey fields and tennis courts
- Embellishment of existing council open space areas
- Design advice to council in terms of providing facilities to satisfy existing demand

These may include partial funding by the Council where an existing deficiency exists, where the Council may wish to have another work completed in the area or where the facility is funded partly or wholly by section 94 contributions.

5.6 Principles for establishment of a planning agreement

Given the Council's section 94 plan does not contemplate the longer term development of the Tea Gardens and Hawks Nest area, there is a need to establish a framework for the provision of facilities that will serve future development particularly of the Crighton holdings.

A planning agreement provides the opportunity to identify those facilities and the timing/thresholds for their provision. The planning agreement may also include the payment of monetary contributions to address certain facilities already addressed in the Tea Gardens /Hawks Nest CP. The amount of such contributions and their timing would be subject to negotiation.

The proposed principles for a Planning Agreement are broadly:

- That the agreement must provide a degree of flexibility whilst ensuring the delivery of services from both parties
- The planning agreement will not include benefits that are wholly unrelated to the development
- The parties will appoint a person to represent them in the negotiations and also appoint a third person to attend and take minutes of all negotiations
- The parties will decide whether to appoint an independent person to facilitate or otherwise participate in the negotiations or aspects of it, and appoint such person
- A timetable for negotiations and the protocols and work practices governing their negotiations would be agreed between the parties
- The key issues for negotiation should be identified by the parties, and the negotiations over these issues should take place
- The parties could undertake further negotiation on the specific terms of the proposed planning agreement as necessary
- If agreement is reached, the proposed planning agreement including the explanatory statement will be prepared and distributed to all parties
- The consent authority will publicly exhibit the application and planning agreement in accordance with the Act
- If the benefit under a planning agreement is the provision of land for a public purpose, the value the benefit will be on the basis of the estimated amount of compensation would be due under the *Land Acquisition (Just Terms Compensation) Act 1991* upon the compulsory acquisition of the land
- If the benefit under a planning agreement is the carrying out of works for a public purpose, the benefit will be valued on the basis of the estimated value of the completed works on the basis of a cost estimate prepared by a registered quantity surveyor
- The agreement will be binding but will not be registered on the title (as the title position will change over time)

6. Potential project commitments

6.1 Introduction

Section 6 has been purposefully left blank as it is dependent on negotiations carried out with the Great Lakes Council to lead to a proposed list of project commitments.

6.2 Discussions with Great Lakes Council

6.3 Preferred planning agreement conditions

6.4 Summary of potential project commitments

Summary of possible project commitments

Item	Section 94 Plan	Works	Value of Works	Cash	Comment	Timing
Open Space						
Environmental lands						
Community Facilities						
Traffic facilities						
Bushfire						
Administration facilities						
Surf lifesaving						

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Appendix A

Execution of planning agreements

Development Contributions – Practice Note

Planning agreements

The purpose of this practice note is to provide advice on the matters surrounding voluntary planning agreements. It provides an overview of current trends and practices, sets out the statutory framework for planning agreements and deals with issues such as the fundamental principles governing the use of planning agreements, as well as public interest and probity considerations. Some examples of the use of planning agreements are also provided, along with a template planning agreement and explanatory note.

Part 1 - Introduction

About planning agreements

The *Environmental Planning and Assessment Amendment (Development Contributions) Act 2005* introduced Subdivision 2 of Division 4 of Part 6 providing for a statutory system of planning agreements.

It was not intended that the new system preclude other kinds of agreements in the planning process. For this reason, no transitional arrangements have been included in the new legislation. However, other kinds of agreements, whether made before or after the new system comes into force, must comply with the general law.

It was largely because of uncertainty surrounding the application of the general law to agreements in the planning process that the new system of planning agreements was enacted.

Furthermore there is uncertainty about the application of the Goods and Services Tax (GST) to other kinds of agreements. The intention of the planning agreements legislation was to overcome that uncertainty and remove the application of the GST to planning agreements as far as possible. However, independent advice should be sought on the GST implications of entering into any sort of agreement in the planning process and on a case specific basis.

About this practice note

This practice note is made for the purposes of clause 25B(2) of the *Environmental Planning and Assessment Regulation 2000*.

The purpose of this practice note is to assist planning authorities, developers, and others in the preparation of planning agreements under s93F of the *Environmental Planning and Assessment Act 1979*, and to understand the role of planning agreements in the planning process.

Section 93F and other provisions in Subdivision 2 of Division 6 of Part 4 of the *EP&A Act* relating to planning agreements were inserted by the *Environmental Planning and Assessment Amendment (Development Contributions) Act 2005*. Related provisions were inserted into the *Regulation* by the *Environmental Planning and Assessment Amendment (Development Contributions) Regulation 2005.* The amendments to the *EP&A Act* and *Regulation* took effect on 8 July 2005. Those amendments, together with this practice note, form the broad planning agreements framework for NSW.

This practice note is not legally binding. In some cases it may advocate greater restrictions on the content and use of planning agreements than is provided for in the *EP&A Act* and *Regulation.* However, the *EP&A Act* and *Regulation* provide only a broad legislative framework for planning agreements, whereas this practice note seeks to provide best practice guidance in relation to their use. It also sets out various templates designed to standardise planning agreements documentation in order to foster efficient systems. It is intended, therefore, that planning authorities, developers, and others will follow this practice note to the fullest extent possible.

The remainder of this practice note is structured as follows:

- **Part 2** provides a brief overview of current practices relating to the use of agreements in the planning process in NSW and the recommendations of the Ministerial Taskforce that lead to amendments to the *EP&A Act* and *Regulation* to provide for a statutory system of planning agreements for the State,
- **Part 3** summarises the legislative framework for planning agreements established by the *EP&A Act* and *Regulation,*
- **Part 4** provides best practice guidelines in relation to planning agreements by identifying and explaining key public interest and probity considerations and fundamental principles relating to the use of planning agreements, and setting out a broad policy framework and basic statutory procedures for negotiating, entering into and administering planning agreements.
- **Part 5** provides examples of the possible use of planning agreements.

- **Attachments A to C** set out several template documents, including a template planning agreement for use in agreements between councils and developers.

Terminology

The introduction of new statutory processes, such as the new statutory system of planning agreements under Division 6 of Part 4 of the *EP&A Act*, invariably lead to the introduction of new terminology that can assist clear and efficient communication.

In this practice note, the following terminology is used to convey several key concepts in relation to planning agreements:

- **development contribution** means the kind of provision made by a developer under a planning agreement, being a monetary contribution, the dedication of land free of cost or the provision of a material public benefit
- **planning benefit** means a development contribution that confers a net public benefit, that is, a benefit that exceeds the benefit derived from measures that would address the impacts of particular development on surrounding land or the wider community
- **public facilities** means public infrastructure, facilities, amenities and services
- **planning obligation** means an obligation imposed by a planning agreement on a developer requiring the developer to make a development contribution
- **public** includes a section of the public
- **public benefit** is the benefit enjoyed by the public as a consequence of a development contribution.

Up-dates to this practice note
It is intended that this practice note will be periodically updated. More detailed information or guidance on specific matters in this practice note may also be the subject of future separate practice notes.

Part 2 - Overview of current trends and practices[1]

Negotiation and agreement between planning authorities and developers to exact public benefits from the planning process are now widespread. However, practices are largely unregulated. The negotiation process often occurs without the involvement of all interested stakeholders, and agreements are entered into without effective public participation.

The levying of s94 contributions and the imposition of conditions of development consent requiring works-in-kind also frequently involve significant negotiation between consent authorities and developers, despite the public impression that such contributions are obtained through strict adherence to the formal processes under the *EP&A Act* and *Regulation*.

There are a number of apparent reasons why the use of agreements in the planning process to exact public benefits has become widespread. These include:

- planning authorities are under increasing pressure from local communities to ensure that development produces targeted public benefits over and above measures to address the impact of development on the public domain,
- development consent conditions, including s94, are ill-equipped to produce such benefits as they are primarily designed to mitigate the external impacts of development on surrounding land and communities,
- as developers increasingly appreciate how their own developments benefit from the provision of targeted public facilities, they are seeking greater involvement in determining the type, standard and location of such facilities,
- negotiation tends to promote co-operation and compromise over conflict and can provide a more effective means for public participation in planning decisions,
- agreements provide a flexible means of achieving tailored development outcomes and targeted public benefits, including a means by which communities can agree to the redistribution of the costs and benefits of development in order to realise their specific preferences for the provision of public benefits,
- agreements can provide enhanced and more flexible infrastructure funding opportunities for planning authorities, subject always to good planning implementation.

Further, planning agreements provide a flexible framework under which the State and local government can share responsibility for the provision of infrastructure in new release areas or in major urban redevelopment projects. Planning agreements permit particular governance arrangements that suit particular cases and foster the provision of infrastructure by the different levels of government in an efficient, co-operative and co-ordinated way.

[1] This Part is taken from Taylor, L., *Bargaining for Developer Contributions in NSW*, A Research Thesis for the Degree of Doctor of Philosophy, Macquarie University 2000.

Part 3 - Outline of statutory framework

Nature of planning agreements

Subdivision 2 of Division 6 of Part 4 of the *EP&A Act* sets out a statutory system of planning agreements in NSW.

Section 93F(1) provides that a planning agreement is a voluntary agreement or other arrangement between one or more planning authorities and a developer under which the developer agrees to make development contributions towards a *public purpose*.

Who is a planning authority?

Section 93C defines a *planning authority* to mean a council, the Minister, the Ministerial corporation constituted under s8(1) of the *EP&A Act*, a development corporation within the meaning of the *Growth Centres (Development Corporations) Act 1974* or a public authority declared by the regulations to be a planning authority.

Clause 25A of the *EP&A Regulation* declares all public authorities to be planning authorities for this purpose.

Who is a developer?

A *developer* is a person who has sought a change to an environmental planning instrument (which includes the making, amendment or repeal of an instrument (s93F(11)), or who has made or proposes to make a development application, or who has entered into an agreement with or is otherwise associated with such a person.

Additional parties to a planning agreement

Section 93F(7) provides that any Minister or public authority or other person approved by the Minister for Infrastructure and Planning is entitled to be an additional party to a planning agreement and to receive a benefit on behalf of the State.

Joint planning agreements

Planning authorities may enter into joint planning agreements.

Section 93F(8) provides that a council is not precluded from entering into joint planning agreements with another council or other planning authority merely because it applies to land not within, or any purposes not related to, the area of the council.

Types of development contributions authorised by planning agreements

Development contributions under a planning agreement can be monetary contributions, the dedication of land free of cost, any other material public benefit, or any combination of them, to be used for or applied towards a public purpose.

Section 93F(4) provides that a provision of a planning agreement is not invalid by reason only that there is no connection between the development and the object of expenditure of any money required to be paid under the provision.

Definition of *public purpose*

Public purpose is defined in s93F(2) to include the provision of, or the recoupment of the cost of providing public amenities and public services (as defined in s93C), affordable housing, transport or other infrastructure. It also includes the funding of recurrent expenditure relating to such things as the monitoring of the planning impacts of development and the conservation or enhancement of the natural environment.

Mandatory contents of planning agreements

Section 93F requires planning agreements to include provisions specifying:

(a) a description of the land to which the agreement applies,
(b) a description of the change to the environmental planning instrument, or the development, to which the agreement applies,
(c) the nature and extent of the development contributions to be made by the developer under the agreement, and when and how the contributions are to be made,
(d) whether the agreement excludes (wholly or in part) the application of s94 or s94A to particular development,
(e) if the agreement does not exclude the application of s94 to a development, whether benefits under the agreement may or may not be considered by the consent authority in determining a contribution in relation to that development under s94,
(f) a dispute resolution mechanism, and
(g) the enforcement of the agreement by a suitable means, such as the provision of a bond or bank guarantee, in the event of a breach by the developer. (Consideration should be given to the type of security which is appropriate to the circumstances of the particular development).

The *EP&A Act* does not preclude a planning agreement containing other provisions that may be necessary or desirable in particular cases, except those provisions mentioned immediately below.

Limitations on the contents of planning agreements

Section 93F(9) precludes a planning agreement from imposing an obligation on a planning authority to grant development consent or to exercise a function under the *EP&A Act* in relation to a change to an environmental planning instrument.

Section 93F(10) provides that a planning agreement is void to the extent, if any, to which it authorises anything to be done in breach of the *EP&A Act*, or an environmental planning instrument or a development consent applying to the land to which the agreement applies.

Provisions of planning agreements relating to s94 or s94A

A planning agreement may wholly or partly exclude the application of s94 or s94A to development that is the subject of the agreement.

Section 93F(5) provides that, in such a case, a consent authority is precluded from imposing a condition of development consent in respect of that development under s94 or s94A except to the extent that any part of those sections are not excluded by the agreement.

A planning agreement may exclude the benefits under the agreement from being considered under s94 in its application to development.

Section 93F(6) provides that in such a case, s94(6) does not apply to any such benefit. Section 94(6) provides that if a consent authority proposes to impose a condition under s94 in respect of development, it must take into consideration any land, money or other material public benefit that the applicant for development consent has elsewhere dedicated free of cost to the consent authority or previously paid to the consent authority, other than a benefit provided as a condition of development consent granted under the *EP&A Act,* or a benefit excluded from consideration under s93F(6).

Application of development contributions obtained under a planning agreement

Sections 93E(1) and (4) require that a planning authority is to hold any monetary contribution paid in accordance with a planning agreement, together with any additional amount earned from its investment, for the purpose for which the payment was required and apply it towards that purpose within a reasonable time.

Section 93E(3) contains a similar requirement in respect of land dedicated in accordance with a planning agreement.

Limitation on provisions of environmental planning instruments

Section 93I(1) invalidates any provision of an environmental planning instrument made after the commencement of that section that *expressly* requires a planning agreement to be entered into before a development application can be made, considered or determined, or that expressly prevents a development consent from being granted or having effect unless or until a planning agreement is entered into.

However, s93D provides that Division 6 of Part 4 of the *EP&A Act* (other than s93I) does not derogate from or otherwise affect any provision of an environmental planning instrument, whether made before or after the commencement of the section, that requires satisfactory arrangements to be made for the provision of particular kinds of public infrastructure, facilities or services before development is carried out.

Determination of development applications

Section79C(1)(a)(iiia) of the *EP&A Act* requires a consent authority, when determining a development application, to take into consideration, so far as is relevant to the proposed development, any planning agreement that has been entered into under s94F or any such draft agreement offered by a developer. Section 79C(1)(d) requires the consent authority to take into consideration any public submissions made in respect of the planning agreement or draft planning agreement.

Section 93I(2) precludes a consent authority from refusing to grant development consent on the ground that a planning agreement has not been entered into in relation to the proposed development or that the developer has not offered to enter into such an agreement.

Section 93I(3) authorises a consent authority to require a planning agreement to be entered into as a condition of a development consent but only if it requires an agreement that is in the terms of an offer made by the developer in connection with the development application or a change to an environmental planning instrument sought by the developer for the purposes of making the development application.

Public notice of planning agreements

Section 93G(1) precludes a planning agreement from being entered into, amended or revoked unless public notice is given of the proposed agreement, amendment or revocation.

Clause 25D of the *EP&A Regulation* makes provision for public notice to be given of an agreement to enter, amend or revoke a planning agreement together with any public notice required under the *EP&A Act* for the relevant proposed change to a local or regional environmental plan or development application.

Clause 25E(1) of the *EP&A Regulation* requires the preparation of an explanatory note by a planning authority which proposes to enter into a planning agreement or an agreement to amend or revoke a planning agreement.

Clause 25E(3) provides that the explanatory note must be prepared jointly with the other parties proposing to enter into the planning agreement.

Clause 25E(4) makes provision for separate explanatory notes in certain circumstances if there are two or more planning authorities involved in the agreement.

Clause 25E(7) provides that a planning agreement may provide that the explanatory note may not be used to assist in construing the agreement.

Provision of information about planning agreements

Sections 93G(3) and (4) apply where the Minister and a council, respectively, are not party to a planning agreement and require the relevant planning authority that is party to the agreement to give certain information to the Minister or the council as relevant within 14 days after the agreement is entered into, amended or revoked.

Clause 25D(6) of the *EP&A Regulation* provides that if a council is not a party to a planning agreement that applies to its area, a copy of the explanatory note must be provided to the Council at the same time as the material under s93G(4) is provided.

Section 93G(5) requires a planning authority that has entered into a planning agreement, while the agreement is in force, to include in its annual report certain particulars relating to the planning agreement during the year to which the report relates.

Clauses 25F and 25G of the *EP&A Regulation* make provision for the keeping and public inspection of planning agreement registers. A council must keep a planning agreement register of any planning agreements that apply to the area of the council. The Director-General must keep a planning agreement register of any planning agreements entered into by the Minister.

Clause 25H of the *EP&A Regulation* makes provision for planning authorities other than the Minister or a council to make planning agreements to which those authorities are party available for public inspection.

Registration of planning agreements

Sections 93H(1) and (4) permit a planning agreement or any amendment or revocation of a planning agreement to be registered if each person with an estate or interest in the land agrees to its registration.

Section 93H(2) requires the Registrar-General to register a planning agreement on its lodgement by a planning authority in a form approved by the Registrar-General.

Section 93H(3) provides that a planning agreement that has been registered under s93H is binding on and enforceable against the owner of the land from time to time as if each owner for the time being had entered into the agreement.

No appeals to the Land and Environment Court

Section 93J(1) expressly excludes a person from appealing to the Land and Environment Court against the failure of a planning authority to enter into a planning agreement or against the terms of a planning agreement.

Jurisdiction of the Land and Environment Court to enforce planning agreements

Section 93J(2) provides that the removal by s93J(1) of an appeal to the Land and Environment Court does not affect the jurisdiction of the Court under section 123 of the *EP&A Act*. Section 123(1) provides that any person may bring proceedings in the Court for an order to remedy or restrain a breach of '*this Act*', whether or not any right of that person has been or may be infringed by or as a consequence of that breach. Section 122(b)(v) provides that in s123 a reference to *this Act* includes a reference to a planning agreement referred to in s93F.

Determinations or directions by the Minister

Section 93K authorises the Minister for Infrastructure and Planning, generally or in any particular case or class of cases, to determine or direct any other planning authority as to the procedures to be followed in negotiating a planning agreement, the publication of those procedures, or any standard requirements with respect to planning agreements.

Commencement and amendment

A planning agreement will take effect in accordance with its terms. Ordinarily, the obligation to perform an agreement will arise, in accordance with the terms of the agreement, when the development to which it relates is commenced.

Clause 25C(2) of the *EP&A Regulation* authorises a planning agreement to specify that a planning agreement does not take effect until the happening of certain particular events.

Clause 25C(3) of the *EP&A Regulation* provides that a planning agreement can be amended or revoked by further agreement in writing signed by the parties (including by a subsequent planning agreement).

Form of planning agreements

A planning agreement must be in writing and signed by all of the parties to the agreement. A planning agreement is not entered into until it is so signed.

Part 4 - Best practice guidelines

Public interest and probity considerations[2]

This section discusses the public interest and probity issues that arise in connection with the use of planning agreements. It aims to lift the general level of awareness of these issues, and to inform the principles, policies and procedures contained in the best practice guidelines relating to planning agreements discussed later in this Part.

Problems inherent in the use of development agreements concern whether an agreement is in the public interest. Generally speaking, the public interest is directed towards securing the fair imposition of planning control for the benefit of the community and as between one developer and another. For this reason, the parties to a planning agreement do not enjoy the same bargaining freedom as do the parties to a commercial contract.

In particular cases, the public interest implicated by a planning agreement may be measured in terms of the need to mitigate any adverse impacts of development on the public domain or the desirability of providing a planning benefit to the wider community. Benefit to the developer is not a primary consideration.

The statutory bargaining framework for planning agreements raises the fundamental issue of what is an appropriate planning agreement. The bargaining process involves the exercise of discretion on both sides, giving planning authorities and developers room to accommodate subjective values and varying concepts of the public interest, private interests and other standards.

The ability for a planning agreement to wholly or partly exclude the application of s94 or s94A to development gives a planning authority scope for limited trade-offs under an agreement. This means that the financial, social and environmental costs and benefits of development can be redistributed through an agreement. However, there is no guarantee that the costs and benefits of development will be equitably distributed within the community. Planning agreements may facilitate the provision of public benefits that do not relate to development. Further, what may be a specific benefit to one group in the community may be a loss to another group or the remainder of the community.

Safeguards in the form of a system of principles, policies and procedures relating to planning agreements are needed to protect the public interest and the integrity of the process, and to guard against misuse of planning discretions and processes. Such misuse has the potential to seriously undermine good comprehensive planning, and public confidence in the planning system.

A system that ensures that planning discretions are exercised openly, honestly, freely and fairly in any given case and fairly and consistently across the board will serve to protect planning agreements from the natural suspicion that changes to environmental planning instruments and development consents can be bought by the highest bidder through planning agreements.

Misuse of planning agreements can occur for a variety of reasons and produce a variety of unwelcome results. Some examples are:

- where a planning authority seeks inappropriate public benefits because of opportunism or to overcome revenue-raising or spending limitations that exist elsewhere.
- where insufficient analysis of the likely planning impacts of proposed development by a planning authority determined to enter into, or to give effect, to a planning agreement.
- where a planning authority allows the interests of individuals or small groups to outweigh the public interest.
- because of an imbalance of bargaining power between the planning authority and developer. For example, abuse would occur if a planning authority sought to improperly rely on its peculiar statutory position in order to extract unreasonable public benefits under a planning agreement.

On the other hand, misuse can also occur if the planning authority's bargaining power is compromised or its decision-making freedom is somehow fettered through a planning agreement.

The potential for misuse also exists where a planning authority, acting as consent authority or in another regulatory capacity in respect of development, is both party to a planning agreement and also a development joint venture partner under the agreement. Special safeguards, such as the

[2] This section is taken from Taylor, L., *Bargaining for Developer Contributions in NSW*, A Research Thesis for the Degree of Doctor of Philosophy, Macquarie University 2000.

intervention of a disinterested third party in the development assessment process, would be needed in such circumstances.

For these reasons, the safeguards applying to the use of planning agreements should:

- provide for a generally applicable test for determining the acceptability of a planning agreement, which embraces amongst other things concepts of reasonableness,
- contain specific measures to protect the public interest and prevent misuse of planning agreements and,
- be open with published rules and accessible procedures,
- provide for effective formalised public participation,
- extend fairness to all parties affected by a planning agreement,
- guarantee regulatory independence of the planning authority.

The generally applicable *acceptability test* referred to above should require that planning agreements:

- are directed towards proper or legitimate planning purposes, ordinarily ascertainable from the statutory planning controls and other adopted planning policies applying to development,
- provide for public benefits that bear a relationship to development that is not *de minimis* (that is benefits that are not wholly unrelated to development),
- produce outcomes that meet the general values and expectations of the public and protect the overall public interest,
- provide for a reasonable means of achieving the relevant purposes and outcomes and securing the benefits, and
- protect the community against planning harm.

Formal public participation in a planning agreements system as referred to above is fundamental as it is the tool which legitimates the redistribution of the costs and benefits of development through planning agreements. That is, it is the means by which the community can express its preference to bear some of the costs of particular development on the public domain in order to share in wider community benefits provided under an agreement.

Fundamental principles

Planning agreements provide a facility for planning authorities and developers to negotiate flexible outcomes in respect of development contributions. They are a means to enable the NSW planning system to deliver sustainable development, through which key economic, social and environmental objectives of the State and local government can be achieved.

Planning agreements authorise development contributions for a variety of public purposes, some of which extend beyond the scope of s94 or s94A of the *EP&A Act*. These additional purposes include the recurrent funding of public facilities provided by councils, the capital and recurrent funding of transport and other State infrastructure and affordable housing, the protection and enhancement of the natural environment, and the monitoring of the planning impacts of development.

As such, the objective of planning agreements is not limited to internalising the potential costs of development on the public domain. Rather, they facilitate the provision of planning benefits by developers. A planning agreement that provides for a planning benefit involves an agreement by the developer to contribute part of the development profit for a public purpose.

Planning agreements are negotiated between planning authorities and developers in the context of applications by developers for changes to environmental planning instruments or for consent to carry out development. In many cases, the planning authority will be a person charged with the exercise of statutory functions in respect of the subject-matter of the agreement, such as the Minister or a council having functions relating to the making, amendment or repeal of an instrument or the determination of a development application.

Accordingly, planning agreements must be governed by the fundamental principle that planning decisions may not be bought or sold. This means that contributions made by developers towards public purposes that are wholly unrelated to their development should be discouraged, and that unacceptable development should not be permitted because of planning benefits offered by developers that do not make the development acceptable in planning terms.

That is not to say that development contributions provided for in a planning agreement must bear the same nexus with development as required by s94. The nexus principle applies to s94 because development contributions can be compulsorily exacted under that section. Because planning agreements, by contrast, are voluntary and facilitate planning benefits, they can allow for a redistribution of the costs and benefits of development subject to the above fundamental principles.

Agreements between planning authorities and developers should not be put in place outside the planning system to secure development contributions that are wholly unrelated to development or that do not make development acceptable.

Fundamental principles governing the participation by planning authorities in planning agreements include:

- planning agreements must be governed by the fundamental principle that planning decisions may not be bought or sold,
- planning authorities should never allow planning agreements to improperly fetter the exercise of statutory functions with which they are charged,
- planning authorities should not use planning agreements as a means to overcome revenue-raising or spending limitations to which they are subject or for other improper purposes,
- planning authorities should not be party to planning agreements in order to seek public benefits that are unrelated to particular development,
- planning authorities should not, when considering applications to change environmental planning instruments or development applications, take into consideration planning agreements that are wholly unrelated to the subject-matter of the application, nor should they attribute disproportionate weight to a planning agreement[3],
- planning authorities should not allow the interests of individuals or interest group to outweigh the public interest when considering planning agreements,
- planning authorities should not improperly rely on their peculiar statutory position in order to extract unreasonable public benefits from developers under planning agreements,
- planning authorities should ensure that their bargaining power is not compromised or their decision-making freedom is not fettered through a planning agreement, and
- planning authorities should avoid, wherever possible, being party to planning agreements where they also have a stake in the development the subject of the agreements.

[3] See *Tesco Stores v Secretary of State for the Environment & Ors*. [1995] 1 WLR 759, where the House of Lords held in relation to planning agreements under s106 of the *Town and Country Planning Act 1991* (UK) that if a planning obligation is completely unrelated to the development, it could not be a material consideration in the determination of an application and could be regarded only as an attempt to buy development consent. But if it has some connection with the proposed development which is not *de minimis*, then regard must be had to it. But the extent, if any, to which it should affect the decision is a matter entirely within the discretion of the decision-maker, who, in exercising that discretion, was entitled to have regard to established planning policy.

Policy and practice framework

This section sets out a best practice policy and practice framework on the use of planning agreements. Planning agreements should comply with the specific requirements in this section to the fullest extent possible.

Acceptability test. It is of paramount importance that all planning agreements should meet the acceptability test set out in the previous Part. Whether a particular planning agreement is acceptable and reasonable is a matter of planning judgement to be exercised in the circumstances of the case in the light of particular State, regional or local planning considerations, as appropriate.

Efficient negotiation systems. Planning authorities, particularly councils, should implement measures that aim to create fast, predictable, transparent and accountable negotiation systems of planning agreements. Such systems should ensure that the negotiation of planning agreements do not unnecessarily delay ordinary planning processes. The systems should contain measures to ensure that the negotiation of planning agreements run in parallel with applications to change environmental planning instruments or development applications, including through pre-application negotiation in appropriate cases. Negotiation systems should be based on principles of co-operation, full disclosure, early warning, and agreed working practices and timetables.

Planning agreements policies and procedures. Planning authorities, particularly councils, should publish policies and procedures concerning their use of planning agreements. These should set out:

- the circumstances in which the planning authority would ordinarily consider entering into a planning agreement,
- the matters ordinarily covered by a planning agreement,
- the form of development contributions ordinarily sought under a planning agreement,
- the kinds of public benefits ordinarily sought and, in relation to each kind of benefit, whether it involves a planning benefit,
- the method for determining the value of public benefits and whether that method involves standard charging,
- whether money paid under different planning agreements is to be pooled and progressively applied towards the provision of public benefits to which the different agreements relate,
- when, how and where public benefits will be provided,
- the procedures for negotiating and entering into planning agreements,
- the planning authority's policies on other matters relating to planning agreements, such as their review and modification, the discharging of the developer's obligations

under agreements, the circumstances, if any, in which refunds may be given, dispute resolution and enforcement mechanisms, and the payment of costs relating to the preparation, negotiation, execution, monitoring and other administration of agreements.

More detailed policies and procedures can be prepared by planning authorities to supplement the high level policies and procedures.

Planning agreements or conditions of development consent? There are no general policy restrictions on the circumstances in which planning agreements may be used, including whether they may be used instead of conditions of development consent. Planning authorities and developers must make a judgement in each particular case about whether the use of a planning agreement is beneficial and otherwise appropriate. However, planning agreements should never be used to require compliance with or re-state obligations imposed by conditions of development consent. This entails unnecessary duplication and could frustrate the developer's right of appeal to the Land and Environment Court against the conditions.

GST considerations. The parties to planning agreements should obtain advice in every case on whether a potential GST liability attaches to the agreement. An agreement potentially involves two taxable supplies: the supply of development rights from the planning authority to the developer and the supply of public benefits by the developer to the planning authority. In other words, both parties may have a GST liability. The imposition of a condition under s93I requiring a planning agreement to be entered into may overcome the potential GST liability attaching to a planning agreement, but legal advice should still be obtained in every case.

Objectives of planning agreements. The objectives of planning agreements will be dictated by the circumstances of individual cases and the policies of planning authorities in relation to their use. However, as a general indication, planning agreements may be directed towards achieving the following broad objectives:

- meeting the demands created by development for new public infrastructure, amenities and services,
- prescribing the nature of development to achieve specific planning objectives,
- securing off-site planning benefits for the wider community so that development delivers a net community benefit,
- compensating for the loss of or damage to a public amenity, service, resource or asset by development through replacement, substitution, repair or regeneration.

Planning benefits. The provision of planning benefits for the wider community through planning agreements necessarily involves capturing part of development profit for that purpose. The value of planning benefits should always be restricted to a reasonable share of development profit. Planning benefits should never be obtained through planning agreements as a form of taxation on development. Accordingly, planning benefits, though primarily directed to the wider community, must never be wholly un-related to development contributing the benefit.

Competing proposals to provide planning benefits. Situations may arise where planning authorities are faced with competing applications each accompanied by offers to enter into planning agreements providing planning benefits. In such cases, provided the planning benefits offered are not wholly unrelated to development, they may be considered in connection with the applications and it may be perfectly rational for the planning authority to approve the proposal which offers the greatest planning benefit in terms of both the development itself and related external public benefits[4].

Relationship between planning agreements and SEPP No.1. The benefits provided under planning agreements should never be used to justify a dispensation with applicable development standards under *State Environmental Planning Policy No.1 – Development Standards* in relation to development.

Past deficiencies in infrastructure provision. Planning agreements may be used to overcome past deficiencies in infrastructure provision that would otherwise prevent development from occurring. This may frequently involve the conferring of a planning benefit under the agreement.

Standard charges. Planning authorities are encouraged to standardise development contributions sought under planning agreements in order to streamline negotiations and provide predictability and certainty for developers. This, however, does not prevent public benefits being negotiated on a case by case basis, particularly where planning benefits are also involved.

Standard-form planning agreements. Planning authorities are also encouraged to publish and use standard forms of planning agreements or standard clauses for inclusion in planning agreements in the interests of process efficiency. Councils are encouraged to use the template planning agreement at Attachment A, wherever suitable.

[4] See the decision of the House of Lords in *Tesco Stores v Secretary of State for the Environment & Ors*. [1995] 1 WLR 759.

Involvement of independent third parties. Independent third parties can be potentially used in a variety of situations involving planning agreements. Planning authorities and developers are encouraged to make appropriate use of them. The situations include:

- where an independent assessment of a proposed change to an environmental planning instrument or development application is necessary or desirable,
- where factual information requires validation in the course of negotiations,
- where sensitive financial or other confidential information must be verified or established in the course of negotiations,
- where facilitation of complex negotiations are required in relation to large projects or where numerous parties or stakeholders are involved,
- where dispute resolution is required under a planning agreement.

Recurrent costs and maintenance payments. Planning agreements may require developers to make contributions towards the recurrent costs of facilities that primarily serve the development to which the planning agreement applies or neighbouring development in perpetuity. However, where the facilities are intended to serve the wider community, planning agreements should only require the developer to make contributions towards the recurrent costs of the facility until a public revenue stream is established to support the on-going costs of the facility.

Pooling of monetary contributions. Planning authorities should disclose to developers, and planning agreements should specifically provide, that monetary contributions paid under different planning agreements are to be pooled and progressively applied towards the provision of public benefits that relate to the various agreements. Pooling may be appropriate to allow public benefits, particularly essential infrastructure, to be provided in a fair and equitable way.

Refunds. Planning agreements may provide that refunds of monetary development contributions made under the agreement are available if public benefits are not provided in accordance with the agreement.

Documentation of planning agreements. The parties to a planning agreement should agree on which party is to draft the agreement so as to avoid duplication of resources and costs.

Monitoring and review of planning agreements. Planning authorities should use standardised systems to monitor the implementation of planning agreements in a systematic and transparent way. This may involve co-operation by different parts of planning authorities. Monitoring systems should enable information about the implementation of planning agreements to be made readily available to public agencies, developers and the community. Planning agreements should contain a mechanism for their periodic review that should involve the participation of all parties.

Modification and discharge of developer's obligations. Planning agreements should not impose obligations on developers indefinitely. Planning agreements should set out the circumstances in which the parties agree to modify or discharge the developer's obligations under the agreement. The modification or discharge should be effected by an amendment to the agreement. The circumstances that may require planning agreements to be modified or discharged may include the following:

- material changes to the planning controls applying to the land to which the agreement applies,
- a material modification to the development consent to which an agreement relates,
- the lapsing of the development consent to which an agreement relates,
- the revocation or modification of a development consent to which an agreement relates by the Minister,
- other material changes in the overall planning circumstances of an area affecting the operation of the planning agreement.

Costs. There is no comprehensive policy on the extent to which planning authorities may recover their costs of preparing, negotiating, executing, monitoring and otherwise administering planning agreements. However, cost recovery should be based on reasonable charges and generally should be shared equally with the developer.

Basic statutory procedure for entering into a planning agreement

The nature of planning agreements and requirements for their public notification and consideration in determining applications dictate the basic procedures for entering into planning agreements.

Planning agreements may be entered into between planning authorities and developers (and associated persons) in relation to changes sought by developers to environmental planning instruments (includes the making, amendment or repeal of instruments), or development applications or proposed development applications.

Planning agreements must be publicly notified and made available for public inspection before they can be entered into.

Planning agreements and public submissions relating to them must be considered, so far as relevant, when deciding to make changes to environmental planning instruments to which they

relate or when determining development applications to which planning agreements relate.

Planning agreements should be negotiated between planning authorities and developers before applications are made so that applications may be accompanied by copies of draft agreements. The basic procedures relating to planning agreements are therefore as follows:

Step 1. Before the making of an application, the planning authority and developer decide whether to negotiate a planning agreement. The parties consider whether other planning authorities and other persons associated with the developer should be additional parties to the agreement. If the developer is not the owner of the relevant land, the landowner should be an additional party to the agreement.

Step 2. If an agreement is negotiated, it is documented as a draft planning agreement and the parties agree on the terms of the accompanying explanatory note required by the *EP&A Regulation*. The parties also agree on the content of the application to which the draft agreement relates.

Step 3. The developer makes the application to the relevant authority, accompanied by the draft planning agreement and the explanatory note. The application must clearly record the developer's offer to enter into the planning agreement if the application is approved. Preferably, the draft agreement should be executed by the developer to indicate the developer's commitment to enter into the agreement if the application is approved. In the case of an application to change an environmental planning instrument, the application may record the developer's offer as being to enter into the planning agreement if consent is subsequently granted to a development application relating to the change to the instrument.

Step 4. Relevant public authorities are consulted in relation to the application and draft planning agreement and any consequential amendments required to the application and draft agreement are made.

Step 5. The application, draft planning agreement and explanatory note are publicly notified and exhibited in accordance with the *EP&A Act* and *Regulation.* Any consequential amendments required to the application and draft agreement are made and, if necessary, the amended application, draft planning agreement and explanatory note are re-exhibited.

Step 6. The draft planning agreement and public submissions are considered in the determination of the application so far as relevant to the application. The weight given to the draft agreement and public submissions is a matter for the relevant authority acting reasonably.

Step 7. If the application, being a change to an environmental planning instrument, is approved, the agreement may be entered into immediately. Alternatively, it can be entered into if consent is subsequently granted to a development application relating to the change to the instrument. If the application, being a development application, is granted consent, a condition may be imposed requiring the planning agreement to be entered into but only in terms of the developer's offer made in connection with the application. The planning authority would resolve to execute the agreement when approving the application. If the application is approved on terms different to the developer's offer, the agreement could not be required to be entered.

Part 5 - Examples of the use of planning agreements

Planning agreements have the potential to be used in a wide variety of planning circumstances and to achieve many different planning outcomes. Their use will be dictated by the circumstances of individual cases and the policies of planning authorities in relation to their use. Accordingly, it is not possible to prescribe their use, nor would this be appropriate.

The examples given in this section serve only to provide an indication of the potential breadth of their scope and application.

Compensation for loss or damage caused by development
Planning agreements can provide for development contributions that compensate for the loss of or damage to a public amenity, service, resource or asset that will or is likely to result from the carrying out of development the subject of the agreement.

For example, development may result in the loss of or adversely affect public open space, public car parking, public access, water and air quality, bushland, wildlife habitat and other natural areas and the like.

The planning agreement could impose planning obligations directed towards replacing, substituting, or restoring the public amenity, service, resource or asset to an equivalent standard to that existing before the development is carried out.

In this way, planning agreements can assist in ameliorating development impacts that may otherwise be unacceptable.

Meeting demand created by development
Planning agreements can also provide for development contributions that meet the demand for new public infrastructure, amenities and services created by development the subject of the agreement. For example, development may create a demand for public transport, drainage services, public roads, public open space, streetscape and

other public domain improvements, community and recreational facilities and the like.
The public benefit provided under the agreement could be the provision, extension or augmentation of public infrastructure, amenities and services to meet the additional demand created by the development.

Prescribing inclusions in development
Planning agreements can be used to secure the implementation of particular planning policies by requiring development to incorporate particular elements that confer a public benefit.

Examples include agreements that require the provision of open space, community or recreational facilities or the retention of urban bushland, or agreements that require development, in the public interest, to meet aesthetic standards, such as design excellence.

Providing planning benefits to the wider community
Planning agreements can be used to secure the provision of planning benefits from development. That is, through a planning agreement, development may provide an overall net benefit to the wider community rather than merely address the more direct impacts of the development on surrounding land or the wider community.

The provision of planning benefits through planning agreements necessarily involves an agreement between a developer and a planning authority to allow the wider community to share in part of the development profit to achieve specified public benefits.

The planning benefit may be provided in conjunction with planning obligations or other measures that address the impacts of particular development on surrounding land or the wider community.

Alternatively, the planning benefit could wholly or partly replace such measures if the developer and the planning authority agree to a redistribution of the costs and benefits of development the subject of a planning agreement in order to allow the wider community, the planning authority and the developer to realise their specific preferences for the provision of public benefits in connection with the development.

Planning benefits may take the form of additional or better quality public facilities than is required to meet particular development. Alternatively, planning benefits may involve the provision of public facilities that, although not strictly required to make the development acceptable in planning terms, are not wholly unrelated to the development. An example of the latter might be development contributions towards the provision or retention of off-site affordable housing.

Recurrent funding
Planning agreements may provide for public benefits that take the form of development contributions towards the recurrent costs of infrastructure, facilities and services.
Such benefits may relate to the recurrent costs of items that primarily serve the development to which the planning agreement applies or neighbouring development. In such cases, the planning agreement may establish an endowment fund managed by a trust, to pay for the recurrent costs of the relevant item in perpetuity. In addition, it may bind future owners in a development to make periodic payment to the fund or otherwise in respect of the recurrent costs of the item.

For example, a planning agreement may fund the recurrent costs of habitat protection in respect of development that will have a demonstrated impact on sensitive habitat which is nearby to the development. Further, a planning agreement may fund the recurrent costs of water quality management in respect of development that will have a demonstrated impact on a natural watercourse that flows through or nearby to the development.

Planning benefits may also take the form of interim funding of the recurrent costs of infrastructure, facilities and services that will ultimately serve the wider community. The planning agreement would only require the developer to make such contributions until a public revenue stream is established to support the on-going costs of the facility.

Attachment A

Template planning agreement

(Between Council and Developer)

PLANNING AGREEMENT

Parties

of ##, New South Wales (**Council**)

and

of ##, New South Wales (**Developer**).

Background

(For Development Applications)

A. On, ##, the Developer made a Development Application to the Council for Development Consent to carry out the Development on the Land.

B. That Development Application was accompanied by an offer by the Developer to enter into this Agreement to make Development Contributions towards the Public Facilities if that Development consent was granted.

(For Changes to Environmental Planning Instruments)

A. On, ##, the Developer made an application to the Council for the Instrument Change for the purpose of making a Development Application to the Council for Development Consent to carry out the Development on the Land.

B. The Instrument Change application was accompanied by an offer by the Developer to enter into this Agreement to make Development Contributions towards the Public Facilities that Development Consent was granted.

C. The Instrument Change was published in NSW Government Gazette No. ## on ## and took effect on ##.

D. On, ##, the Developer made a Development Application to the Council for Development Consent to carry out the Development on the Land.

Operative provisions

1 Planning agreement under the Act

The Parties agree that this Agreement is a planning agreement governed by Subdivision 2 of Division 6 of Part 4 of the Act.

2 Application of this Agreement

[*Drafting Note* 2: Specify the land to which the Agreement applies and the development to which it applies]

3 Operation of this Agreement

[*Drafting Note* 3: Specify when the Agreement takes effect and when the Parties must execute the Agreement]

4 Definitions and interpretation

4.1 In this Agreement the following definitions apply:

Act means the *Environmental Planning and Assessment Act 1979* (NSW).

Dealing, in relation to the Land, means, without limitation, selling, transferring, assigning, mortgaging, charging, encumbering or otherwise dealing with the Land.

Development means ##

Development Application has the same meaning as in the Act.

Development Consent has the same meaning as in the Act.

Development Contribution means a monetary contribution, the dedication of land free of cost or the provision of a material public benefit.

GST has the same meaning as in the GST Law.

GST Law has the meaning given to that term in *A New Tax System (Goods and Services Tax) Act 1999* (Cth) and any other Act or regulation relating to the imposition or administration of the GST.

Instrument Change means ## Local Environmental Plan ##.

Land means Lot ## DP ##, known as ##.

Party means a party to this agreement, including their successors and assigns.

Public Facilities means ##.

Regulation means the *Environmental Planning and Assessment Regulation 2000*.

4.2 In the interpretation of this Agreement, the following provisions apply unless the context otherwise requires:

(a) Headings are inserted for convenience only and do not affect the interpretation of this Agreement.

(b) A reference in this Agreement to a business day means a day other than a Saturday or Sunday on which banks are open for business generally in Sydney.

(c) If the day on which any act, matter or thing is to be done under this Agreement is not a business day, the act, matter or thing must be done on the next business day.

(d) A reference in this Agreement to dollars or $ means Australian dollars and all amounts payable under this Agreement are payable in Australian dollars.

(e) A reference in this Agreement to any law, legislation or legislative provision includes any statutory modification, amendment or re-enactment, and any subordinate legislation or regulations issued under that legislation or legislative provision.

(f) A reference in this Agreement to any agreement, deed or document is to that agreement, deed or document as amended, novated, supplemented or replaced.

(g) A reference to a clause, part, schedule or attachment is a reference to a clause, part, schedule or attachment of or to this Agreement.

(h) An expression importing a natural person includes any company, trust, partnership, joint venture, association, body corporate or governmental agency.

(i) Where a word or phrase is given a defined meaning, another part of speech or other grammatical form in respect of that word or phrase has a corresponding meaning.

(j) A word which denotes the singular denotes the plural, a word which denotes the plural denotes the singular, and a reference to any gender denotes the other genders.

(k) References to the word 'include' or 'including are to be construed without limitation.

(l) A reference to this Agreement includes the agreement recorded in this Agreement.

(m) A reference to a party to this Agreement includes a reference to the servants, agents and contractors of the party, and the party's successors and assigns.

(n) Any schedules and attachments form part of this Agreement.

5 Development Contributions to be made under this Agreement

[*Drafting Note* 5: Specify the development contributions to be made under the agreement; when they are to be made; and the manner in which they are to be made]

6 Application of the Development Contributions

6.1 [Specify the times at which, the manner in which and the public purposes for which development contributions are to be applied]

7 Application of s94 and s94A of the Act to the Development

[*Drafting Note* 7: Specify whether and to what extent s94 and s94A apply to development the subject of this Agreement]

8 Registration of this Agreement

[*Drafting Note* 8: Specify whether the Agreement is to be registered as provided for in s93H of the Act]

9 Review of this Agreement

[*Drafting Note* 9: Specify whether, and in what circumstances, the Agreement can or will be reviewed and how the process and implementation of the review is to occur].

10 Dispute Resolution

[*Drafting Note* 10*:* Specify an appropriate dispute resolution process]

11 Enforcement

[*Drafting Note* 11*:*Specify the means of enforcing the Agreement]

12 Notices

12.1 Any notice, consent, information, application or request that must or may be given or made to a Party under this Agreement is only given or made if it is in writing and sent in one of the following ways:

(a) Delivered or posted to that Party at its address set out below.

(b) Faxed to that Party at its fax number set out below.

(c) Emailed to that Party at its email address set out below.

Council

Attention: ##

Address: ##

Fax Number: ##

Email: ##

Developer

Attention: ##

Address: ##

Fax Number: ##

Email: ##

12.2 If a Party gives the other Party 3 business days notice of a change of its address or fax number, any notice, consent, information, application or request is only given or made by that other Party if it is delivered, posted or faxed to the latest address or fax number.

12.3 Any notice, consent, information, application or request is to be treated as given or made at the following time:

(a) If it is delivered, when it is left at the relevant address.

(b) If it is sent by post, 2 business days after it is posted.

(c) If it is sent by fax, as soon as the sender receives from the sender's fax machine a report of an error free transmission to the correct fax number.

12.4 If any notice, consent, information, application or request is delivered, or an error free transmission report in relation to it is received, on a day that is not a business day, or if on a business day, after 5pm on that day in the place of the Party to whom it is sent, it is to be treated as having been given or made at the beginning of the next business day.

13 Approvals and consent

Except as otherwise set out in this Agreement, and subject to any statutory obligations, a Party may give or withhold an approval or consent to be given under this Agreement in that Party's absolute discretion and subject to any conditions determined by the Party. A Party is not obliged to give its reasons for giving or withholding consent or for giving consent subject to conditions.

14 Assignment and Dealings

[*Drafting Note* 14: Specify any restrictions on the Developer's dealings in the land to which the Agreement applies and the period during which those restrictions apply]

15 Costs

[*Drafting Note* 15: Specify how the costs of negotiating, preparing, executing, stamping and registering the Agreement are to be borne by the Parties]

16 Entire agreement

This Agreement contains everything to which the Parties have agreed in relation to the matters it deals with. No Party can rely on an earlier document, or anything said or done by another Party, or by a director, officer, agent or employee of that Party, before this Agreement was executed, except as permitted by law.

17 Further acts

Each Party must promptly execute all documents and do all things that another Party from time to time reasonably requests to affect, perfect or complete this Agreement and all transactions incidental to it.

18 Governing law and jurisdiction

This Agreement is governed by the law of New South Wales. The Parties submit to the non-exclusive jurisdiction of its courts and courts of appeal from them. The Parties will not object to the exercise of jurisdiction by those courts on any basis.

19 Joint and individual liability and benefits

Except as otherwise set out in this Agreement, any agreement, covenant, representation or warranty under this Agreement by 2 or more persons binds them jointly and each of them individually, and any benefit in favour of 2 or more persons is for the benefit of them jointly and each of them individually.

20 No fetter

Nothing in this Agreement shall be construed as requiring Council to do anything that would cause it to be in breach of any of its obligations at law, and without limitation, nothing shall be construed as limiting or fettering in any way the exercise of any statutory discretion or duty.

21 Representations and warranties

The Parties represent and warrant that they have power to enter into this Agreement and comply with their obligations under the Agreement and that entry into this Agreement will not result in the breach of any law.

22 Severability

If a clause or part of a clause of this Agreement can be read in a way that makes it illegal, unenforceable or invalid, but can also be read in a way that makes it legal, enforceable and valid, it must be read in the latter way. If any clause or part of a clause is illegal, unenforceable or invalid, that clause or part is to be treated as removed from this Agreement, but the rest of this Agreement is not affected.

23 Modification

No modification of this Agreement will be of any force or effect unless it is in writing and signed by the Parties to this Agreement.

24 Waiver

The fact that a Party fails to do, or delays in doing, something the Party is entitled to do under this Agreement, does not amount to a waiver of any obligation of, or breach of obligation by, another Party. A waiver by a Party is only effective if it is in writing. A written waiver by a Party is only effective in relation to the particular obligation or breach in respect of which it is given. It is not to be taken as an implied waiver of any other obligation or breach or as an implied waiver of that obligation or breach in relation to any other occasion.

25 GST

If any Party reasonably decides that it is liable to pay GST on a supply made to the other Party under this Agreement and the supply was not priced to include GST, then recipient of the supply must pay an additional amount equal to the GST on that supply.

Execution

Dated: ##

Executed as an Agreement: ##

Attachment B

Template explanatory note

Environmental Planning and Assessment Regulation 2000

(Clause 25E)

Explanatory Note

Draft Planning Agreement

Under s93F of the Environmental Planning and Assessment Act 1979

1. Parties

(Planning Authority)

(Developer)

2. Description of Subject Land

3. Description of Proposed Change to Environmental Planning Instrument/Development Application

4. Summary of Objectives, Nature and Effect of the Draft Planning Agreement

5. Assessment of the Merits of the Draft Planning Agreement

The Planning Purposes Served by the Draft Planning Agreement

How the Draft Planning Agreement Promotes the Objects of the Environmental Planning and Assessment Act 1979

How the Draft Planning Agreement Promotes the Public Interest

For Planning Authorities:

(a) Development Corporations - How the Draft Planning Agreement Promotes its Statutory Responsibilities

(b) Other Public Authorities - How the Draft Planning Agreement Promotes the Objects (if any) of the Act under Which it is Constituted

(c) Councils – How the Draft planning Agreement Promotes the Elements of the Council's Charter

(d) All Planning Authorities – Whether the Draft Planning Agreement Conforms with the Authority's Capital Works Program

The Impact of the Draft Planning Agreement on the Public or Any Section of the Public

Other Matters

Signed and Dated by All Parties

Attachment C

Template condition of development consent

(Where planning agreement accompanied a development application)

> ##. Pursuant to section 80A(1) of the *Environmental Planning and Assessment Act 1979*, the planning agreement that relates to the development application the subject of this consent must be entered into before [*Insert Requirement*].

(Where planning agreement accompanied an application to change an environmental planning instrument)

> ##. Pursuant to section 80A(1) of the *Environmental Planning and Assessment Act 1979*, the planning agreement that accompanied the application made by [*Insert Name of Developer*] to [*Insert Name of Planning Authority*] dated [*Insert Date*] relating to [*Specify Name of Environmental Planning Instrument*] for the purpose of the making of the development application the subject of this consent.

Appendix B

Open space facilities at Tea Gardens/Hawks Nest

Existing Facilities – Tea Gardens/Hawks Nest

Structure Open Space	Open Space
- Courts and fields including the Memorial Park Public Reserve (lot 6) in Tea Gardens and the Myall Sports Reserve (R86322) at Hawks Nest - Tea Gardens Reserve (1.2 hectares) – a large district field comprising four small multi-use fields, toilets and storage facilities - Reserve in Hawks Nest (4 hectares) classified as large district courts and field consisting of a multi-use field, two tennis courts, one croquet court, swings, toilet facilities and a park (ERM, 2006b).	- Open space in the area has typically been provided in the following ratios: - small parks at about 25% - large parks without structured facilities at about 30% - courts at about 15% - playing fields at about 30% (ERM, 2006b).

Volume 3B: Traffic Impact Assessment

Better Transport Futures

Mark Waugh Pty Limited
ABN 67 106 169 180
Transport Planning & Engineering

Proposed Riverside Residential Subdivision, Tea Gardens NSW

Crighton Properties Pty Ltd

Traffic Impact Assessment

August 2008

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Contents

1. Executive Summary 1

2. Introduction 2
2.1 Background 2
2.2 Purpose of Investigations 2

3. Existing Situation 3
3.1 Background and Site Location 3
3.2 Local Road System 4
3.2.1 Road Characteristics 4
3.3 Traffic Volumes 5
3.3.1 Traffic Survey 5
3.4 Intersection Control and Operation 6
3.5 Road Network Improvements 7
3.6 Public Transport, Pedestrians and Cyclists 7

4. Proposed Development 8
4.1 Development and Access Arrangements 8
4.2 Traffic Generation 8
4.3 Site Access 9
4.4 Traffic Distribution 9
4.5 Pedestrian Access 9
4.6 Public Transport Facilities 9
4.7 Site Operations and Access Arrangements 10
4.8 Parking Requirements 10
4.9 Other developments 10

5. Urban Design Principles 12
5.1 Urban Design Principles 12
5.1.1 Riverside Transport Objectives 12

6. Assessment of Transport Operations 13
6.1 Staging Assumptions 13
6.2 Site Access Operations 13
6.3 Road Network Performance and Capacity 14
6.4 Traffic Distribution 14
6.5 Intersection Operation 15
6.5.1 Project Application (381 lots) 15
6.5.2 Concept Plan and Development Staging 17
6.5.3 Project Development – Stage One and Two (1045 lots) 17
6.5.4 Toonang Drive Access 21
6.6 Road Safety 21
6.6.1 Intersection of Myall Street and Myall Quays Boulevard 21
6.7 Pedestrian and Cyclist Facilities 22
6.8 Public Transport 22
6.9 Road Capacity - Myall Street 23
6.10 Internal Road Network 23

7. Summary, Conclusions and Recommendations 25
7.1 Summary 25
7.2 Conclusion 26
7.3 Recommendations 26

Appendix A Traffic Survey Results 27
Appendix B Sidra Intersection Modelling Results 28
Appendix C Criteria for interpreting results of SIDRA.....64
Appendix D Site Concept Plans.....65
Appendix E Urban Design Principles.....70

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1. Executive Summary

Crighton Property Group are preparing a Part 3A (Project and Concept Plan) application for the proposed Riverside development at Tea Gardens, NSW. The concept plan development includes approximately 1045 lots and associated works, with the project plan covering 381 lots within this plan.

The traffic analysis task has involved the following considerations:

- whether the existing Myall Quays intersection can cater for the project plan threshold of 381 lots
- timing of when additional access via a second intersection with Myall Street is required
- impacts of the full concept plan development of 1045 lots
- likely further impact of the additional 1500 lots to be developed at Myall River Downs and
- the future impact of proposed industrial development to the west of Myall Street

The study investigations have revealed the following outcomes in relation to traffic and access issues:

1. Operation of the existing intersection of Myall Street and Myall Quays Boulevard was assessed as having adequate capacity to cater for the flows associated with the project application stage of the development on the site (381 lots), for both the current 2007 and future 2017 design years.
2. The existing intersection has also been analysed to assess the impact of further residential development with access via Myall Quays Boulevard. This analysis indicates that some 590 residential lots could be developed off Myall Quays Boulevard using the existing intersection. Beyond 590 lots, the junction would need to be upgraded, or an additional access provided.
3. The existing intersection when combined with the proposed second access to the north on Myall Street is able to cater for the full 1045 lots under the concept plan
4. The additional access available via Toonang Drive also contributes to a higher overall level of service at the proposed access junctions.
5. The proposed Myall River Downs residential development. Can be accessed via a single 4-way roundabout upgrade of the existing Myall Street / Myall Quays Boulevard intersection, having adequate capacity to cater for both the Myall Quays and Myall River Downs development.
6. The second Myall Street access with development of about 500 lots of Myall River Downs would require upgrade to roundabout control, because of the additional through traffic movements.
7. With then introduction of the industrial land to the west of Myall Street, access to this activity can be catered for via a 4th leg to the second Myall Street access. This operates satisfactorily under roundabout control for both the current 2007 and future 2017 design years.

From the study, it is concluded that the existing road system beyond the site is able to cater for the traffic demands of the proposed residential development of both Myall Quays and Myall River Downs. The existing intersection control at Myall Quays Boulevard and Myall Street, when combined with a 2nd intersection (of similar design) on Myall Street, and also with access to Toonang Drive can accommodate the entire Riverside Concept Plan area (1045 lots.)

The two southern intersections of Myall Street will only require upgrading at or before the development of either or both of Myall River Downs or the industrial land to the west of Myall Street.

It is recommended that the concept plan and project application reflect the following commitments:

1. The second access to Myall Street (as a priority controlled junction) is provided prior to the development of 500 lots within the concept plan. (i.e. before the 590 threshold.)
2. Access to be provided to Toonang Drive in line with the Concept plan staging, at say 700 lots. (i.e. before the 1045 yield.)
3. The Riverside Concept plan in isolation be allowed to be developed in total (1045 lots) based on the capacity of the proposed 4 intersections
4. The two southern intersections of Myall Street only to be upgraded at / before the requirement is reached for these to act as 4-way intersections. (i.e. access is triggered by either or both of Myall River Downs or the industrial land to the west of Myall Street.)

2. Introduction

2.1 Background

Mark Waugh Pty Ltd was commissioned by Crighton Property Group to prepare a Traffic Impact Assessment to support the Part 3A (Project and Concept Plan) application for the proposed Riverside development at Tea Gardens, NSW. The scope of this report has also been extended to consider the cumulative impact of likely further development of the Myall River Downs site opposite.

The work presented in this report focuses on the traffic and transport elements of the proposal in the context of the existing situation and known development plans for the area.

2.2 Purpose of Investigations

The traffic investigations documented in this report have been prepared to support the Part 3A (Project and Concept Plan) application for the proposed Riverside development at Tea Gardens, NSW. The report is required as part of the application to the Department of Planning NSW.

This report presents the findings of the traffic investigations and assessment of the proposal. It is structured as follows:

- **Chapter 2** outlines the existing situation in the vicinity of the subject site, including discussion on the planned development growth within the vicinity and road network changes to support it.
- **Chapter 3** describes the traffic and parking features of the proposal.
- **Chapter 4** details the assessment of traffic operations related to the proposal
- **Chapter 5** summarises the findings of this investigation, outlining conclusions and recommendations for the traffic operations of the site to support the application for the proposal.

3. Existing Situation

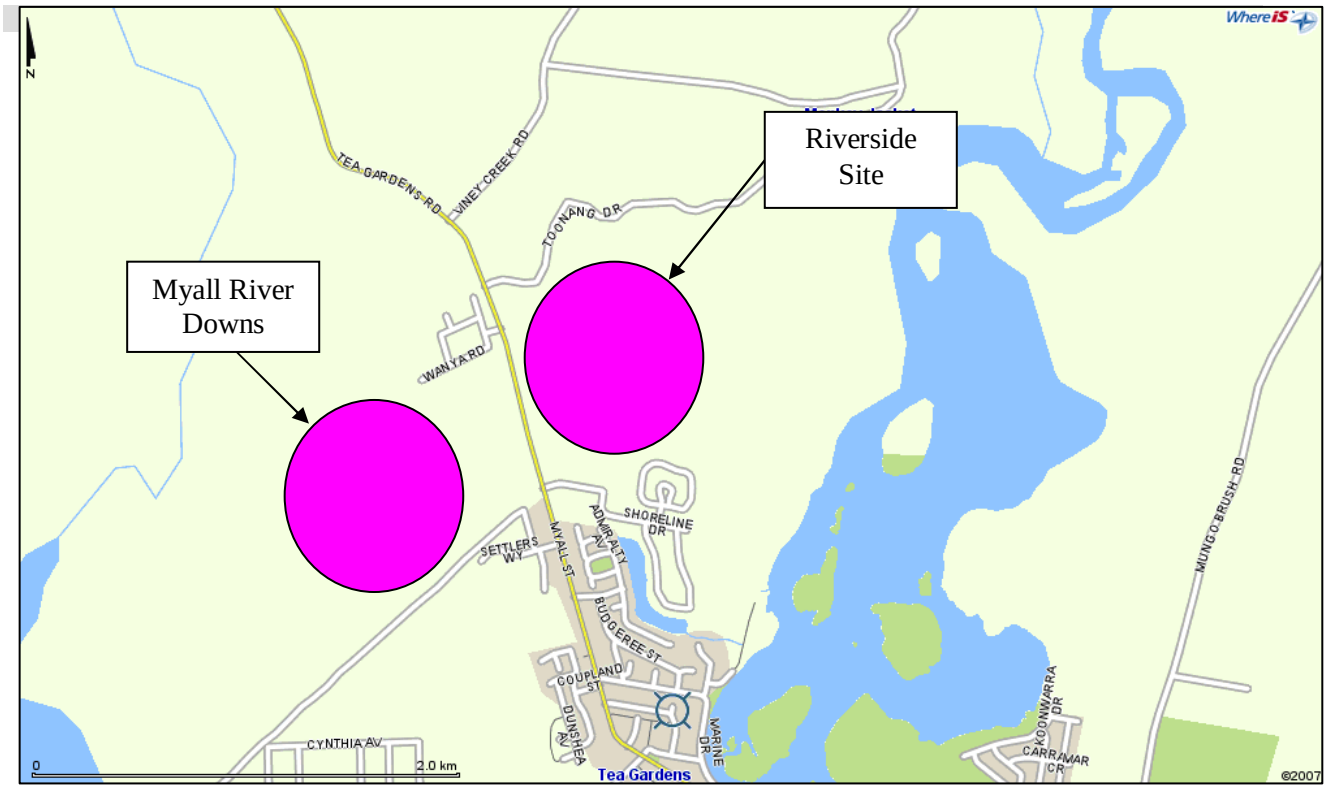
3.1 Background and Site Location

The subject site is located on a parcel of land off Myall Street, in the district of Tea Gardens. It is bounded to the south by existing residential development within Myall Quays and to the north by Toonang Drive and existing and proposed future residential development. To the west is Myall Street providing access to the greater road network. The land is currently vacant and predominantly cleared. The site is directly accessible from Myall Street, Toonang Drive and Myall Quays Boulevard.

Myall Quays and Myall River Downs are two developments located on opposite sides (east and west) of Myall Street, the main road access to the existing villages of Tea Gardens and Hawks Nest. Great Lakes Council has prepared a Development Control Plan No 30 Dated 1999 in addition to the Hawks Nest/ Tea Gardens Conservation and Development Strategy and a Local Environmental Plan. These planning documents covering the developments include potential for up to 2500 – 3000 residential dwellings, the shopping centre with supermarket, specialty retail and other services, service station, commercial centre, medical centre, restaurants and other employment lands.

Current proposals for the two sites provide for approximately 1000 dwellings at Riverside with the Myall River Downs covering a further 1500 dwellings (approximately.)

The location of the site is shown below in **Figure 3.1**.



Source: Where Is.com

Figure 3.1 – Site Location

3.2 Local Road System

3.2.1 Road Characteristics

Myall Street

Myall Street, (Main Road 506) is the main road link to and from the villages of Tea Gardens and Hawks Nest and the Pacific Highway (H10) to the west. As an arterial road, it currently has a two lane sealed carriageway of approximately 13 metres width in the vicinity of the site. The posted speed limit adjacent to the site is a 50 kph local speed zone. Approximately ½ kilometre to the north of the site the speed limit changes to 80 kph at the fringe of the Tea Gardens urban development. Site observations and previous investigations for Myall Quays have indicated the following in relation to traffic operations:

1. Council traffic survey data from December 2001/January 2002 shows Myall Street carries an Annual Average Daily traffic (AADT) flow of 3927 vehicles per day.
2. AADT growth for Myall Street was around 5.5% between 1989 and 1998.
3. The growth rate for 1998-2002 slowed to 2.7%
4. Typical peak hour flows on Myall Street in January 2001 were observed as up to 250 vehicles per hour. Seasonal variations in flow mean that this number is considerably less in September
5. Sight distances are more than satisfactory on all approaches to the subject site
6. Existing traffic flows are relatively light with ample gaps to allow safe entering for vehicles entering the traffic stream from side roads
7. The existing route operates at a satisfactory level of service as evidenced from the lack of traffic management devices installed.
8. Pedestrian facilities in the vicinity are limited to those being installed as part of the Myall Quays development

Photo 1 – View west along Myall Street showing typical cross section

Myall Quays Boulevard
This main access road will serve the shopping centre, proposed commercial development and surrounding residential development as well as the subject site. It has been designed as a dual carriageway boulevard and ultimately with roundabout control at the intersection with Myall Street.

Photo 2 – View north along Myall Quays Boulevard showing typical cross section of southbound lanes

3.3 Traffic Volumes

3.3.1 Traffic Survey

As part of this project, traffic volume data has been collected during a survey of intersection traffic volumes at the intersection of Myall Street and Myalls Quay Boulevard. These surveys were completed on Thursday 8th Match 2007. The results of this survey are provided in **Appendix A** to this report.

The results from the traffic survey indicate that during the surveyed morning peak period (8.00 to 9.00 AM) the two-way traffic flow along Myall Street to the west of Myall Boulevard was in the order of 362 vehicles. The majority of vehicles were light vehicles, with limited heavy goods vehicles observed during the survey period. The survey showed that the westbound movement towards the Pacific Highway was the dominant flow with 193 vehicles (or 73%) whilst the eastbound movement was 169 vehicles.

The corresponding results from the afternoon survey show that the flows are reversed, with the dominant movement being eastbound. During the surveyed peak period (4.30 to 5.30 PM) the two-way traffic flow along Myall Street was in the order of 421 vehicles. The majority of vehicles were again light vehicles, with limited heavy goods vehicles observed during the survey period. The survey showed that the eastbound movement towards Hawks Nest was the dominant movement with 250 vehicles (or 59 %) whilst the westbound movement was 171 vehicles.

The traffic flows along Myall Quays Boulevard were much lower. During the morning peak period the two-way flow was 135 vehicles per hour and in the afternoon was 256, reflecting the demands associated with the shopping centre.

The results of the traffic survey are summarised in **Table3.1** below.

Table 3.1 – Traffic Volumes

Road	Peak Period	Peak flow	Mid-Block Road Capacity[2]	Volume / Capacity
Myall Street	AM peak	193 eastbound 169 westbound	900 (one-way)	0.214 0.187
	PM peak	173 eastbound 250 westbound	900 (one-way)	0.192 0.277
Myall Quays Boulevard	AM peak	76 northbound 59 southbound	900 (one-way)	0.084 0.065
	PM peak	113 northbound 143 southbound	900 (one-way)	0.125 0.159

Notes: 1. Peak flow from March 2007 traffic survey results by Mark Waugh Pty Ltd
2. RTA 2002, Urban Road Conditions Level of Service C

Table 3.1 demonstrates that both Myall Street and Myall Quays Boulevard are currently operating well within their technical and functional capacity levels as an arterial road (Myall Street) and local collector road (Myall Quays Boulevard).

Using Table 4.4 from the RTA Guide to Traffic Generating Developments (reproduced below), it can be seen that the ultimate capacity for Myall Street in this location is around 1,400 vehicles per hour in one direction. For the current observed traffic flows along Myall Street it can be seen that the level of service for road users is A or B.

Table 4.4
Urban road peak hour flows per direction

Level of Service	One Lane (veh/hr)	Two Lanes (veh/hr)
A	200	900
B	380	1400
C	600	1800
D	900	2200
E	1400	2800

Source: RTA Guide to Traffic Generating Developments, version 2.2 dated October 2002.

3.4 Intersection Control and Operation

As discussed above, there are a number of intersections and driveways in the general vicinity of the subject site. These intersections are in the main simple give way controlled intersections. There are also a number of driveways to individual residential lots.

The intersection of Myall Street and Myall Quays Boulevard is the major intersection in the vicinity of the site. It provides a give way control with a central right turn lane, so that westbound through movements are not impeded by traffic waiting to turn right into the side road. There is also a left turn deceleration lane for traffic turning left into the side road off Myall Street. For traffic exiting Myall Quays Boulevard

there is a left turn acceleration lane to reduce the delays for these vehicles. The layout of intersection has been reviewed on site and provides good visibility in all directions, due to the straight alignment of both of the roads.

From the RTA Road Design Guide, the intersection provides a Type AUR intersection control, with the additional benefit of the left turn deceleration and acceleration lane.

It is useful to consider the Austroads threshold levels for intersection capacity under uninterrupted flow conditions. **Table 3.2** presents these thresholds. Where traffic flows fall within these limits intersection operation is essentially at no delay or interruption for approaching drivers other than to obey the requisite road rules.

Table 3.2 Intersection Capacity – Uninterrupted Flow Conditions

Road Type	Light Crossing or turning volumes Maximum Design Hour Volumes, Two-way (vph)		
Two Lane through Roadway	400	500	650
Cross Road	250	200	100
Four Lane through roadway	1000	1500	2000
Cross road	100	50	25

Source: Austroads Guide to Traffic Engineering Practice - Part 5, 1988

For both the morning and afternoon peak periods, the survey results indicate that these limits are not met and that therefore the traffic experiences minimal delays, except for those associated with slowing down and speeding up to negotiate the intersection. This confirms site observations during the peak periods.

3.5 Road Network Improvements

The only known road improvements in the vicinity are those associated with the proposed access to the Riverside, Myall River Downs and adjacent industrial estate projects. The long term access arrangements for these projects make provision for upgrading intersection controls to roundabouts, and potentially also for the duplication of the road carriageway between the two nominated access points on Myall Street. These potential upgrades are discussed in later sections of this report.

It is understood there are no major road network improvements planned in the vicinity of the subject site, apart from normal road maintenance performed by Council and the RTA.

3.6 Public Transport, Pedestrians and Cyclists

Public transport in the vicinity of the site is limited. School buses provide access for school children between this area and Raymond Terrace. However, these services do not provide a high standard of service suitable for regular commuters.

Pedestrians and cyclists are able to use the public roads in the vicinity of the site. During the survey there was limited cyclist and pedestrian movements observed.

4. Proposed Development

4.1 Development and Access Arrangements

A concept plan application is to be made to the NSW Department of Planning (DoP) for approval to subdivide the subject site into around 1045 residential lots and associated works. The development will be constructed in a number of stages. A Project Application is to be lodged for approximately the first 381 lots.

The plans for the residential development show that access to the subject site will initially be provided via one intersection on Myall Street which currently exists. Further intersections to Myall Street and Toonang Drive are proposed in subsequent Stages.

The intersection of Myall Street and Myall Quays Boulevard is currently constructed as a give way control. It is proposed to construct the second access on Myall Street as a give way control in an early stage of the development. Under full development and with the development of industrial land opposite the subject site which appears likely to proceed at some future date both of the Myall Street intersections will be upgraded then to 4-way roundabout control.

This assessment is for the full concept plan of 1045 lots, with consideration of the first stage project approval of 381 lots. It also considers the longer term effects of the potential continuation of the industrial estate on the western side of Myall Street, and also the development potential of Myall River Downs, assumed as a maximum potential of 1500 lots. The timing of both of these potential developments is not currently known but there effects have been taken into account in terms of determining the appropriate ultimate level of road infrastructure requirements.

Details of the concept plan and project plan are included in **Appendix D**.

4.2 Traffic Generation

The level of traffic generation from the development proposal has been assessed using the rates available from the standard RTA guidelines for Traffic Generating Developments. These Guidelines indicate a range of traffic generation rates depending on the type land use activity, including residential subdivisions.

The RTA guidelines indicate the critical movement periods for residential are during the morning and afternoon peak periods. These movements are associated with work and school trips. Morning peak flows are generally more critical, as the afternoon peak flows often occur over a longer time frame with less of a peak. For the purposes of this assessment, it has been assumed that the morning and afternoon traffic flows are similar.

The RTA Guide to Traffic Generating developments indicates that typical traffic generation rates for residential subdivisions such as the subject site are 0.85 trips per dwelling during the peaks and 9 trips per dwelling per day.

For the project plan residential development of 381 residential lots the peak hour flows would be in the order of 324 vehicle movements per hour and 3429 vehicle movements per day. It is considered that these rates provide the upper limit for traffic flows and that actual traffic flows could be considerably lower. A review of the current development in the locality of the site indicates that a significant portion of the current residents are retired, and therefore do not have school related trips or work related trips. Assuming the subject development also accommodates a large number of retired people, and then the traffic flows would be much lower.

In addition, it is important to note that a significant portion of the traffic will be contained traffic, associated with trips to the shops, schools, etc. Advice from the RTA Guide to Traffic Generating Developments indicates that typically some 25% of traffic is localised traffic, contained within the area of a development such as this and that this traffic does not use the external road network.

Traffic demands will also be reduced due to the layout of the site, providing a positive encouragement for pedestrians and cyclists for the short trips required to the adjacent facilities and developments. It can also be seen that the home office facilities will encourage a significant portion of the future residents to work from home, using the internet and phone as part of the communication package. The location of the development discourages daily commuting to the major centre such as Newcastle, thereby attracting people who can work form home.

It is considered that with the containment of trips form the design of the site as well as home based work, the normal traffic generation rate of 0.85 can be reduced by some 35%, giving an external trip generation rate of 0.55 trips per dwelling during the peak periods. Daily rates would also be reduced by a similar rate. Using these rates, the Stage One of the development (381 lots) would generate some 209 vehicles per hour two-way and the full development of 1045 would generate 575 vehicle movements per hour.

4.3 Site Access

For the purposes for the project plan vehicle access to the site will be provided via two access points. The existing intersection of Myall Street and Myall Quays Boulevard will provide one access point initially whilst a second access point will be provided to the north of this existing intersection. The timing of the second intersection is discussed in Section 6 of this report. The access roads to the subject site will need to be designed in accordance with the RTA and Council requirements. There will be no direct property access to Myall Street, with all access provided via the internal road network.

4.4 Traffic Distribution

It is considered that the traffic distribution would be similar to the existing observed distribution. Whilst a large number of work related trips would be west towards the Pacific Highway (Raymond Terrace, Newcastle etc) it can be seen that leisure associated trips for retired people would be east towards Hawks Nest e.g. golf course, shops and the beach. This is reflected in the current distribution at the intersection of Myall Street and Myall Quays Boulevard, where in the morning peak 70% of the traffic is west bound towards the Pacific Highway. However, in the afternoon peak period the flows are nearer 60% towards the east.

For the purposes of this assessment, the traffic has been distributed in a similar manner to the existing observed splits.

4.5 Pedestrian Access

Pedestrian access to the site would be via existing facilities along Myall Street augmented by the development as proposed by the proponent. It is considered that the augmented existing facilities in the local area will be more than adequate for the proposed development. In addition, there will be an extensive network of pedestrian and cyclist (dual use) paths within the site. These paths will connect with the existing residential development adjacent to the site as well as connections to waterways and the existing shops at the entry to the subject site.

4.6 Public Transport Facilities

The location of the site means that school children in particular will require a bus run to service the site. There is an existing school bus run that operates from this area. The demands on this existing service may

require additional or improved runs to service this development. It is noted that a bus route throughout the development is proposed. The school bus run could be extended through the development if required, as the layout allows for through traffic movements. In the early stages of the development, it would be beneficial to provide a bus stop and shelter adjacent to the site entry point on Myall Street in the location allowed for adjacent to the shopping centre, to provide a pick up/drop off point for schoolchildren.

The provision of school and regular bus routes to the subject site will be encouraged through discussions with the local bus company, with a view to extending and improving the existing service.

4.7 Site Operations and Access Arrangements

The indicative site plans for the proposed concept and project plan application are presented in **Appendix C** to this report. Overall access geometry would need to meet the requisite Council standards for residential subdivision. The internal road layout will need to be designed in accordance with Council residential subdivision code taking into account intersection controls, pedestrian requirements as well as existing road geometry requirements such as carriageway width etc.

The internal road network has been planned with careful consideration of the needs of the new community, both at the concept and project plan phase of the project.

The longer term planning for the area surrounding the subject site includes development of industrial and other residential land, on both sides of Myall Street. It is envisaged that the two intersections along Myall Street that would provide the main points of access to the new areas.

It is understood that the longer term planning for the area surrounding the subject site includes the development of approximately 15,000 m^2 industrial uses and other residential land, on both sides of Myall Street. It is envisaged that the two intersections along Myall Street that would provide the main points of access to these new areas would be controlled ultimately by roundabouts.

The technical analysis for the development of the site in relation to the form of intersection control required to provide satisfactory access for the residential site is discussed further in **Section 6.**

4.8 Parking Requirements

It can be seen that the new development will require parking for the residents but that it can be contained within the site. As per Council design requirements, there will be garage requirements for the future development as well as driveway requirements etc.

It is considered that all future parking for the development can be contained on site and that there is no further requirement to review parking for the development.

4.9 Other developments

There are a number of other key developments proposed in the general vicinity of the site. These include:

- Myall River Downs incorporating an additional approximately 1500 lot residential lots
- Industrial floor space of approximately 15,000 m^2

Timing of implementation of these two developments is expected to be beyond the timeframe planned for development of the Riverside project. Both of the developments will impact upon access to Myall Street in the long term, with access to these sites proposed at 4 way intersections as upgrades of the two

Riverside access points, to minimise the number of access points to the main road Myall Street. The industrial development which is at the preliminary stages of planning is proposed to have access via two access points on Myall Street, the access to the existing industrial land, and via a fourth leg to the proposed second access into the Riverside site..

The preliminary plans for the Riverside development indicate that access in the long term would be provided via two 4-way roundabout controlled intersections that would provide access to the subject residential development as well as Myall River Downs, and the future industrial development.

It is important to note however that both the Myall River Downs and the future industrial development have not yet been approved. However, when assessing the access options for the subject residential development the impact of this industrial land should be taken into account, to ensure robustness of intersection design.

The assessment of intersection controls and staging of access considered in Section 6 of this report has taken the above planning timeframe into consideration.

5. Urban Design Principles

5.1 Urban Design Principles

The Riverside development provides an opportunity to contribute to the integration of land use and transport integration, through the adoption of urban design principles that encourage the full range of transport alternatives for visitors and residents of the site. The transport goals for the development are outlined below. **Appendix E** to the report includes a more detailed working paper describing the principles of encouraging a change in travel behaviour through the provision of alternative transport considered early in the development process.

5.1.1 Riverside Transport Objectives

The following transport objectives have been put forward as part of the concept master plan for the Riverside site:

Pedestrians:

- Improve the Pedestrian Environment
- Promote walking as principle local transport through and to the site.
- Give pedestrians priority over vehicles within the site
- Enhance walking linkages - provide direct links within the site and to neighbouring attractions to encourage walking as key local transport. Provide signage with travel times to local attractions
- Provide pedestrian links through proposed green/ open spaces
- Provide pedestrian linkages back to Myall Street and the local shopping centre
- Provide a high standard of pedestrian accessibility / mobility within and to the site with continuity, consistency of materials, signposting, lighting

Vehicle Access and Movement:

- Primary vehicle access (including service vehicles) from Myall Street and Myall Quay Boulevard
- In line with promoting pedestrian priority for the site minimise vehicle crossing points of footpath areas
- Promote traffic calming within the local road system to enhance pedestrian safety
- Consider reducing road widths to improve pedestrian environment in areas of high pedestrian activity, low vehicle usage and high residential amenity (but still allowing for essential vehicle access and movement)

Public Transport:

- Promote access to public transport from the site using local shops as focal point for access to bus services, with a high degree of permeability for local service access to the site
- Provide high quality bus facilities at Myall Street and Myall Quay Boulevard

Cycling:

- Consider nominating a route for cyclists around (rather than through) the site to protect and enhance the environment in high pedestrian activity areas

Parking:

- Provide requisite parking on site to match development needs
- Recognize parking requirement for storage of vehicles
- Manage on street parking adjacent to site for maximum benefit of site activities (Cafes etc.)

These objectives were taken into account in the development of the site concept Master plan.

6. Assessment of Transport Operations

6.1 Staging Assumptions

For the purposes of considering the impacts of the proposed development including the assumed staging of implementation, the relationship to other potential development in the area has been assumed as summarised in **Table 6.1** below. The process of analysis has involved the following:

1. Assess the ability of the existing Myall Quays intersection to cater for the project plan development threshold of 381 lots
2. If spare capacity is still available, assess the ability of the existing Myall Quays intersection to cater for a portion of the concept plan development threshold up to the level of 1045 lots.
3. When capacity of the existing Myall Quays intersection is reached, assess the capacity of the proposed second access under priority control to cater for the remainder of the concept plan development threshold up to the level of 1045 lots.
4. Consider the impacts of the additional access points onto Toonang Drive also available to access Myall Street to the north.
5. Add a portion of the Myall River Downs Project to the existing Myall Quays intersection, upgrading to roundabout control if necessary
6. Add additional development from the Myall River Downs Project. Assess the capacity of the 2nd Riverside access, upgrading to roundabout control if necessary
7. Add the industrial development via a 4th leg to the 2nd Riverside access, upgrading to roundabout control if necessary.

This process of analysis of the development staging is iterative, and assumes the timing of the Riverside Downs and Industrial development post dates the Subject Riverside development.

Table 6.1 Site Access and staging Assumptions

Stage	Development Staging	Myall Quays intersection	Proposed 2nd access
	Riverside - 381 lots	Existing	
	Riverside - 590 lots	Existing	
	Riverside - 1045 lots	Existing	T intersection
	Riverside - 1045 lots + 500 Myall River Downs	4-way Rbt	T intersection
	Riverside - 1045 lots + 1500 Myall River Downs	4-way Rbt	3-way Rbt
	Riverside - 1045 lots + 1500 Myall Down + Industrial	4-way Rbt	4-way Rbt

The results of this process in terms of intersection performance and recommendations for staged implementation of the proposed junctions on Myall Street

6.2 Site Access Operations

It is proposed to provide all vehicle access to the site via two access points on Myall Street and two on Toonang Drive. One of these access points is already constructed (Myall Quays Boulevard) whilst the second access to the west will be built as part of a later stage of the development. It has been identified that during the initial stages of the development both of these intersections will be give way controlled, but that improved access control i.e. roundabout control will be required to facilitate full development of this site and the industrial land on the opposite side of Myall Street. The timing of the development of the roundabout controls will be tied to the various development staging, ensuring that adequate levels of service are maintained. The analysis here assesses the immediate needs of the subject residential development.

6.3 Road Network Performance and Capacity

From **Table 3.1**, the current peak one-way hourly traffic flows along Myall Street is in the order of 250 vehicles westbound in the PM peak and 193 vehicles per hour one-way in the AM peak. From Table 4.4 of the RTA Guide to Traffic Generating Developments it can be seen that the level of service for the current flows is B and A respectively. This assumes the heavy good vehicles content is in the order of 5% and that the road is relatively flat in this location.

Upon completion of the full development of the project application area of 381 residential lots on the subject site, there could be up to 209 vehicles per hour generated by the development during the critical morning and afternoon peak periods. Assuming 70% of this traffic has an origin/destination to the west towards the Pacific Highway, it can be seen that traffic flows along Myall Street could increase by nearly 150 vehicles per hour one-way in the critical direction (westbound AM peak, eastbound PM peak). This would increase the total hourly flows from the current critical peak westbound flow of 150 vehicles per hour in the AM peak to 300 vehicles per hour. In the afternoon peak the critical eastbound flow on Myall Street would increase from 173 vehicles hour to 323 vehicles per hour.

This would mean that there would no change to the existing level of service of B for road users along Myall Street to the west of the development access points. Level of service B is defined as "*This level is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is less than that of the level of Service A*". It is considered that the additional traffic generated by the development will have an acceptable impact upon the existing operation of Myall Street.

Typically, as traffic flows increase along a length of road drivers habits alter. The main change is that people alter their time of travel where possible to avoid travelling during the peak periods. This effectively increases the duration of the peak hour along the key routes whilst reducing the absolute peak demand along a road during the critical peak periods.

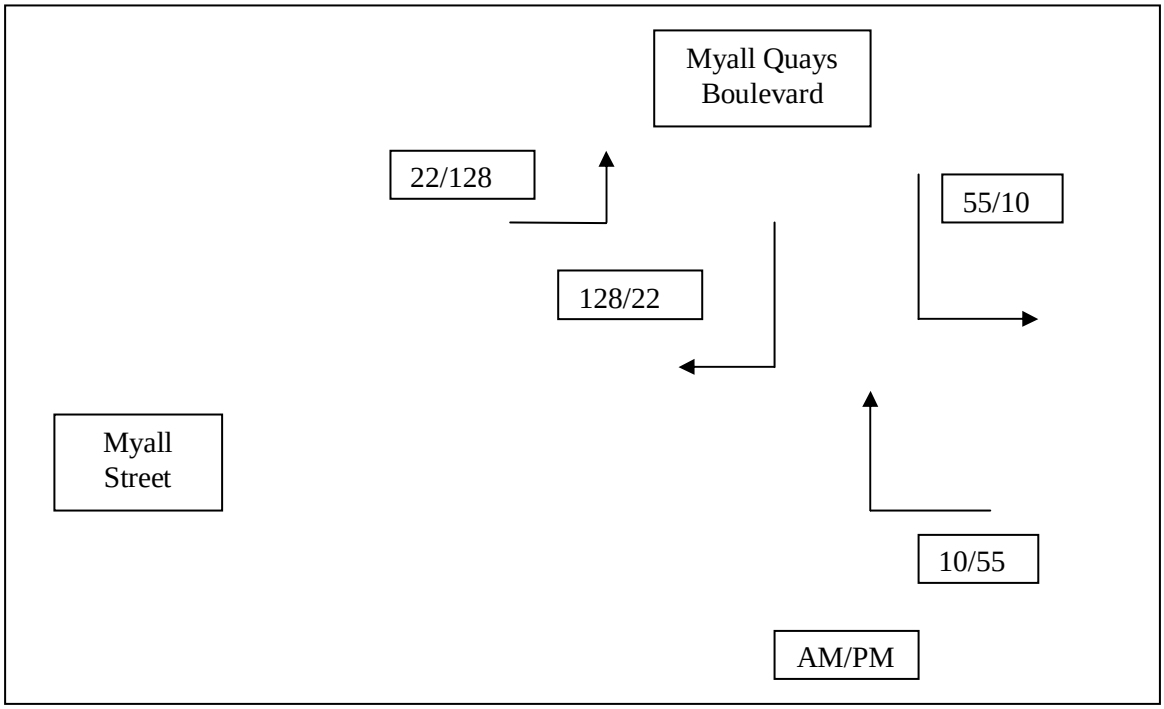
The key issue will therefore be the operation of the intersection of Myall Street and the two access points.

6.4 Traffic Distribution

For the Project Application portion of the development, it is proposed to utilise the existing intersection only (at Myall Quays Boulevard), as all of the additional traffic associated with the development of 381 residential lots can be accommodated by the existing intersection. We note that the applicant may wish to commission the second access to Myall Street prior to the completion of the 381 lots. However this is not required on purely technical grounds, in terms of traffic capacity requirements. As the development proceeds beyond this first Project Application stage, it can be seen that traffic can be distributed from the development via four separate access points with three connections to Myall Street.

It is considered that 70% of the traffic will wish to head north from the site towards Raymond Terrace and Newcastle via the Pacific Highway during the morning peak period as per the existing observations. The layout of the site allows ease of choice for drivers to use any of the four entry/exit points to gain access to the greater road network. It is considered that 35% of the traffic will use the southern intersection (existing give way controlled intersection at Myall Quays Boulevard) whilst the remaining 65% of the traffic will use the future access points to the north.

Using the above assumptions, the future traffic flows associated with the Project Application Stage of the development are presented below.



The above traffic flows have been used for the analysis of the impact of the subject site.

6.5 Intersection Operation

6.5.1 Project Application (381 lots)

The additional traffic associated with the proposed project application development has been determined using the future flows associated with the development shown above. The intersections have been assessed using the standard computer package Sidra. Sidra is a traffic analysis tool developed originally by the Australian Road Research Board. It calculates the amount of delay to vehicles using an intersection, and gives a level of service rating which indicates the relative performance of the nominated intersection treatment. Levels of service of A to C are considered to be satisfactory, a level of service of D is acceptable, and levels of E and F are considered unsatisfactory. SIDRA also calculates the degree of saturation, which indicates the amount of **spare capacity** available.
See **Appendix D** for full definition of SIDRA results.

The proposed development will be constructed over a number of stages, as required by market demand for the residential lots. As a worst case scenario, it has been assumed that the project plan development (381 lots) is constructed entirely in 2007. The additional development flows shown above have been added to the current observed traffic flows to assess the performance of the intersection with the additional flows.

The results of the analysis for the existing intersection control with the additional traffic generated by 381 lots are shown overleaf in **Table 6.2**.

Table 6.2 – Intersection of Myall Street and Myall Quays Boulevard, current intersection layout, 2007 traffic flows plus 381 lots (AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays Boulevard	0.065/0.134	9.0/9.8	A/A	2/5
Right turn out Myall Quays Boulevard	0.293/0.119	13.7/14.3	B/B	12/4
Through N-bound	0.074/0.049	0.0/0.0	A/A	0/0
Through S-bound	0.068/0.087	0.0/0.0	A/A	0/0

NB: Average delay, degree of saturation and level of service for the most delayed movement

The above analysis shows that with the full stage one of the development (381 of the residential lots) the existing intersection control at Myall Street and Myall Quays Boulevard are adequate. The level of service and associated delays will be similar to the existing situation and existing road users will notice minimal increases in delays and congestion at this intersection.

The intersections have also been assessed for the future design year of 2017. The through traffic movements on Myall Street have been increased by 25%, representing an annual increase of 2.5% in background traffic flows. The results of this analysis are presented in **Table 6.3** below.

Table 6.3 – Intersection of Myall Street and Myall Quays Boulevard, current intersection layout, 2017 traffic flows plus 381 lots (AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays Boulevard	0.066/0.140	9.1/10.0	A/A	2/5
Right turn out Myall Quays Boulevard	0.328/0.132	15.4/15.5	C/C	14/4
Through N-bound	0.092/0.062	0.0/0.0	A/A	0/0
Through S-bound	0.084/0.094	0.0/0.0	A/A	0/0

NB: Average delay, degree of saturation and level of service for the most delayed movement

The above results indicate that the existing priority controlled intersections will continue to provide a high level of control for all road users over a 10 year design timeframe for the Project Application Stage of the development (381 lots). The approach road capacity on Myall Street is also satisfactory as a two lane road configuration, and does not require upgrading to cater for this project application development.

6.5.2 Concept Plan and Development Staging

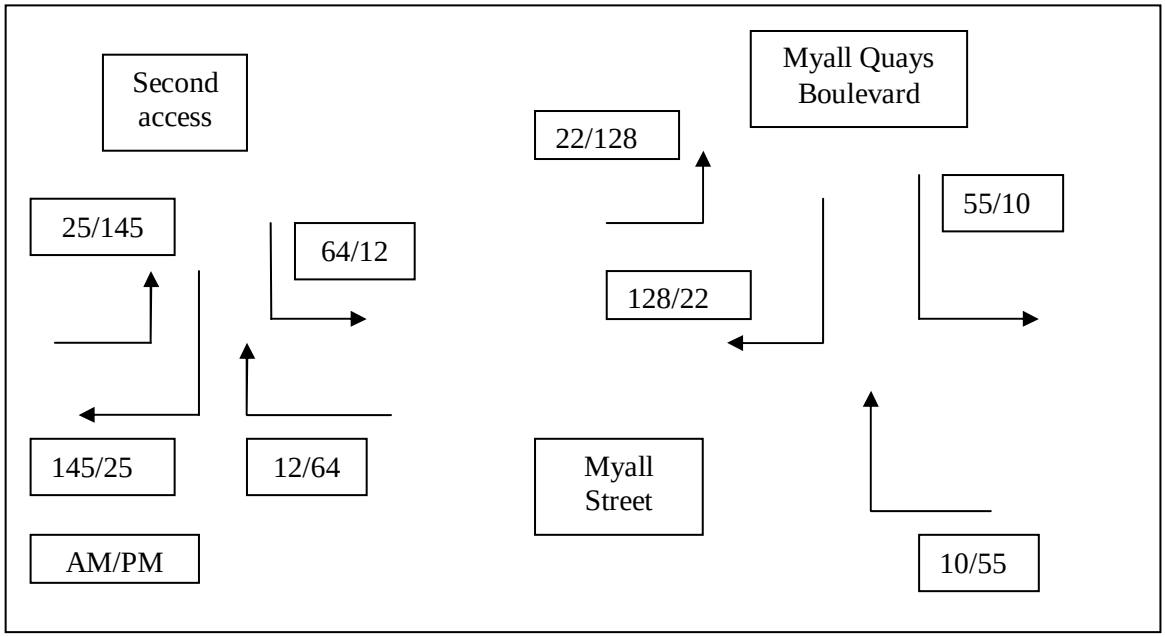
The relationship of the proposed project application to the overall concept plan and surrounding development has been tested as follow:

1. Introduction of the 2nd Myall Street access at or before completion of project plan stage (381 lots.)
2. Increase the level of lots developed from the concept plan, up to a maximum of 1045 lots
3. Continue to increase level of lots developed from the concept plan, up to a maximum of 1045 lot
4. Determine the point at which the intersection of Myall Quays Boulevard and Myall Street needs to be upgraded to roundabout control
5. Increase the development in Myall River downs (opposite the site and access onto Myall Street / Myall Quays Boulevard intersection (Max 1500 lots overall)
6. Assess the level of traffic on Myall Street, between the intersection at Myall Quays Boulevard and the future second access and determine road geometry i.e. 1 or 2 lanes in each direction
7. Assess the level of traffic on Myall Street, north and south of the roundabouts and determine at what point the road needs to be upgraded to 4 lanes

6.5.3 Project Development – Stage One and Two (1045 lots)

The full development at Myall Quays will provide 1045 residential lots. During the first stage, access will be via the existing single access point at the priority controlled intersection of Myall Quays Boulevard and Myall Street. During the development of the Riverside site a second access will be provided to the north of the existing intersection, providing a priority controlled intersection similar to the intersection of Myall Quays Boulevard and Myall Street. The development will also ultimately provide connections to Toonang Drive.

Once the second access is to Myall Street is constructed, it can be seen that traffic from Myall Quays will be distributed between these two access points. The total flows associated with the development of 1045 lots, including the current traffic flows using Myall Quays Boulevard are shown below:



The second access has been assessed to review the capacity of this intersection with the additional traffic associated with the full development of 1045 residential lots. (This is a conservative approach as there will be some traffic that will make use of the connections to Toonang Drive.) The analysis has allowed for the additional through movements associated with the flows at the existing intersection as well as background traffic growth to the future design year of 2012. The results of the analysis for the second intersection are shown below in Table 6.4.

Table 6.4 – Intersection of Myall Street and 2nd Access, Priority Control intersection layout, 2012 traffic flows plus 1045 lots (AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays Boulevard	0.016 / 0.080	9.2 / 10.8	A / A	1 / 3
Right turn out Myall Quays Boulevard	0.450 / 0.084	21.5 / 18.8	B / B	21 /3
Through w-bound	0.190 / 0.089	0.0 / 0.0	A / A	0 / 0
Through e-bound	0.103 / 0.194	0.0 / 0.0	A / A	0 / 0

NB: Average delay, degree of saturation and level of service for the most delayed movement

The above analysis shows that with the proposed second access point, the full development of 1045 lots can be developed at Myall Quays through the combination of the existing priority controlled intersection of Myall Street and Myall Boulevard together with the second priority controlled intersection. The additional connections to the north via Toonang Drive will also be available and will actually result in a better overall level of service in the area.

With the development of Myall River Downs on the western side of Myall Street from Myall Quays, the intersection of Myall Quays Boulevard and Myall Street will need to be upgraded to a roundabout control, to allow for a 4-way intersection. The Myall River Downs development could potentially yield an additional 1500 residential lots when fully development. It is considered that the traffic generation rates for this residential development will be similar to the Myall Quays development, with 0.55 trips per lot during the peak periods. Using this rate, the impact of the traffic associated with this development has been assessed on the 4-way roundabout controlled intersection of Myall Quays Boulevard and Myall Street.

It has been assumed that this development could occur within a 5 year design frame. Therefore the background traffic flows on Myall Street have been increased by 2.5% per annum for the future design year of 2012. The Myall River Downs development flows have then been added to this base flow. The results of the Sidra analysis are presented in **Table 6.5** overleaf:

Table 6.5 – Intersection of Myall Street and Myall Quays Boulevard, roundabout intersection layout, 2012 traffic flows plus 1045 lots (Myall Quays) plus 1500 lots (Myall River Downs) AM/PM

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays	0.117/0.288	14.0/14.5	B/B	5/15
Right turn out Myall Quays	0.338/0.146	13.4/45.6	B/B	19/7
Right turn into Myall River Downs	0.222/0.487	12.9/13.1	B/B	12/33
Right turn out Myall River Downs	0.319/0.070	14.1/12.5	B/B	15/3
Through w-bound	0.195/0.282	6.5/7.2	A/A	10/15
Through e-bound	0.222/0.487	6.1/6.3	A/A	12/33

NB: Average delay, degree of saturation and level of service for the most delayed movement

The above analysis for the 4-way roundabout controlled intersection shows that the proposed roundabout has adequate capacity to cater for the residential development at Myall Quays (1045 lots) plus the Myall River Downs residential development (1500 lots).

A further analysis test has been completed at the intersection of Myall Street and the second access to Myall Quays. Whilst the Sidra analysis indicates that the roundabout at the intersection of Myall Quays has adequate capacity, the additional traffic from Myall River Downs will impact upon the operation of the intersection of the second access point to Myall Quays and Myall Street. As the through movements increase on the main road, the delays for the turning traffic increase.

To assess the impact of the Myall River Downs development at this intersection, a series of tests were completed to determine the cut-off point for the satisfactory operation of this intersection. By a series of iterative tests, it was determined that 500 lots could be developed on Myall River Downs without providing unacceptable delays at the intersection of Myall Street and the second access to Myall Quays. Beyond this level of development at Myall River Downs, the turning movements at the intersection of Myall Quays and the second access became unacceptable.

The results for the analysis of the second access, with 1045 lots developed on Myall Quays and 500 lots at Myall River Downs are shown below in Table 6.6.

Table 6.6 – Intersection of Myall Street and 2nd Access, Priority Control intersection layout, 2012 traffic flows plus 1045 lots and 500 lots Myall River Downs(AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays Boulevard	0.016 / 0.096	9.3 / 11.9	A / A	1 / 3
Right turn out Myall Quays Boulevard	0.623 / 0.127	32.9 / 25.8	C / B	31 / 4
Through w-bound	0.267 / 0.125	0.0 / 0.0	A / A	0 / 0
Through e-bound	0.121 / 0.268	0.0 / 0.0	A / A	0 / 0

NB: Average delay, degree of saturation and level of service for the most delayed movement

Beyond the development of 500 lots at Myall River Downs, the second access to Myall Quays will need to be upgraded to ensure acceptable delays for the traffic turning in and out of Myall Quays. As an interim access, the intersection can be upgraded to a three-way roundabout. The results for the analysis of this 3-way roundabout are provided in **Table 6.7** below:

Table 6.7 – Intersection of Myall Street and 2nd Access, Priority Control intersection layout, 2012 traffic flows plus 1045 lots and 1500 lots Myall River Downs(AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays 2nd access	0.023 / 0.068	12.2 / 11..3	B / B	1 / 3
Right turn out Myall Quays 2nd access	0.109 / 0.024	12.5 / 15.1	B / B	5 / 1
Through w-bound	0.409 / 0.165	5.2 / 4.5	A / A	35 /9
Through e-bound	0.183 / 0.450	4.5 / 4.8	A / A	10 / 29

The above analysis shows that with the provision of a 3-way roundabout at the second access point for Myall Quays, the full development at Myall River Downs of 1500 lots can be developed as well as the 1045 lots at Myall Quays.

The final consideration of future proposed development involves the construction of an industrial area to the west of Myall Street. The plans for this development indicate that access would be provided opposite the proposed second access to Myall Quays, via a 4-way roundabout controlled intersection as well as via the existing industrial access to the north on Myall Street. This new access would involve the introduction of a 4th leg at this intersection.

The impact of the proposed industrial development has been assessed for the future design year of 2017. This has allowed for the full development of the Myall Quays residential development (1045 lots), full development at Myall River Downs residential site (1500 lots) and provision of 15,000 m^2 of general industrial area. The RTA Guide to Traffic Generating Developments has been used to determine the volume of traffic associated with this development, with a rate of 1 trip per 100 m^2 used to assess the impact.

It has been assumed (conservatively) that all of the industrial traffic will access Myall Street via a single access with a 4-way roundabout proposed. The analysis has been completed for the future design of 2017, with 2.5% growth allowed for through traffic flows along Myall Street. The results of the analysis for the 4-way roundabout are presented in Table 6.8 overleaf:

Table 6.8 – Intersection of Myall Street and 2nd Access, 4-way roundabout, 2017 traffic flows plus 1045 lots (Myall Quays) plus 1500 lots (Myall River Downs) plus 15,000 m² Industrial AM/PM

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays 2nd access	0.023 / 0.070	12.9 / 11.4	B / B	1 / 3
Right turn out Myall Quays 2nd access	0.134 / 0.025	13.3 / 15.6	B / B	7 / 1
Right turn into Industrial area	0.276 / 0.529	11.6 / 11.9	B / B	16 /38
Right turn out Industrial area	0.012 / 0.058	16.1 / 12.9	B / B	1 / 2
Through w-bound	0.612 / 0.210	6.1 / 4.6	A / A	48 / 12
Through e-bound	0.275 / 0.531	4.6 / 5.2	A / A	16 / 38

The above analysis confirms that with the full development of Myall Quays (1045 lots), Myall River Downs (1500 lots) and the Industrial development (15,000 m²) the 4-way roundabout at the second access point to Myall Quays will have adequate capacity to cater for the predicted traffic flows.

6.5.4 Toonang Drive Access

The traffic analysis completed here has conservatively assumed that all access from the development will use the proposed new access points on Myall Street. It should be noted that the development also proposes access at two points onto Toonang Drive to the north of the subject site, and so it can be expected that some traffic will use this route. Base traffic flows on Toonang Drive were not recorded, however based on the level of development noted it is expected that peak flows along this route would be of the order of 100 vehicles per hour. The level traffic use of Toonang Drive will be influenced by the design form of the internal road network of the proposed estate, where it is not intended to encourage this as a major access route for the estate. It is likely that some of the traffic assigned in the previous analysis to use the second Myall Street access would in fact use the Toonang Drive access. If this were as high as 50% (which is considered unlikely) this would be in the order of 75 vehicles per hour at peak times. This would place the traffic flows within the environmental capacity limits of a local road, and with an existing built form observed as a sealed bitumen road with a pavement width of approximately 6 metres and shoulders of about 1.2 meters, it is considered that the road is capable of accommodating this level of traffic. It is likely in fact that because of the internal design proposed for the estate more traffic will use the Myall Street access.

6.6 Road Safety

6.6.1 Intersection of Myall Street and Myall Quays Boulevard

The intersection of Myall Street and Myall Quays Boulevard is a RTA Type AUR intersection, with shoulder widening to allow for westbound through movements on Myall Street to continue without being impeded by traffic turning right into Myall Quays Boulevard. There are also left turn lanes. The intersection is located on a straight section of road and as such offers good visibility on all approaches. The available visibility exceeds the requirements of the RTA Road Design Guide and as such it is considered that the intersection provides a safe and acceptable layout. The layout is clearly laid out and offers a high level of access.

It is considered that this intersection provides a safe and appropriate location and layout for the proposed residential development.

With the future upgrade of this intersection to a roundabout control (when the industrial land is developed opposite the site) the safety will be increased further, as the hazards associated with the right turn movements will be significantly reduced with a roundabout control. Roundabouts provide a higher level of control compared with a give way controlled intersection. It is considered that a roundabout at this location will provide a safe and appropriate level of control at this intersection.

It is considered that the proposed second access can also operate in a safe and appropriate manner, initially also as a RTA Type AUR intersection. This second access will have a similar layout to the intersection of Myall Street and Myall Quays Boulevard and will provide good visibility on all approaches that exceed the requirements. This intersection will be designed in accordance with the RTA Road Design Guide and Council requirements.

The levels of traffic generated by this project plan proposal are able to be accommodated through the two priority controlled intersections. The timing of the provision of roundabout control will therefore be determined by the rate of development, particularly the proposed industrial land, on the opposite side of Myall Street and the future development of the Riverside site under the concept plan.

6.7 Pedestrian and Cyclist Facilities

Encouraging pedestrian movement through an improved overall environment for walking is a key principle of the Riverside concept plan. The concept allows for promotion of walking as principle local transport through and to the site. Where ever possible pedestrians would be given priority over vehicles within the site, with walking linkages enhanced to provide direct links within the site and to neighbouring attractions to encourage walking. Signage with travel times to local attractions would also be considered. Pedestrian links would be provided through proposed green/ open spaces with linkages back to Myall Street and the local shopping centre

Overall it is proposed to provide a high standard of pedestrian accessibility / mobility within and to the site with continuity, consistency of materials, signposting, lighting and so on.

Cyclists can use the roads within the development and pedestrians will be provided with footpaths along the side of the roads within the development. There will also be a number of off road combined footway/cycle ways that will provide a high level of convenience and comfort for pedestrians and cyclists.

It is considered that the site has been well designed for pedestrian and cyclist access and permeability.

6.8 Public Transport

It is proposed to promote access to public transport from the site using the local shops as focal point for access to bus services, with a high degree of permeability for local service access to the site. The concept plan has considered the provision of a number of roads within the internal structure that are capable of accommodating bus operations. The proposal focuses on the provision of high quality bus facilities at Myall Street and Myall Quay Boulevard as a recognised transport node for the area.

It is considered that there will be an increase in demand for the school bus runs that currently operate along Myall Street. The additional demand can be accommodated by augmenting the existing bus service in this location. A new bus stop should be considered adjacent to the site on Myall Street to service the development. Provision has already been made in Myall Street here for the inclusion of a bus stop. A future route through the development should also be considered for the school bus run.

6.9 Road Capacity - Myall Street

In order to determine the proportion of existing road space used by forecast traffic flows, the nominal capacity of each road segment needs to be determined. The Volume to Capacity Ratio (V/C Ratio) is an accepted measure for evaluating operating conditi0on of roads and the potential breakdown in traffic flow, which results in delay or reductions in travel speed along a link in urban environment.

As traffic volumes on a road link grow towards the capacity value, travel speeds deteriorate from the free flow speed. When the volume on a link is at capacity (i.e. the V/C ratio reaches 100% or 1.0), the average free flow travel speed is not constant and can reduce significantly under certain conditions.

The peak movement along a traffic lane has been used for the analysis of mid-block performance with each traffic lane assumed to be capable of accommodating 1,400 vehicles per hour before traffic speed is significantly impacted. The V/C Ratio at capacity for the mid-block performance assessment has been assumed 1,400 vehicles per hour as 100% or 1.0. This is consistent with performance measures presented in the RTA's Guide to Traffic Generating Development (SEPP 11) and Austroads Guide to Traffic Engineering Practice Part 2: Road Capacity (1988).

The above mid-block operating criterion has been applied here to evaluate road link operations in the forecast with development of Riverside scenarios.

The increased development levels will substantially increase the traffic volumes on Myall Street. Current traffic flows are relatively low but with the increased residential (and future industrial development) flows this will increase. The total traffic flows associated with the residential development at both Myall Quays and Myall River Downs. The two-way traffic flows on Myall Street to the west of Myall Quays Boulevard will be 1226 vehicles per hour in the AM peak and 1222 vehicles per hour in the PM peak. The peak directional flow will be 933 vehicles per hour.

Based on the above criteria for mid block capacity it can be seen that Myall Street will continue to operate at satisfactory levels as a 2 lane road

6.10 Internal Road Network

The project plan and concept plan illustrating the proposed general layout of the site are included in **Appendices C** to this report. The overall layout and access arrangements have been designed to meet the nominated transport objectives and to provide an environment that favours the pedestrian whilst still allowing vehicular access where required. Some movement corridors are exclusively pedestrian only. Others have been designed with sufficient width for cars and where required to allow for service vehicle access. The overall alignment of on site roads has been developed to provide an environment that encourages low speed vehicle movement, improving overall safety and enhancing the pedestrian friendly environment. This is reinforced through a consistent hierarchy of road forms that reinforces the principles of movement in all forms in appropriate local environments that promote and enhance the overall safety and amenity of the area. Access geometry would meet the requisite standards for vehicle movement, with the basic principles of urban design guidelines such as AMCORD applied to reinforce the desired vehicle environment.

The designated speed of roads within the estate would be that of a normal residential area. That is the normal 50 kph speed limit would apply.

The planning that has been undertaken as part of the development of the concept plan and project application for the Riverside development has considered a wide range of factors in terms of the function of the various local roads within the development. This has included a combination of road typologies

that have been chosen to suit specific road environments, from quiet local streets where it is intended that the motor car does not dominate, to allowing sufficient space on collector routes for alternate transport (bus) services.

Of particular concern in this regard is the tendency for nearly all local authorities to err on the conservative side and insist on road carriageway widths that are excessive and that encourage vehicle speeds that are too high. This not only impinges on the overall safety of neighbourhoods, it also results in a higher maintenance burden for the council's who inherit the wider roads (more pavement to maintain) and also then have to maintain the various speed control devices also. Narrower carriageway pavements suited to the road function can avoid this in the first place.

It is intended that by applying appropriate widths and road alignments in the first instance it is not then necessary to implement other forms of traffic calming that have become widely accepted as they are retrofitted into older road networks where the basic design has not considered the mix of road safety amenity and environmental issues that are a part of current planning techniques.

The full range of design features will not be evident until detail design is completed, but can include features such as threshold treatments, intersection priority controls (stop and give way signs) as measures of speed control within the estate. It is also possible to offset parking at some locations so that the overall perception of width of carriageway is lessened and hence speeds are influenced positively (reduced) without the need to introduce draconian measures such as speed humps into a new estate.

The road design elements have been chosen to incorporate open swale drains etc to integrate the design with the open space and other elements of the overall concept plan.

Extensive discussions have been held with Great Lakes Council Officers regarding the road design standards. All issues have been resolved, and design principles have been adopted that will achieve appropriate Council pavement standards.

7. Summary, Conclusions and Recommendations

7.1 Summary

From the study work, the following summary is provided:

1. The subject site is located on a parcel of land within Tea Gardens. The project application proposal is to develop some 381 residential dwellings with associated road network and off street parking from a potential 1045 lots in the overall concept plan.
2. All vehicle access to the project application stage will be provided off Myall Street. Access will be provided via the existing intersection of Myall Street and Myall Quays Boulevard and a future new access to the north of this intersection is to be subsequently commissioned.
3. Existing traffic flows have been surveyed at the intersection of Myall Street and Myall Quays Boulevard and the overall traffic flows are low and well within the existing road capacity.
4. The traffic flows associated with the proposed development application of 381 lots have been determined using the RTA Guide to Traffic Generating Developments together with a reduction for internal traffic movements and allowance for home based business as well as lower demand associated with retired people living at the development. This guide indicates there could be some 215 vehicles per hour associated with the proposed development during the peak periods. The traffic has been assigned to the road network in a similar manner to the existing surveyed flows at the intersection of Myall Street and Myall Quays Boulevard.
5. The operation of the existing intersection of Myall Street and Myall Quays Boulevard has been assessed using the standard computer program Sidra. The Sidra analysis indicates that the existing intersection control will have adequate capacity to cater for the flows associated with the project application stage of the development on the site, for both the current 2007 and future 2017 design years.
6. The intersection has then been analysed further to assess the impact of further residential development with access via Myall Quays Boulevard. This Sidra analysis indicates that some 590 residential lots could be developed off Myall Quays Boulevard using the existing intersection control. Beyond 590 lots, this intersection on its own would need to be upgraded to a roundabout control.
7. The existing intersection when combined with the proposed second access to the north on Myall Street is able to cater for the full 1045 lots under the concept plan
8. The additional access available via Toonang Drive also contributes to a higher overall level of service at the proposed access junctions, and along Myall Street by allowing greater dispersal of traffic flows.
9. The assessment has then taken into account the proposed Myall River Downs residential development. Plans for this development indicate some 1500 residential lots could be developed on this land. Traffic generation rates are again expected to be lower than normal, due to home based business as well as retired residential reducing peak hour demands. Access to these lots will be provided via a roundabout controlled intersection at Myall Street and Myall Quays Boulevard, with a fourth leg providing access to these lots.
10. The Sidra analysis indicates that a single 4-way roundabout will have adequate capacity to cater for both the Myall Quays and Myall River Downs development. Delays and congestion for all road users would be acceptable. Again, this analysis has been completed for the future design year of 2017.
11. Additional testing of the second Myall Street access with development of Myall River Downs indicates that this junction would require upgrade to roundabout control as a 3 leg intersection, because of the additional through traffic movements. Analysis indicates this would occur at a development level of approximately 500 lots.

12. With the introduction of the industrial land to the west of Myall Street, access to this activity can be catered for via a 4th leg to the second Myall Street access. This operates satisfactorily under roundabout control for both the current 2007 and future 2017 design years.
13. If the industrial land were to commence development prior to Myall River Downs, then the need for the 4th leg and roundabout control at the 2nd Myall Street access is triggered by this activity.
14. The existing layout of the intersections on Myall Street provides a clear and easily understood layout. Sight visibility lines on all approaches are good and it is considered that existing intersection of Myall Street and Myall Quays Boulevard can provide a safe and appropriate layout to cater for the predicted flows associated with the development.
15. The future need to upgrade intersections on Myall Street to roundabout control will be determined by the rate of development of the proposed Myall River Downs residential development and the industrial land on the opposite side of Myall Street to Myall Quays and not by the Riverside concept plan development based on the known timing of developments.
16. The existing two lane configuration of Myall Street will provide adequate capacity for all road users including this proposed residential development.
17. The internal road layout will be designed in accordance with the Council requirements.
18. Pedestrians and cyclists will be catered for with a combination of off-road and on-road facilities.
19. The development will require access for children to the existing school bus runs to Raymond Terrace. As part of the development a bus stop and shelter are to be provided adjacent to the entry points on Myall Street.
20. A bus route is proposed to be implemented in consultation with the local bus company through the development.
21. Extensive discussions have been held with Great Lakes Council Officers regarding the road design standards. All issues have been resolved, and design principles have been adopted that will achieve appropriate Council pavement standards.

7.2 Conclusion

From the study, it is concluded that the existing road system beyond the site is able to cater for the traffic demands of the proposed residential development of both Myall Quays and Myall River Downs. The existing intersection control at Myall Quays Boulevard and Myall Street when combined with a 2nd intersection (of similar design) on Myall Street, together with access to Toonang Drive can accommodate the entire Riverside Concept Plan area (1045 lots.)

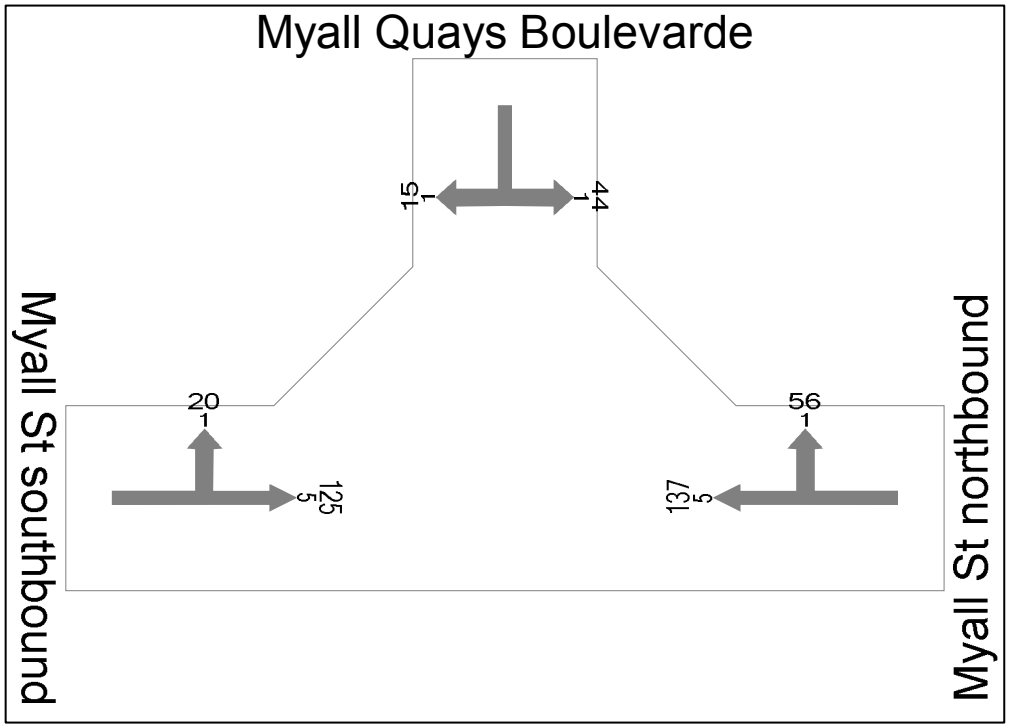
The two southern intersections of Myall Street will only require upgrading at or before the development of either or both of Myall River Downs or the industrial land to the west of Myall Street.

7.3 Recommendations

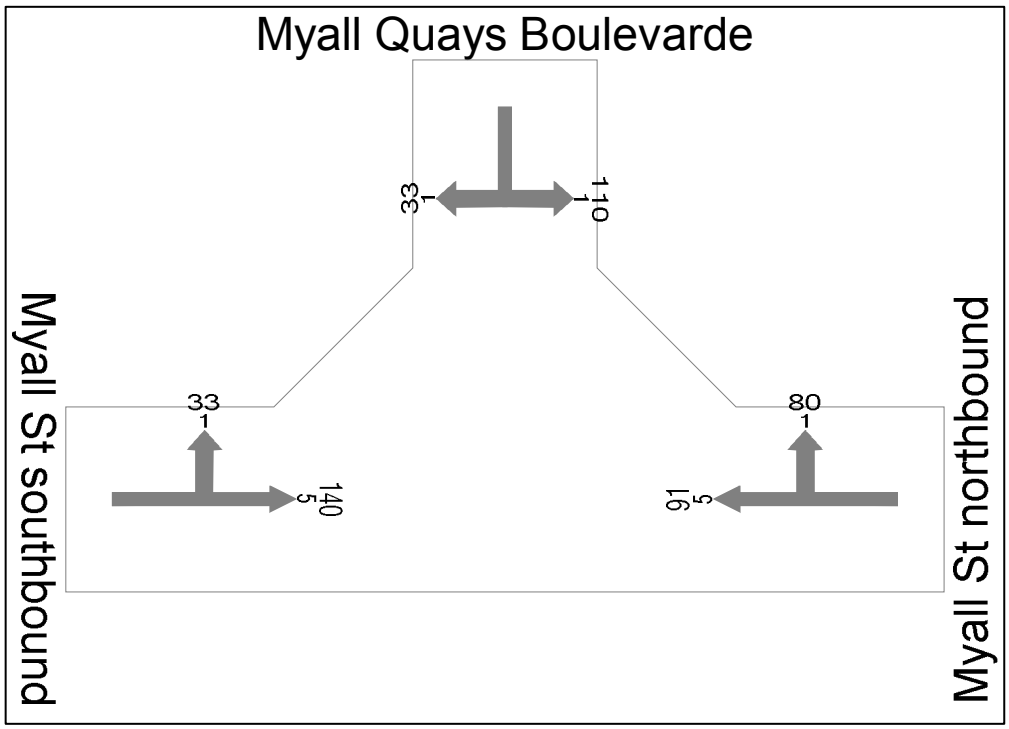
In consideration of the staging of the Concept Plan it is recommended that the concept plan and project application reflect the following commitments:

1. The second access to Myall Street (as a priority controlled junction) be provided prior to the development of 500 lots within the concept plan. (i.e. before the 590 threshold.)
2. Access to be provided to Toonang Drive in line with the Concept plan staging, at say 700 lots. (i.e. before the 1045 yield.)
3. The Riverside Concept plan in isolation be allowed to be developed in total (1045 lots) based on the capacity of the proposed 4 intersections
4. The two southern intersections of Myall Street only to be upgraded at / before the requirement arises for these to act as 4-way intersections. (i.e. access is triggered by either or both of Myall River Downs or the industrial land to the west of Myall Street.)

Appendix A Traffic Survey Results



2007 AM peak existing traffic flows – Myall Street and Myall Quays Boulevard

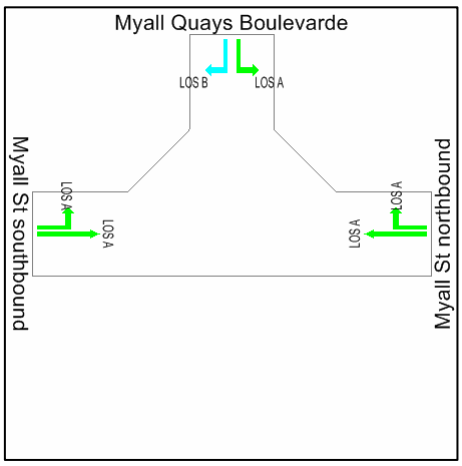


2007 PM peak existing traffic flows – Myall Street and Myall Quays Boulevard

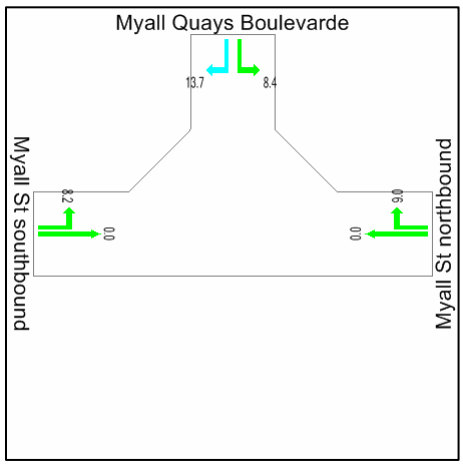
Appendix B Sidra Intersection Modelling Results

Intersection Summary
Myall St and Myall Quays Boulevard
2007 AM flows base plus 381 lots One access

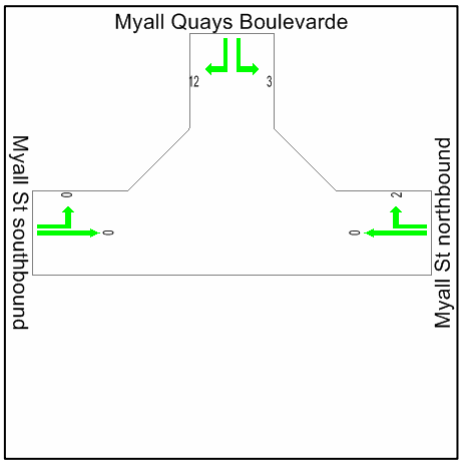
Performance Measure	Vehicles	Persons
Demand Flows - Total	645 veh/h	968 pers/h
Percent Heavy Vehicles	2.9 %	
Degree of Saturation	0.293	
Effective Intersection Capacity	2200 veh/h	
95% Back of Queue (m)	12 m	
95% Back of Queue (veh)	1.7 veh	
Control Delay (Total)	1.09 veh-h/h	1.64 pers-h/h
Control Delay (Average)	6.1 s/veh	6.1 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	266 veh/h	399 pers/h
Effective Stop Rate	0.41 per veh	0.41 per pers
Proportion Queued	0.21	0.21
Travel Distance (Total)	391.1 veh-km/h	586.6 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	7.6 veh-h/h	11.4 pers-h/h
Travel Time (Average)	42.6 secs	42.6 secs
Travel Speed	51.2 km/h	51.2 km/h
Operating Cost (Total)	264 $/h	264 $/h
Fuel Consumption (Total)	39.1 L/h	
Carbon Dioxide (Total)	98.0 kg/h	
Hydrocarbons (Total)	0.152 kg/h	
Carbon Monoxide (Total)	6.18 kg/h	
NOX (Total)	0.210 kg/h	



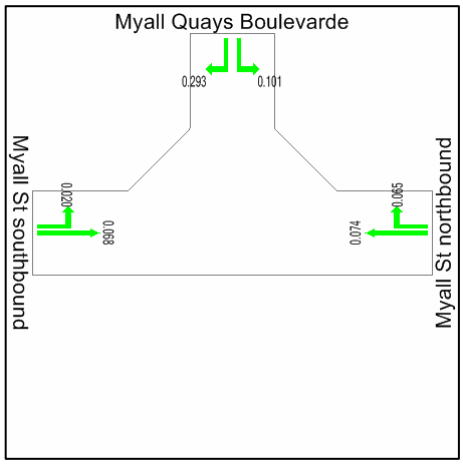
Level of service



Delays



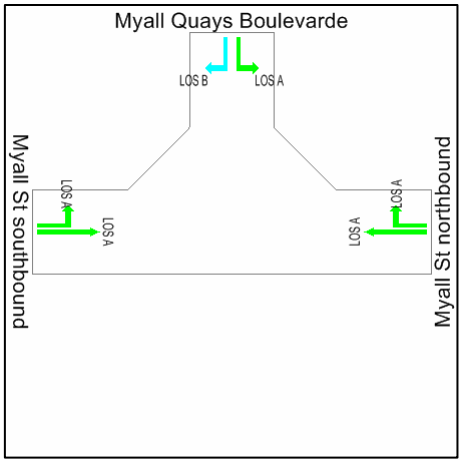
95th percentile queue



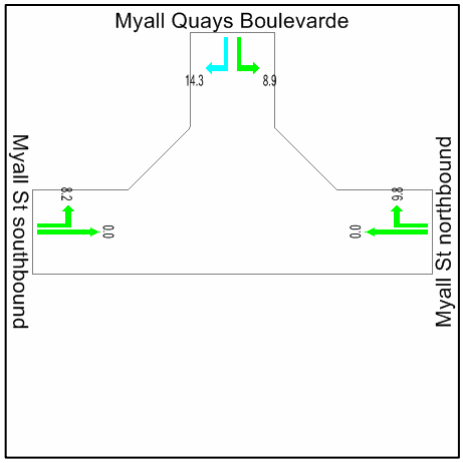
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2007 PM flows base+381 lots one access

Performance Measure	Vehicles	Persons
Demand Flows - Total	739 veh/h	1109 pers/h
Percent Heavy Vehicles	2.3 %	
Degree of Saturation	0.140	
Effective Intersection Capacity	5285 veh/h	
95% Back of Queue (m)	5 m	
95% Back of Queue (veh)	0.7 veh	
Control Delay (Total)	1.31 veh-h/h	1.96 pers-h/h
Control Delay (Average)	6.4 s/veh	6.4 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	340 veh/h	510 pers/h
Effective Stop Rate	0.46 per veh	0.46 per pers
Proportion Queued	0.18	0.18
Travel Distance (Total)	448.2 veh-km/h	672.3 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	8.8 veh-h/h	13.2 pers-h/h
Travel Time (Average)	42.8 secs	42.8 secs
Travel Speed	51.0 km/h	51.0 km/h
Operating Cost (Total)	305 $/h	305 $/h
Fuel Consumption (Total)	46.1 L/h	
Carbon Dioxide (Total)	115.3 kg/h	
Hydrocarbons (Total)	0.183 kg/h	
Carbon Monoxide (Total)	7.83 kg/h	
NOX (Total)	0.256 kg/h	



Level of service



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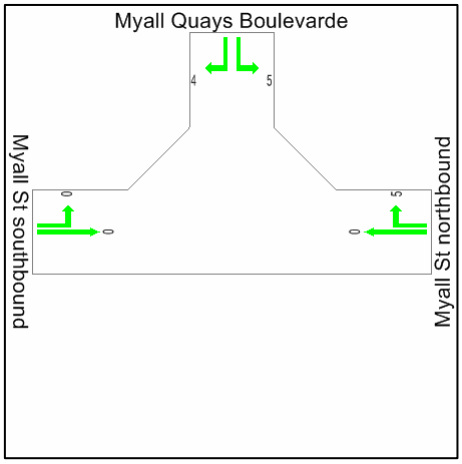
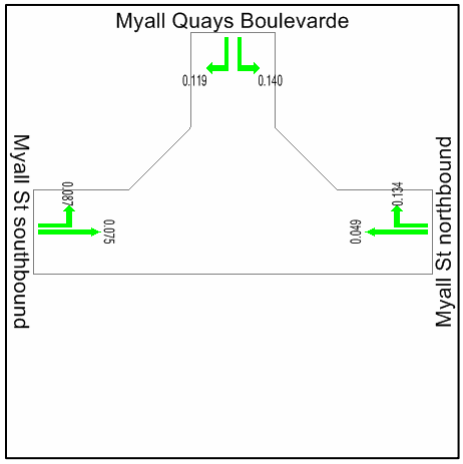


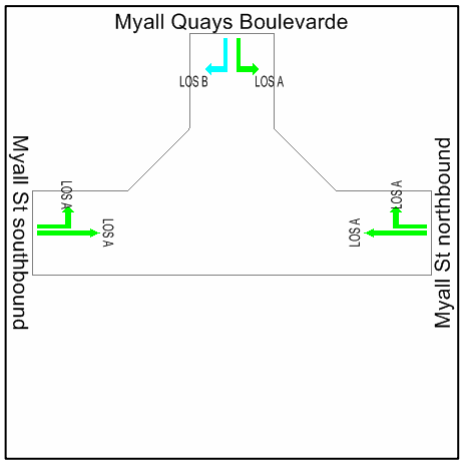
95th percentile queue



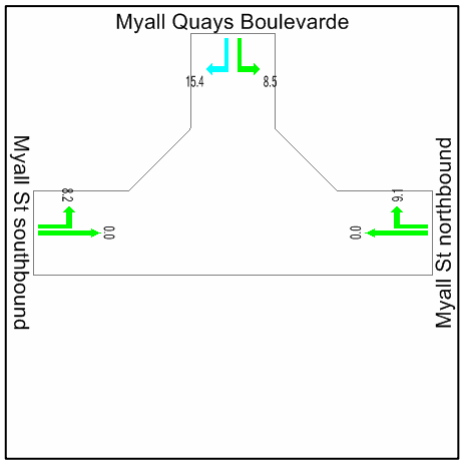
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2017 AM flows base plus 381 lots One access

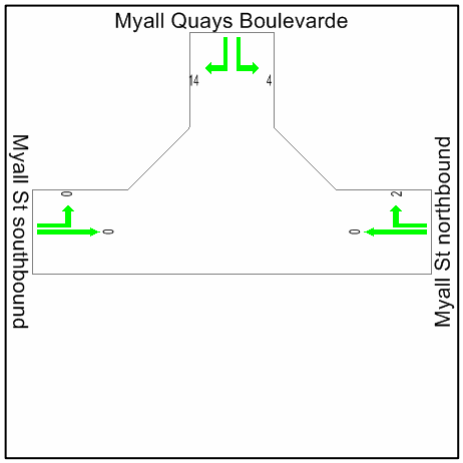
Performance Measure	Vehicles	Persons
Demand Flows - Total	713 veh/h	1070 pers/h
Percent Heavy Vehicles	3.1 %	
Degree of Saturation	0.328	
Effective Intersection Capacity	2177 veh/h	
95% Back of Queue (m)	14 m	
95% Back of Queue (veh)	2.0 veh	
Control Delay (Total)	1.17 veh-h/h	1.76 pers-h/h
Control Delay (Average)	5.9 s/veh	5.9 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	276 veh/h	414 pers/h
Effective Stop Rate	0.39 per veh	0.39 per pers
Proportion Queued	0.21	0.21
Travel Distance (Total)	432.3 veh-km/h	648.5 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	8.4 veh-h/h	12.6 pers-h/h
Travel Time (Average)	42.4 secs	42.4 secs
Travel Speed	51.5 km/h	51.5 km/h
Operating Cost (Total)	289 $/h	289 $/h
Fuel Consumption (Total)	42.6 L/h	
Carbon Dioxide (Total)	106.5 kg/h	
Hydrocarbons (Total)	0.164 kg/h	
Carbon Monoxide (Total)	6.43 kg/h	
NOX (Total)	0.224 kg/h	



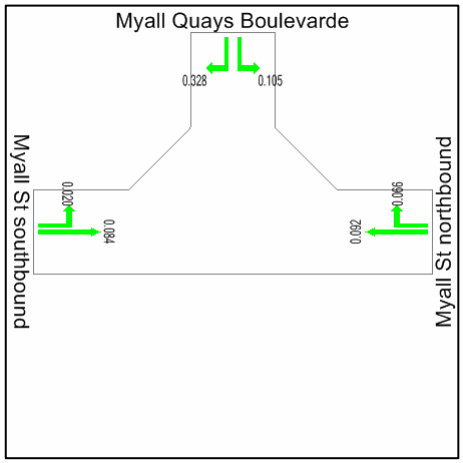
Level of service



Delays



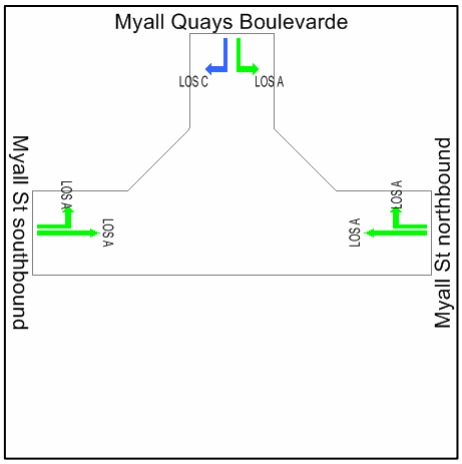
95th percentile queue



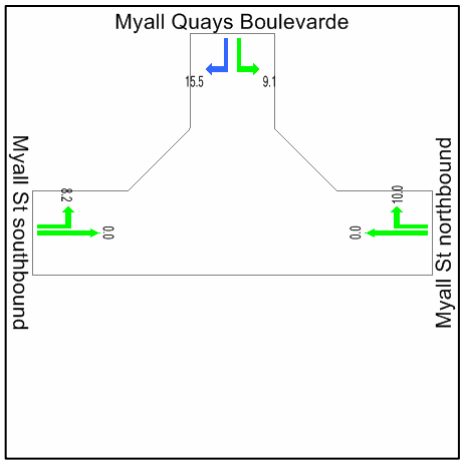
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2017 PM flows base+381 lots one access

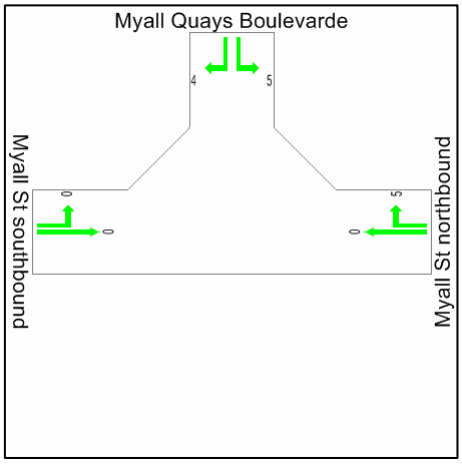
Performance Measure	Vehicles	Persons
Demand Flows - Total	800 veh/h	1200 pers/h
Percent Heavy Vehicles	2.5 %	
Degree of Saturation	0.146	
Effective Intersection Capacity	5485 veh/h	
95% Back of Queue (m)	5 m	
95% Back of Queue (veh)	0.7 veh	
Control Delay (Total)	1.34 veh-h/h	2.01 pers-h/h
Control Delay (Average)	6.0 s/veh	6.0 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	346 veh/h	519 pers/h
Effective Stop Rate	0.43 per veh	0.43 per pers
Proportion Queued	0.18	0.18
Travel Distance (Total)	485.2 veh-km/h	727.8 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	9.4 veh-h/h	14.2 pers-h/h
Travel Time (Average)	42.5 secs	42.5 secs
Travel Speed	51.4 km/h	51.4 km/h
Operating Cost (Total)	327 $/h	327 $/h
Fuel Consumption (Total)	49.1 L/h	
Carbon Dioxide (Total)	122.8 kg/h	
Hydrocarbons (Total)	0.193 kg/h	
Carbon Monoxide (Total)	8.04 kg/h	
NOX (Total)	0.268 kg/h	



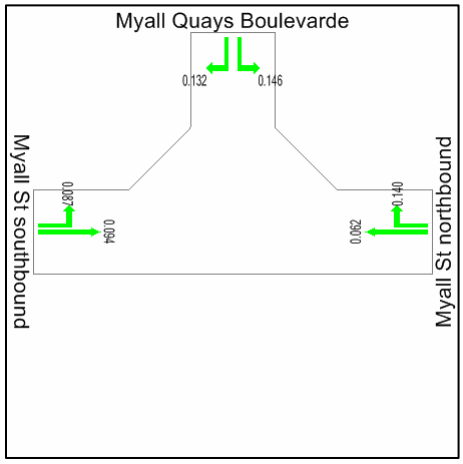
Level of service



Delays



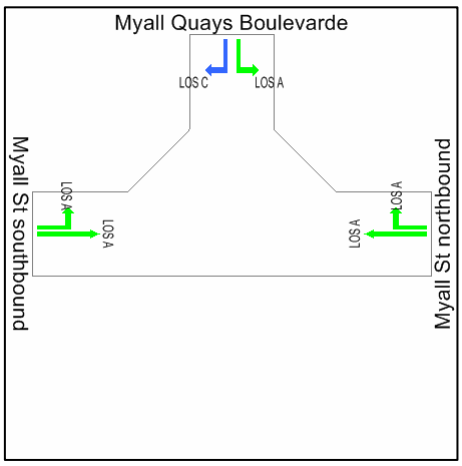
95th percentile queue



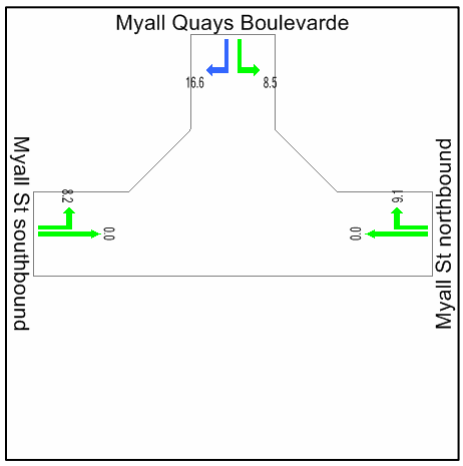
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 AM flows base plus 590 lots One access

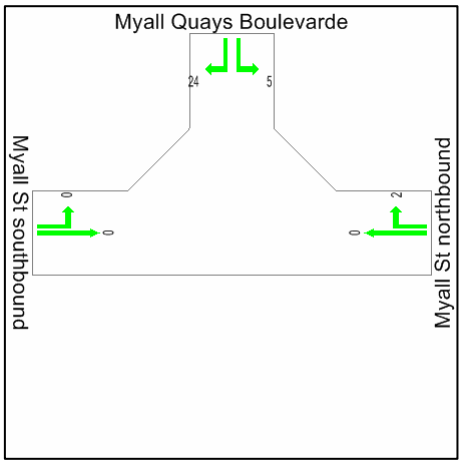
Performance Measure	Vehicles	Persons
Demand Flows - Total	793 veh/h	1190 pers/h
Percent Heavy Vehicles	2.5 %	
Degree of Saturation	0.453	
Effective Intersection Capacity	1751 veh/h	
95% Back of Queue (m)	24 m	
95% Back of Queue (veh)	3.4 veh	
Control Delay (Total)	1.64 veh-h/h	2.46 pers-h/h
Control Delay (Average)	7.4 s/veh	7.4 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	381 veh/h	572 pers/h
Effective Stop Rate	0.48 per veh	0.48 per pers
Proportion Queued	0.26	0.26
Travel Distance (Total)	480.8 veh-km/h	721.2 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	9.7 veh-h/h	14.5 pers-h/h
Travel Time (Average)	43.9 secs	43.9 secs
Travel Speed	49.7 km/h	49.7 km/h
Operating Cost (Total)	333 $/h	333 $/h
Fuel Consumption (Total)	49.2 L/h	
Carbon Dioxide (Total)	123.1 kg/h	
Hydrocarbons (Total)	0.194 kg/h	
Carbon Monoxide (Total)	8.02 kg/h	
NOX (Total)	0.267 kg/h	



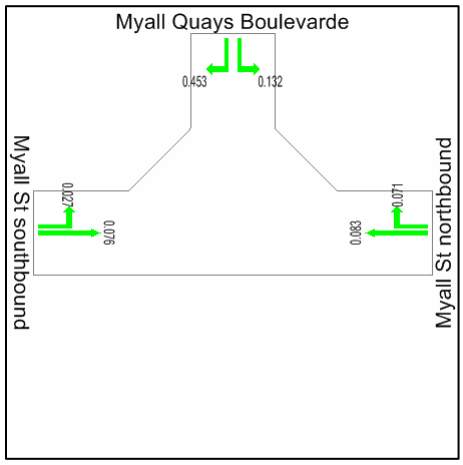
Level of service



Delays



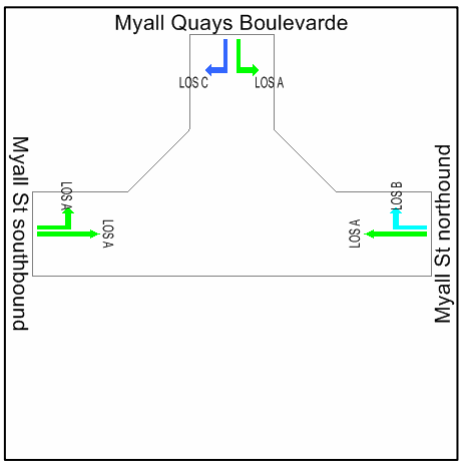
95th percentile queue



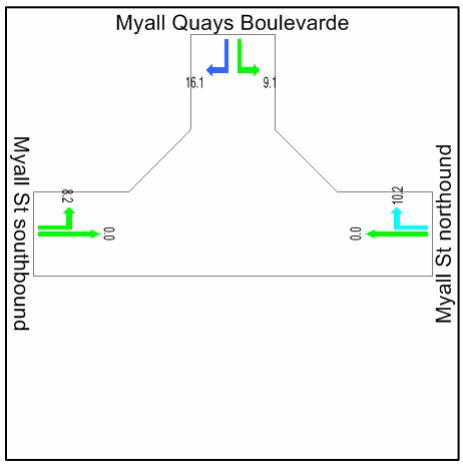
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 PM flows base+590 lots one access

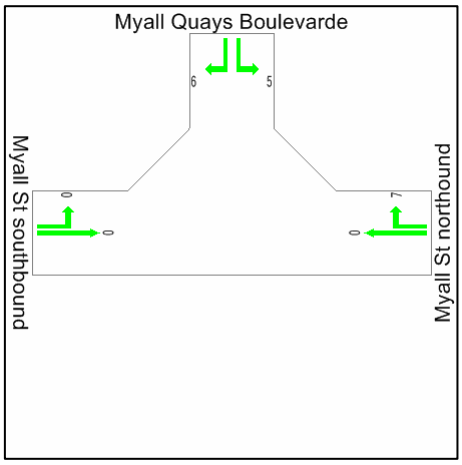
Performance Measure	Vehicles	Persons
Demand Flows - Total	864 veh/h	1296 pers/h
Percent Heavy Vehicles	2.2 %	
Degree of Saturation	0.176	
Effective Intersection Capacity	4913 veh/h	
95% Back of Queue (m)	7 m	
95% Back of Queue (veh)	0.9 veh	
Control Delay (Total)	1.63 veh-h/h	2.44 pers-h/h
Control Delay (Average)	6.8 s/veh	6.8 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	419 veh/h	628 pers/h
Effective Stop Rate	0.48 per veh	0.48 per pers
Proportion Queued	0.20	0.20
Travel Distance (Total)	523.8 veh-km/h	785.7 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	10.4 veh-h/h	15.5 pers-h/h
Travel Time (Average)	43.2 secs	43.2 secs
Travel Speed	50.5 km/h	50.5 km/h
Operating Cost (Total)	360 $/h	360 $/h
Fuel Consumption (Total)	54.3 L/h	
Carbon Dioxide (Total)	135.8 kg/h	
Hydrocarbons (Total)	0.217 kg/h	
Carbon Monoxide (Total)	9.33 kg/h	
NOX (Total)	0.303 kg/h	



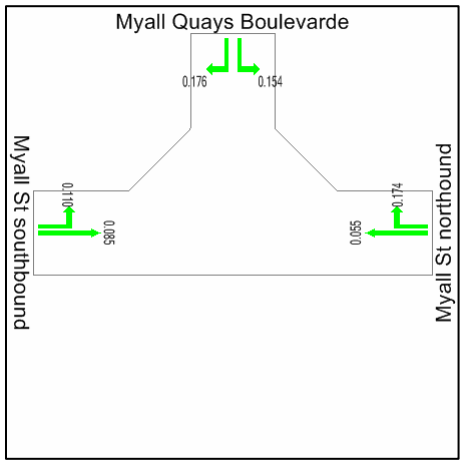
Level of service



Delays



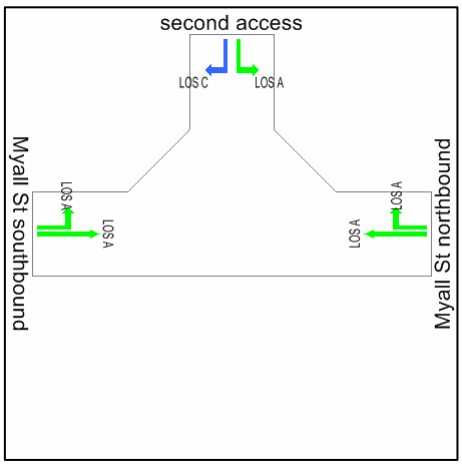
95th percentile queue



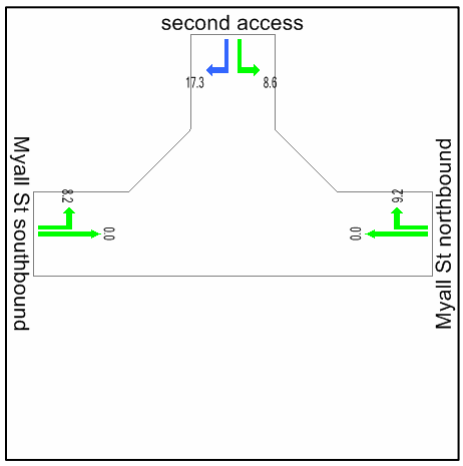
Degree of saturation

Intersection Summary
2nd access and Myall St
2017 AM flows base+1045

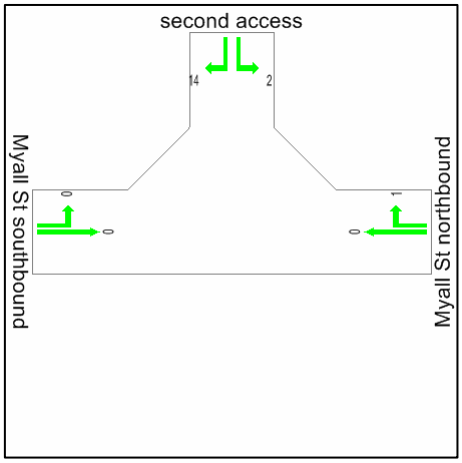
Performance Measure	Vehicles	Persons
Demand Flows - Total	721 veh/h	1082 pers/h
Percent Heavy Vehicles	4.0 %	
Degree of Saturation	0.335	
Effective Intersection Capacity	2152 veh/h	
95% Back of Queue (m)	14 m	
95% Back of Queue (veh)	2.0 veh	
Control Delay (Total)	0.87 veh-h/h	1.31 pers-h/h
Control Delay (Average)	4.3 s/veh	4.3 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	184 veh/h	276 pers/h
Effective Stop Rate	0.26 per veh	0.26 per pers
Proportion Queued	0.15	0.15
Travel Distance (Total)	437.1 veh-km/h	655.7 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	8.2 veh-h/h	12.2 pers-h/h
Travel Time (Average)	40.8 secs	40.8 secs
Travel Speed	53.5 km/h	53.5 km/h
Operating Cost (Total)	279 $/h	279 $/h
Fuel Consumption (Total)	40.0 L/h	
Carbon Dioxide (Total)	100.2 kg/h	
Hydrocarbons (Total)	0.145 kg/h	
Carbon Monoxide (Total)	4.90 kg/h	
NOX (Total)	0.195 kg/h	



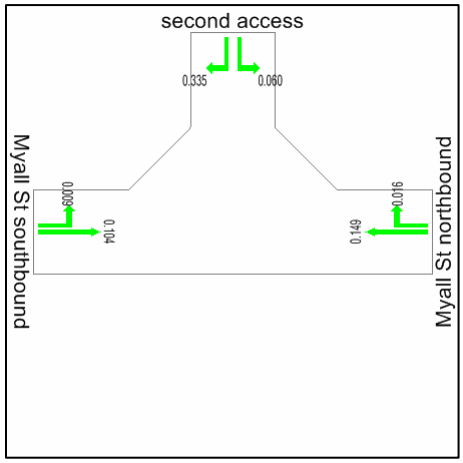
Level of service



Delays



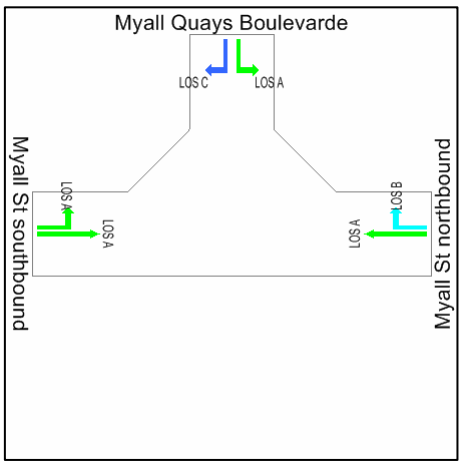
95th percentile queue



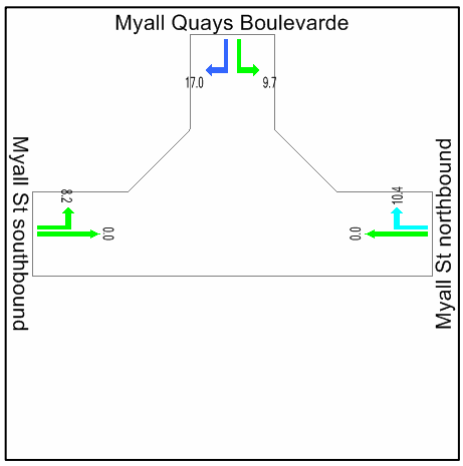
Degree of saturation

Intersection Summary
2nd access and Myall St
2017 PM flows base+1045

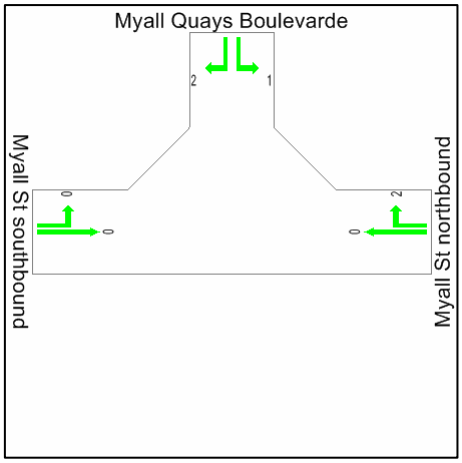
Performance Measure	Vehicles	Persons
Demand Flows - Total	721 veh/h	1082 pers/h
Percent Heavy Vehicles	4.0 %	
Degree of Saturation	0.163	
Effective Intersection Capacity	4421 veh/h	
95% Back of Queue (m)	2 m	
95% Back of Queue (veh)	0.3 veh	
Control Delay (Total)	0.61 veh-h/h	0.91 pers-h/h
Control Delay (Average)	3.0 s/veh	3.0 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	158 veh/h	238 pers/h
Effective Stop Rate	0.22 per veh	0.22 per pers
Proportion Queued	0.06	0.06
Travel Distance (Total)	436.8 veh-km/h	655.2 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	7.9 veh-h/h	11.8 pers-h/h
Travel Time (Average)	39.4 secs	39.4 secs
Travel Speed	55.4 km/h	55.4 km/h
Operating Cost (Total)	271 $/h	271 $/h
Fuel Consumption (Total)	39.5 L/h	
Carbon Dioxide (Total)	98.9 kg/h	
Hydrocarbons (Total)	0.142 kg/h	
Carbon Monoxide (Total)	4.82 kg/h	
NOX (Total)	0.193 kg/h	



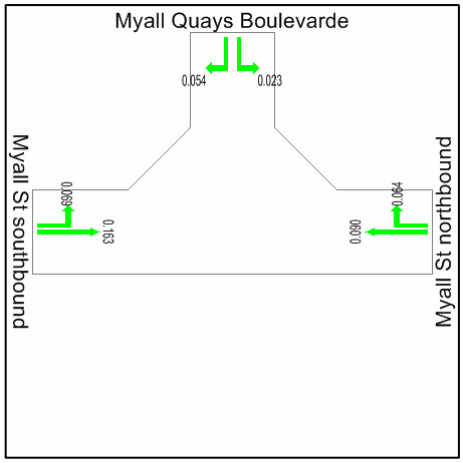
Level of service



Delays



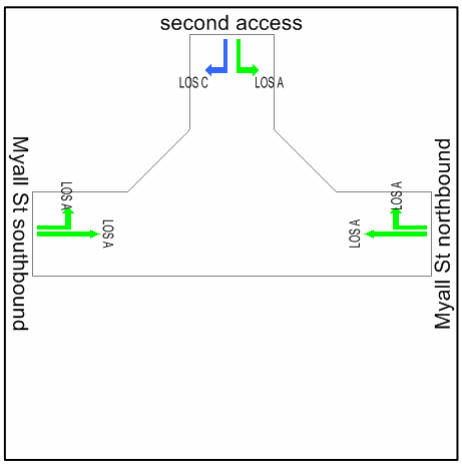
95th percentile queue



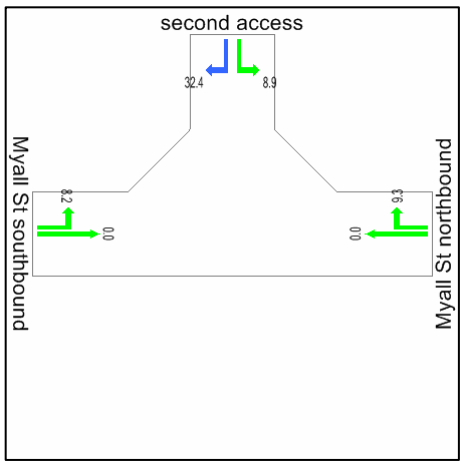
Degree of saturation

Intersection Summary
2nd access and Myall St
2012 2nd access+1045+500 lots

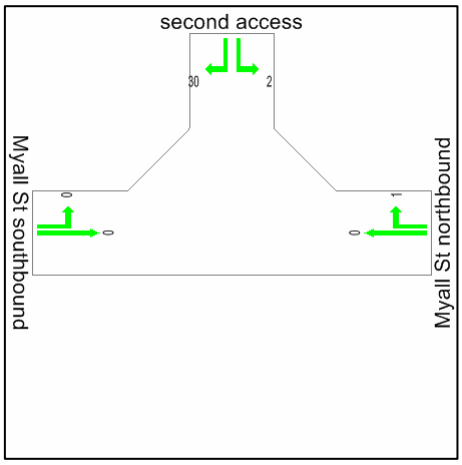
Performance Measure	Vehicles	Persons
Demand Flows - Total	1017 veh/h	1526 pers/h
Percent Heavy Vehicles	4.2 %	
Degree of Saturation	0.618	
Effective Intersection Capacity	1644 veh/h	
95% Back of Queue (m)	30 m	
95% Back of Queue (veh)	4.3 veh	
Control Delay (Total)	1.66 veh-h/h	2.49 pers-h/h
Control Delay (Average)	5.9 s/veh	5.9 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	246 veh/h	369 pers/h
Effective Stop Rate	0.24 per veh	0.24 per pers
Proportion Queued	0.16	0.16
Travel Distance (Total)	616.6 veh-km/h	924.9 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	11.9 veh-h/h	17.9 pers-h/h
Travel Time (Average)	42.3 secs	42.3 secs
Travel Speed	51.6 km/h	51.6 km/h
Operating Cost (Total)	404 $/h	404 $/h
Fuel Consumption (Total)	56.2 L/h	
Carbon Dioxide (Total)	140.6 kg/h	
Hydrocarbons (Total)	0.201 kg/h	
Carbon Monoxide (Total)	6.36 kg/h	
NOX (Total)	0.264 kg/h	



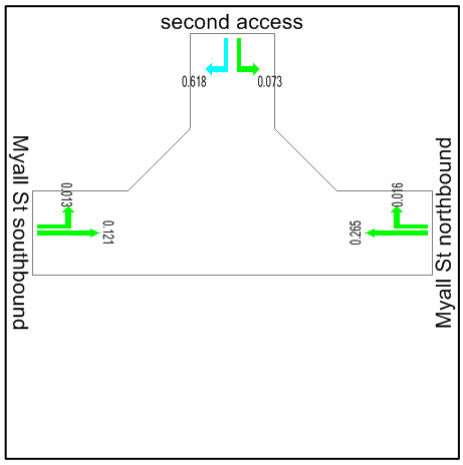
Level of service



Delays



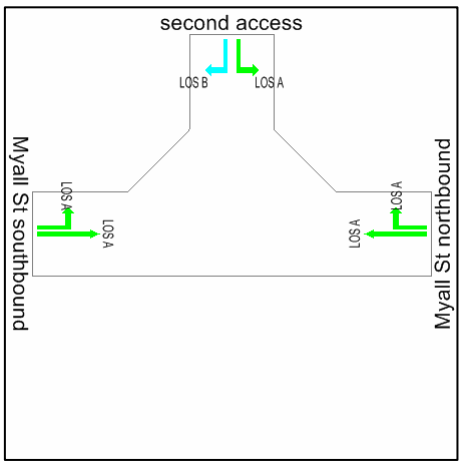
95th percentile queue



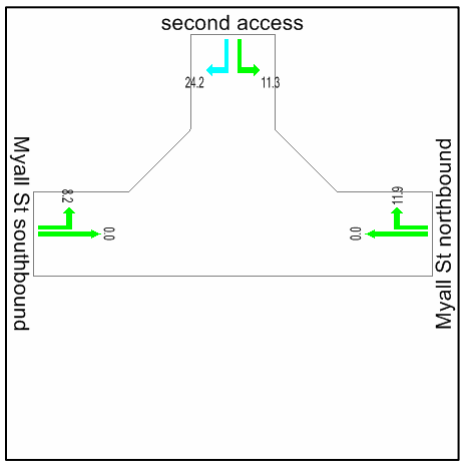
Degree of saturation

Intersection Summary
2nd access and Myall St
2012 2nd access+1045+500 lots

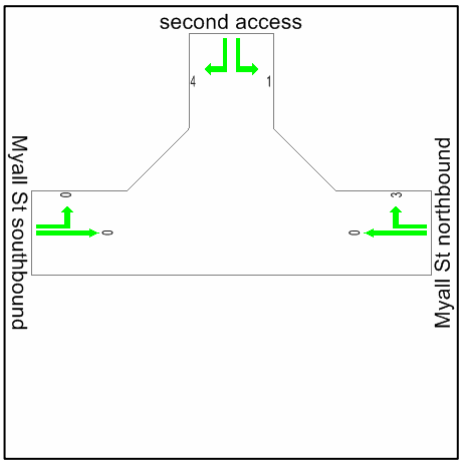
Performance Measure	Vehicles	Persons
Demand Flows - Total	976 veh/h	1464 pers/h
Percent Heavy Vehicles	4.1 %	
Degree of Saturation	0.266	
Effective Intersection Capacity	3674 veh/h	
95% Back of Queue (m)	4 m	
95% Back of Queue (veh)	0.5 veh	
Control Delay (Total)	0.77 veh-h/h	1.15 pers-h/h
Control Delay (Average)	2.8 s/veh	2.8 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	185 veh/h	277 pers/h
Effective Stop Rate	0.19 per veh	0.19 per pers
Proportion Queued	0.07	0.07
Travel Distance (Total)	591.4 veh-km/h	887.1 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	10.6 veh-h/h	15.9 pers-h/h
Travel Time (Average)	39.2 secs	39.2 secs
Travel Speed	55.7 km/h	55.7 km/h
Operating Cost (Total)	363 $/h	363 $/h
Fuel Consumption (Total)	52.4 L/h	
Carbon Dioxide (Total)	131.3 kg/h	
Hydrocarbons (Total)	0.185 kg/h	
Carbon Monoxide (Total)	5.90 kg/h	
NOX (Total)	0.248 kg/h	



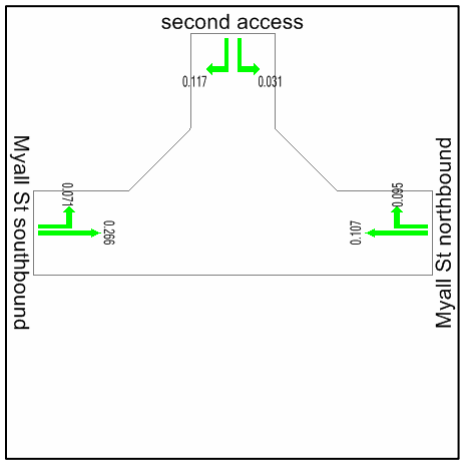
Level of service



Delays



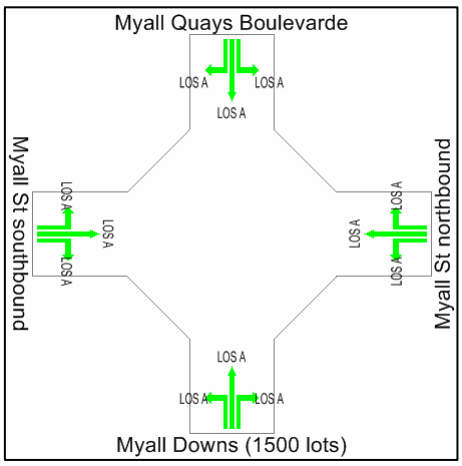
95th percentile queue



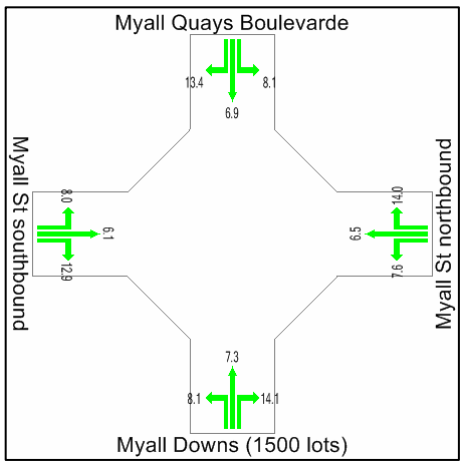
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 AM flows base+1045 lots + 1500 lots Myall Downs

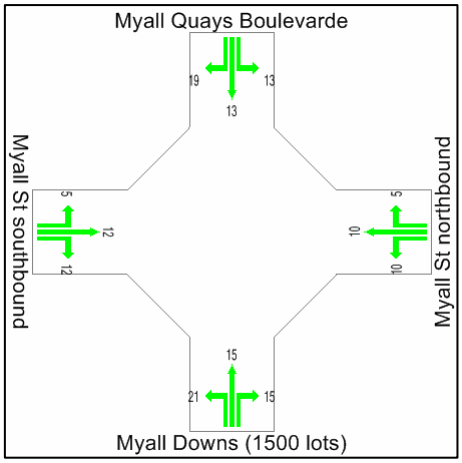
Performance Measure	Vehicles	Persons
Demand Flows - Total	1924 veh/h	2886 pers/h
Percent Heavy Vehicles	1.2 %	
Degree of Saturation	0.401	
Effective Intersection Capacity	4794 veh/h	
95% Back of Queue (m)	21 m	
95% Back of Queue (veh)	3.0 veh	
Control Delay (Total)	5.26 veh-h/h	7.89 pers-h/h
Control Delay (Average)	9.8 s/veh	9.8 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	1339 veh/h	2008 pers/h
Effective Stop Rate	0.70 per veh	0.70 per pers
Proportion Queued	0.60	0.60
Travel Distance (Total)	1208.4 veh-km/h	1812.6 pers-km/h
Travel Distance (Average)	628 m	628 m
Travel Time (Total)	25.9 veh-h/h	38.9 pers-h/h
Travel Time (Average)	48.5 secs	48.5 secs
Travel Speed	46.6 km/h	46.6 km/h
Operating Cost (Total)	898 $/h	898 $/h
Fuel Consumption (Total)	134.7 L/h	
Carbon Dioxide (Total)	336.8 kg/h	
Hydrocarbons (Total)	0.559 kg/h	
Carbon Monoxide (Total)	26.12 kg/h	
NOX (Total)	0.800 kg/h	



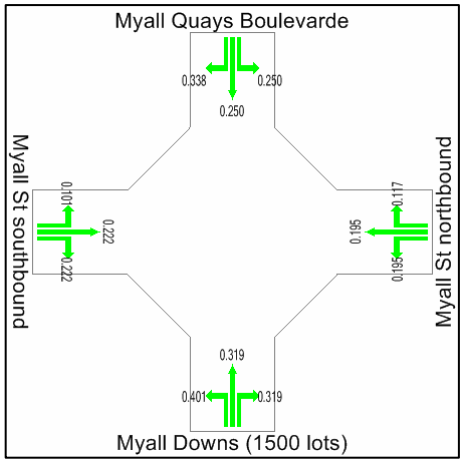
Level of service



Delays



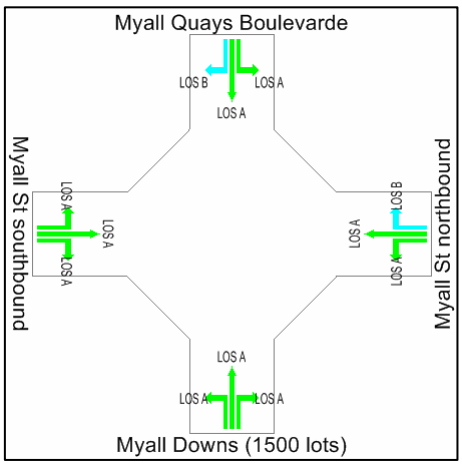
95th percentile queue



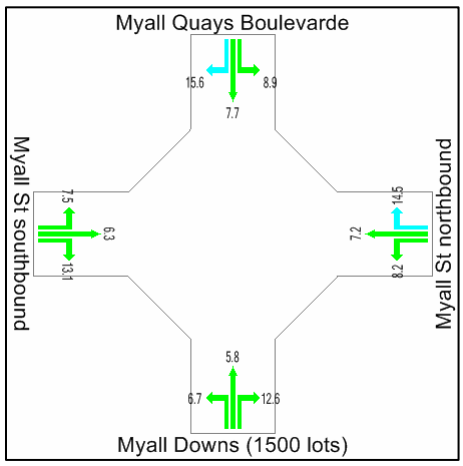
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 PM flows base+1045 lots +1500 lots Myall Downs

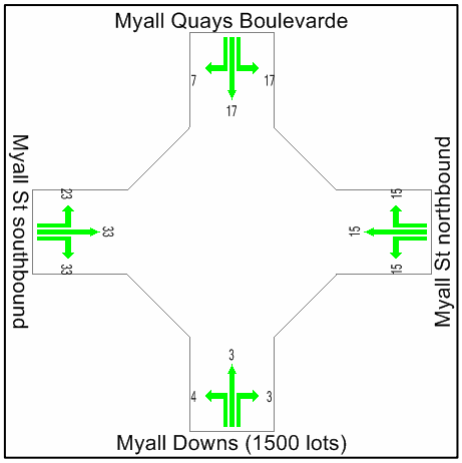
Performance Measure	Vehicles	Persons
Demand Flows - Total	2015 veh/h	3023 pers/h
Percent Heavy Vehicles	1.5 %	
Degree of Saturation	0.487	
Effective Intersection Capacity	4139 veh/h	
95% Back of Queue (m)	33 m	
95% Back of Queue (veh)	4.6 veh	
Control Delay (Total)	5.58 veh-h/h	8.38 pers-h/h
Control Delay (Average)	10.0 s/veh	10.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	1410 veh/h	2115 pers/h
Effective Stop Rate	0.70 per veh	0.70 per pers
Proportion Queued	0.63	0.63
Travel Distance (Total)	1266.2 veh-km/h	1899.4 pers-km/h
Travel Distance (Average)	628 m	628 m
Travel Time (Total)	27.3 veh-h/h	41.0 pers-h/h
Travel Time (Average)	48.8 secs	48.8 secs
Travel Speed	46.3 km/h	46.3 km/h
Operating Cost (Total)	950 $/h	950 $/h
Fuel Consumption (Total)	143.7 L/h	
Carbon Dioxide (Total)	359.4 kg/h	
Hydrocarbons (Total)	0.595 kg/h	
Carbon Monoxide (Total)	28.05 kg/h	
NOX (Total)	0.857 kg/h	



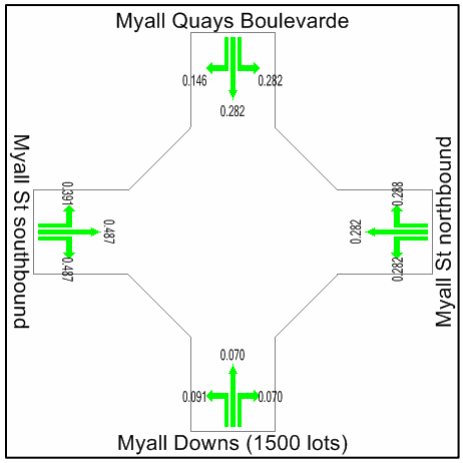
Level of service



Delays



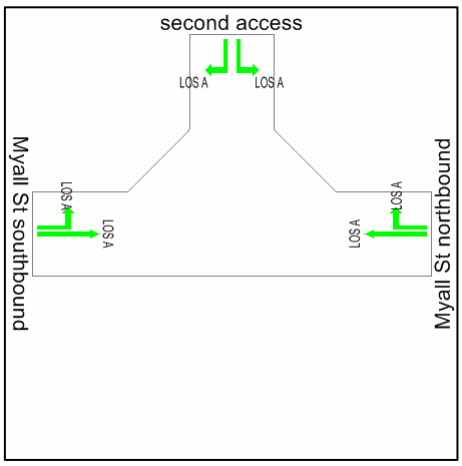
95th percentile queue



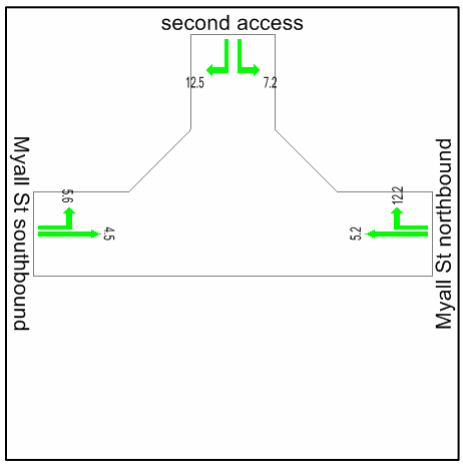
Degree of saturation

Intersection Summary
2nd access and Myall St
2012 AM flows base+1045+1500 roundabout

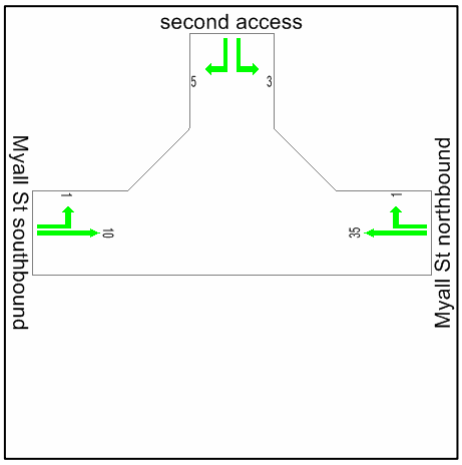
Performance Measure	Vehicles	Persons
Demand Flows - Total	1238 veh/h	1857 pers/h
Percent Heavy Vehicles	4.4 %	
Degree of Saturation	0.490	
Effective Intersection Capacity	2527 veh/h	
95% Back of Queue (m)	35 m	
95% Back of Queue (veh)	4.8 veh	
Control Delay (Total)	2.08 veh-h/h	3.12 pers-h/h
Control Delay (Average)	6.0 s/veh	6.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	586 veh/h	880 pers/h
Effective Stop Rate	0.47 per veh	0.47 per pers
Proportion Queued	0.33	0.33
Travel Distance (Total)	764.4 veh-km/h	1146.5 pers-km/h
Travel Distance (Average)	617 m	617 m
Travel Time (Total)	15.3 veh-h/h	22.9 pers-h/h
Travel Time (Average)	44.4 secs	44.4 secs
Travel Speed	50.0 km/h	50.0 km/h
Operating Cost (Total)	543 $/h	543 $/h
Fuel Consumption (Total)	85.9 L/h	
Carbon Dioxide (Total)	215.1 kg/h	
Hydrocarbons (Total)	0.331 kg/h	
Carbon Monoxide (Total)	15.54 kg/h	
NOX (Total)	0.503 kg/h	



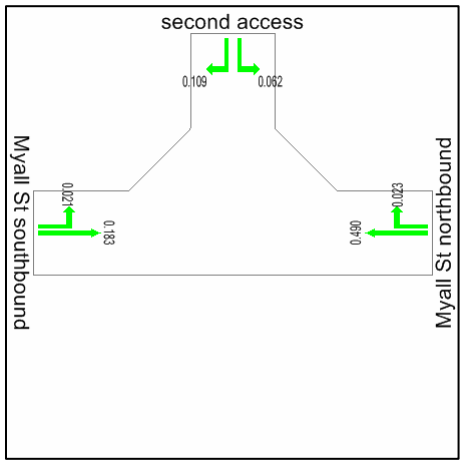
Level of service



Delays



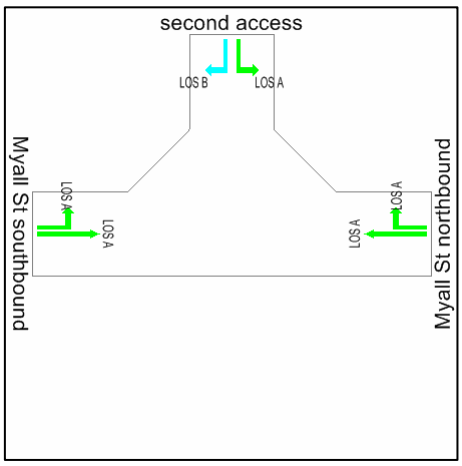
95th percentile queue



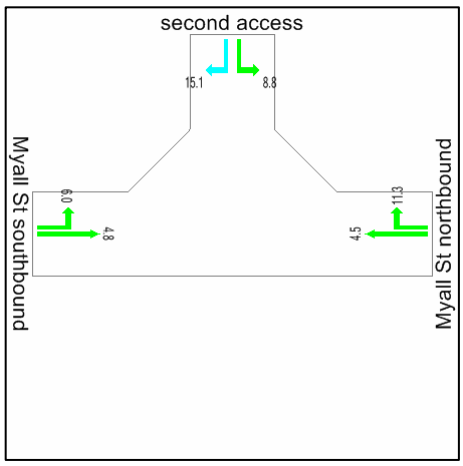
Degree of saturation

Intersection Summary
2nd access and Myall St
2012 PM flows base+1045+1500 Downs

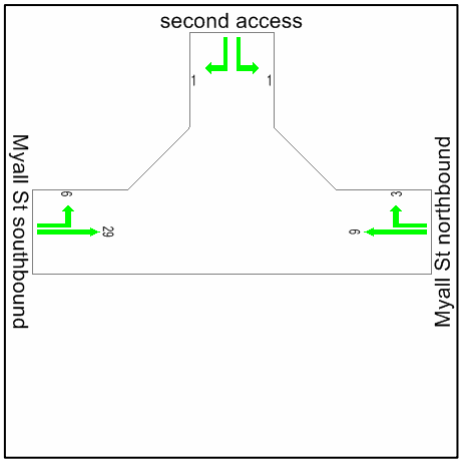
Performance Measure	Vehicles	Persons
Demand Flows - Total	1220 veh/h	1830 pers/h
Percent Heavy Vehicles	4.4 %	
Degree of Saturation	0.450	
Effective Intersection Capacity	2708 veh/h	
95% Back of Queue (m)	29 m	
95% Back of Queue (veh)	4.0 veh	
Control Delay (Total)	1.82 veh-h/h	2.73 pers-h/h
Control Delay (Average)	5.4 s/veh	5.4 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	513 veh/h	770 pers/h
Effective Stop Rate	0.42 per veh	0.42 per pers
Proportion Queued	0.21	0.21
Travel Distance (Total)	749.4 veh-km/h	1124.1 pers-km/h
Travel Distance (Average)	614 m	614 m
Travel Time (Total)	14.6 veh-h/h	21.9 pers-h/h
Travel Time (Average)	43.1 secs	43.1 secs
Travel Speed	51.3 km/h	51.3 km/h
Operating Cost (Total)	519 $/h	519 $/h
Fuel Consumption (Total)	81.9 L/h	
Carbon Dioxide (Total)	205.2 kg/h	
Hydrocarbons (Total)	0.312 kg/h	
Carbon Monoxide (Total)	14.38 kg/h	
NOX (Total)	0.474 kg/h	



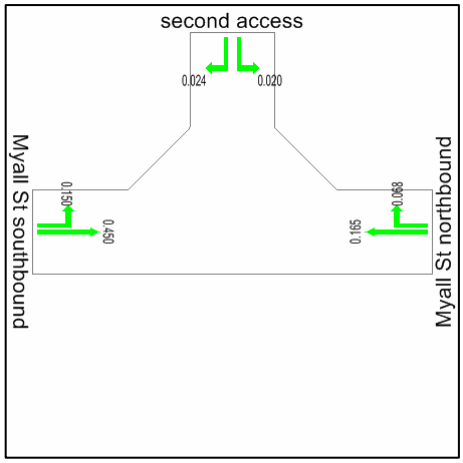
Level of service



Delays



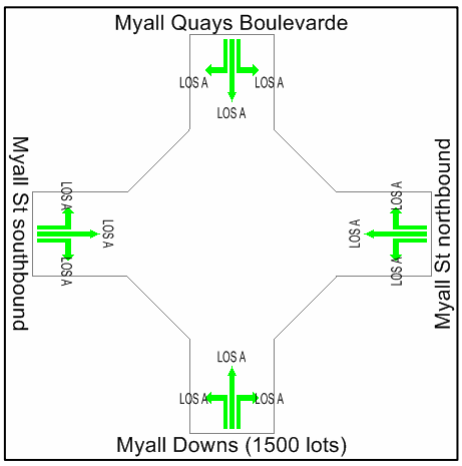
95th percentile queue



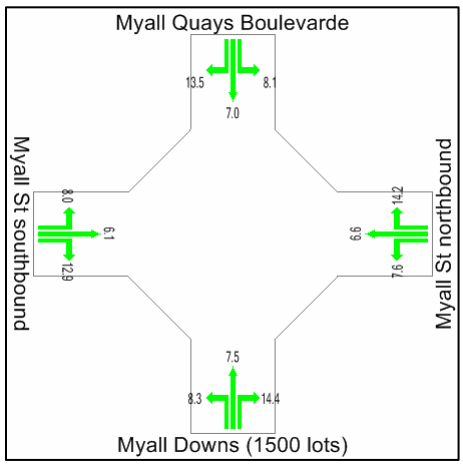
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 AM flows base+1045+1500+industrial roundabout

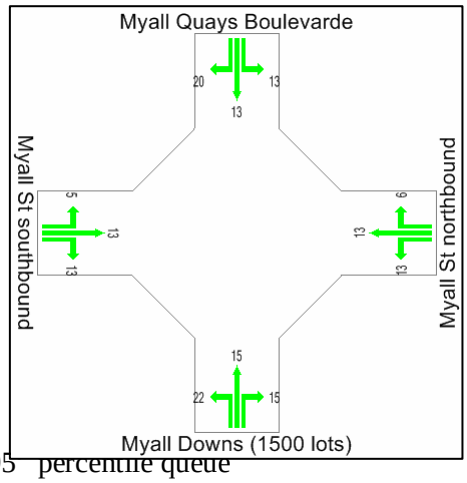
Performance Measure	Vehicles	Persons
Demand Flows - Total	1973 veh/h	2960 pers/h
Percent Heavy Vehicles	1.3 %	
Degree of Saturation	0.410	
Effective Intersection Capacity	4813 veh/h	
95% Back of Queue (m)	22 m	
95% Back of Queue (veh)	3.1 veh	
Control Delay (Total)	5.41 veh-h/h	8.11 pers-h/h
Control Delay (Average)	9.9 s/veh	9.9 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	1385 veh/h	2078 pers/h
Effective Stop Rate	0.70 per veh	0.70 per pers
Proportion Queued	0.62	0.62
Travel Distance (Total)	1238.4 veh-km/h	1857.5 pers-km/h
Travel Distance (Average)	628 m	628 m
Travel Time (Total)	26.6 veh-h/h	39.9 pers-h/h
Travel Time (Average)	48.5 secs	48.5 secs
Travel Speed	46.6 km/h	46.6 km/h
Operating Cost (Total)	921 $/h	921 $/h
Fuel Consumption (Total)	138.4 L/h	
Carbon Dioxide (Total)	346.3 kg/h	
Hydrocarbons (Total)	0.574 kg/h	
Carbon Monoxide (Total)	26.87 kg/h	
NOX (Total)	0.823 kg/h	



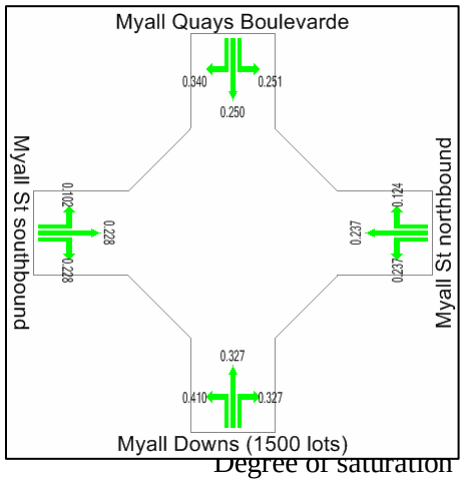
Level of service



Delays



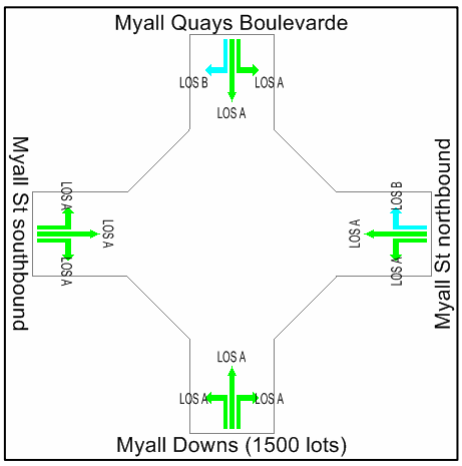
95 percentile queue



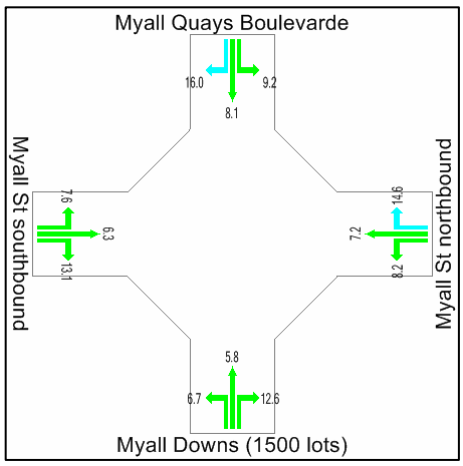
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 PM flows base+1045+1500+Industrial roundabout

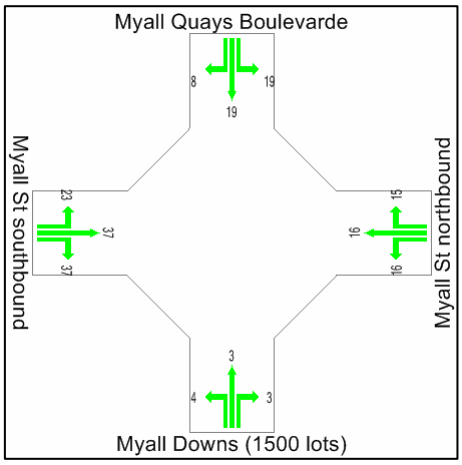
Performance Measure	Vehicles	Persons
Demand Flows - Total	2064 veh/h	3096 pers/h
Percent Heavy Vehicles	1.6 %	
Degree of Saturation	0.521	
Effective Intersection Capacity	3960 veh/h	
95% Back of Queue (m)	37 m	
95% Back of Queue (veh)	5.1 veh	
Control Delay (Total)	5.73 veh-h/h	8.59 pers-h/h
Control Delay (Average)	10.0 s/veh	10.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	1452 veh/h	2178 pers/h
Effective Stop Rate	0.70 per veh	0.70 per pers
Proportion Queued	0.65	0.65
Travel Distance (Total)	1296.2 veh-km/h	1944.3 pers-km/h
Travel Distance (Average)	628 m	628 m
Travel Time (Total)	28.0 veh-h/h	42.0 pers-h/h
Travel Time (Average)	48.8 secs	48.8 secs
Travel Speed	46.3 km/h	46.3 km/h
Operating Cost (Total)	974 $/h	974 $/h
Fuel Consumption (Total)	147.6 L/h	
Carbon Dioxide (Total)	369.2 kg/h	
Hydrocarbons (Total)	0.610 kg/h	
Carbon Monoxide (Total)	28.84 kg/h	
NOX (Total)	0.882 kg/h	



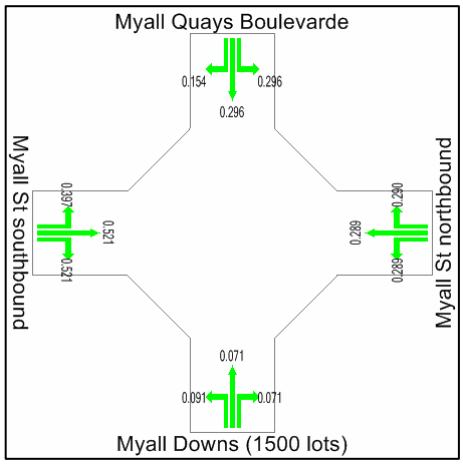
Level of service



Delays



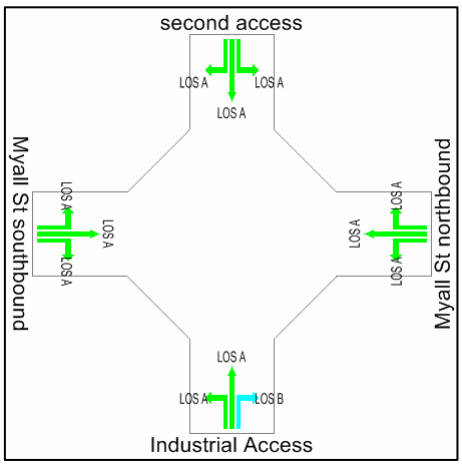
95th percentile queue



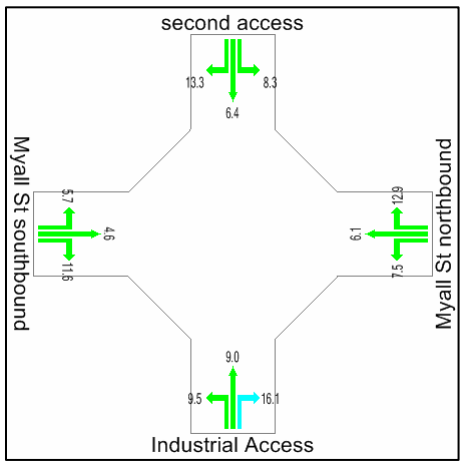
Degree of saturation

Intersection Summary
2nd access and Myall St
20012 AM flows base+1045+1500+Industrial roundabout

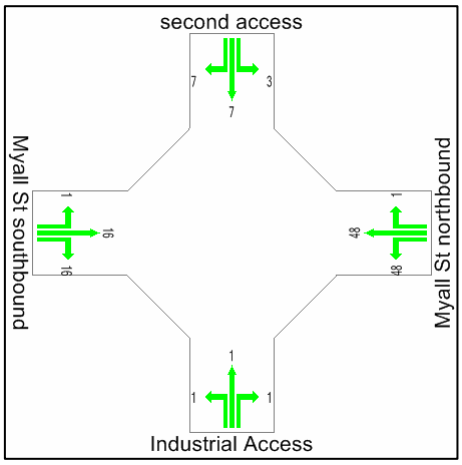
Performance Measure	Vehicles	Persons
Demand Flows - Total	1514 veh/h	2271 pers/h
Percent Heavy Vehicles	5.0 %	
Degree of Saturation	0.614	
Effective Intersection Capacity	2465 veh/h	
95% Back of Queue (m)	48 m	
95% Back of Queue (veh)	6.5 veh	
Control Delay (Total)	2.93 veh-h/h	4.39 pers-h/h
Control Delay (Average)	7.0 s/veh	7.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	811 veh/h	1216 pers/h
Effective Stop Rate	0.54 per veh	0.54 per pers
Proportion Queued	0.45	0.45
Travel Distance (Total)	937.3 veh-km/h	1406.0 pers-km/h
Travel Distance (Average)	619 m	619 m
Travel Time (Total)	19.2 veh-h/h	28.7 pers-h/h
Travel Time (Average)	45.5 secs	45.5 secs
Travel Speed	48.9 km/h	48.9 km/h
Operating Cost (Total)	685 $/h	685 $/h
Fuel Consumption (Total)	110.0 L/h	
Carbon Dioxide (Total)	275.6 kg/h	
Hydrocarbons (Total)	0.426 kg/h	
Carbon Monoxide (Total)	20.60 kg/h	
NOX (Total)	0.655 kg/h	



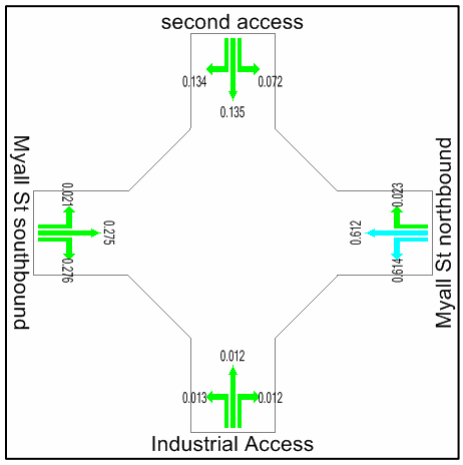
Level of service



Delays



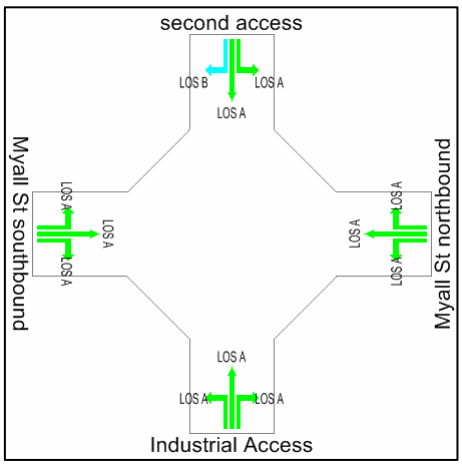
95th percentile queue



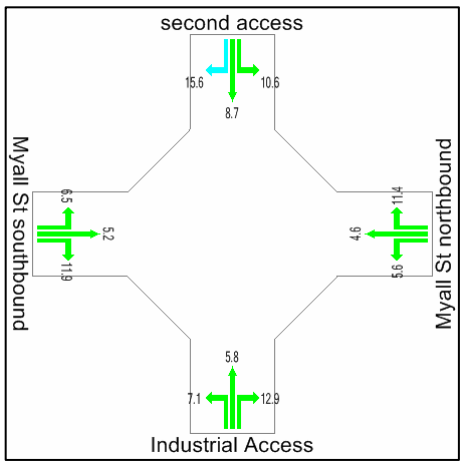
Degree of saturation

Intersection Summary
2nd access and Myall St
2017 PM flows base+1045+1500+Industrial

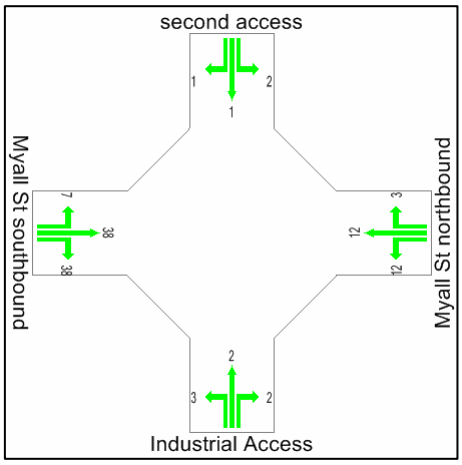
Performance Measure	Vehicles	Persons
Demand Flows - Total	1502 veh/h	2253 pers/h
Percent Heavy Vehicles	4.9 %	
Degree of Saturation	0.531	
Effective Intersection Capacity	2827 veh/h	
95% Back of Queue (m)	38 m	
95% Back of Queue (veh)	5.3 veh	
Control Delay (Total)	2.49 veh-h/h	3.74 pers-h/h
Control Delay (Average)	6.0 s/veh	6.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	705 veh/h	1057 pers/h
Effective Stop Rate	0.47 per veh	0.47 per pers
Proportion Queued	0.33	0.33
Travel Distance (Total)	924.0 veh-km/h	1385.9 pers-km/h
Travel Distance (Average)	615 m	615 m
Travel Time (Total)	18.4 veh-h/h	27.6 pers-h/h
Travel Time (Average)	44.1 secs	44.1 secs
Travel Speed	50.2 km/h	50.2 km/h
Operating Cost (Total)	658 $/h	658 $/h
Fuel Consumption (Total)	105.3 L/h	
Carbon Dioxide (Total)	263.8 kg/h	
Hydrocarbons (Total)	0.404 kg/h	
Carbon Monoxide (Total)	19.16 kg/h	
NOX (Total)	0.620 kg/h	



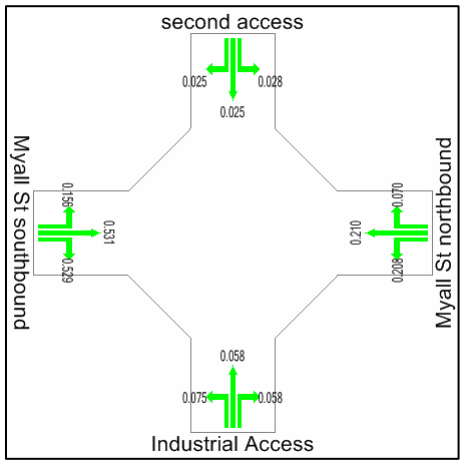
Level of service



Delays



95th percentile queue



Degree of saturation

Appendix C Criteria for interpreting results of SIDRA

1-Level of Service (LoS)

LoS	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Good	Good
B	Good, with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	Satisfactory	Satisfactory, but requires accident study
D	Operating near capacity	Near capacity and requires accident study
E	At capacity, excessive delay: roundabout requires other control method	At capacity, requires other control mode
F	Unsatisfactory, requires other control mode or additional capacity	Unsatisfactory, requires other control mode

2-Average Vehicle Delay (AVD)

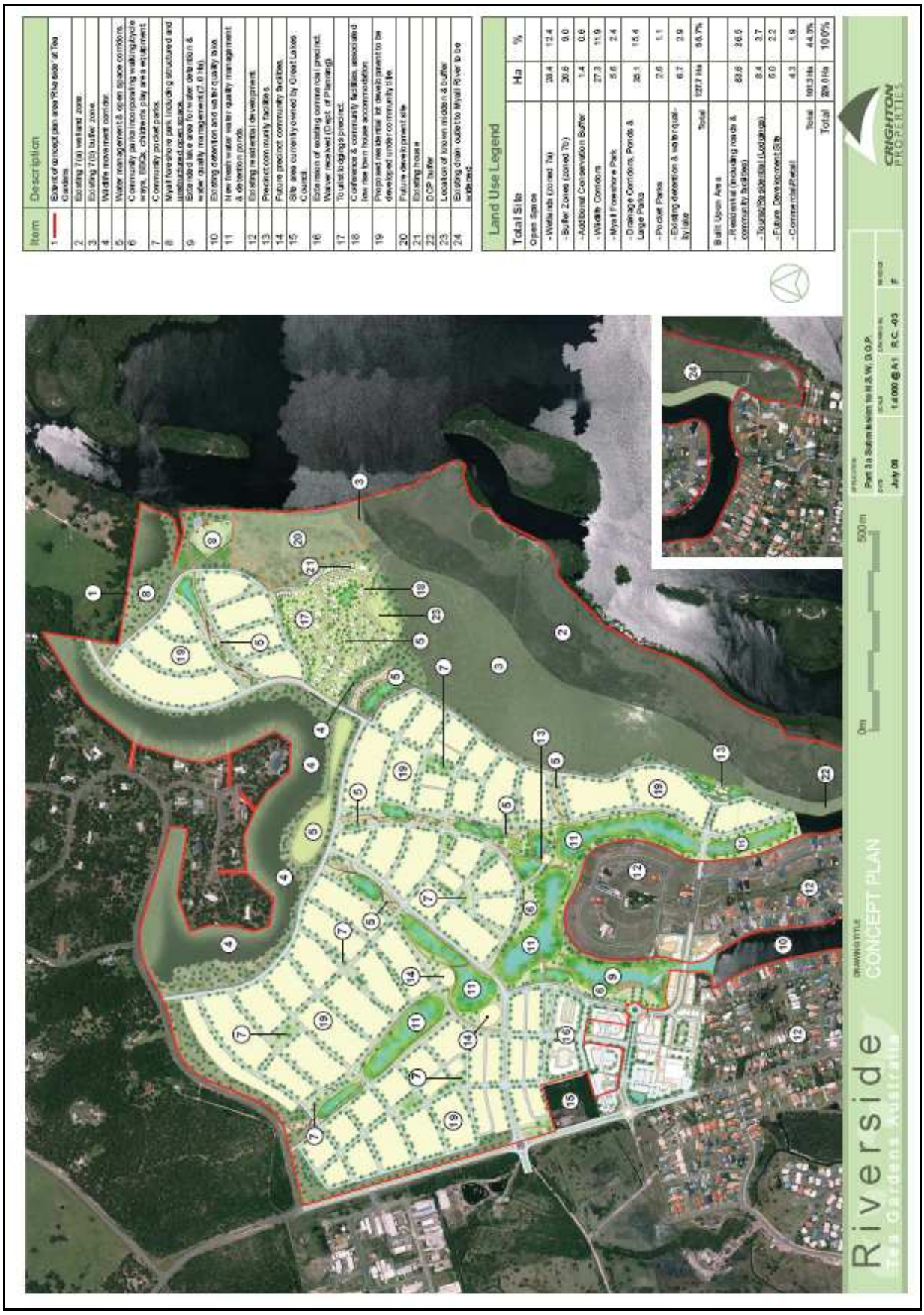
The AVD is a measure of operational performance of an intersection relating to its LoS. The average delay should be taken as a guide only for an average intersection. Longer delays may be tolerated at some intersections where delays are expected by motorists (e.g. those in inner city areas or major arterial roads).

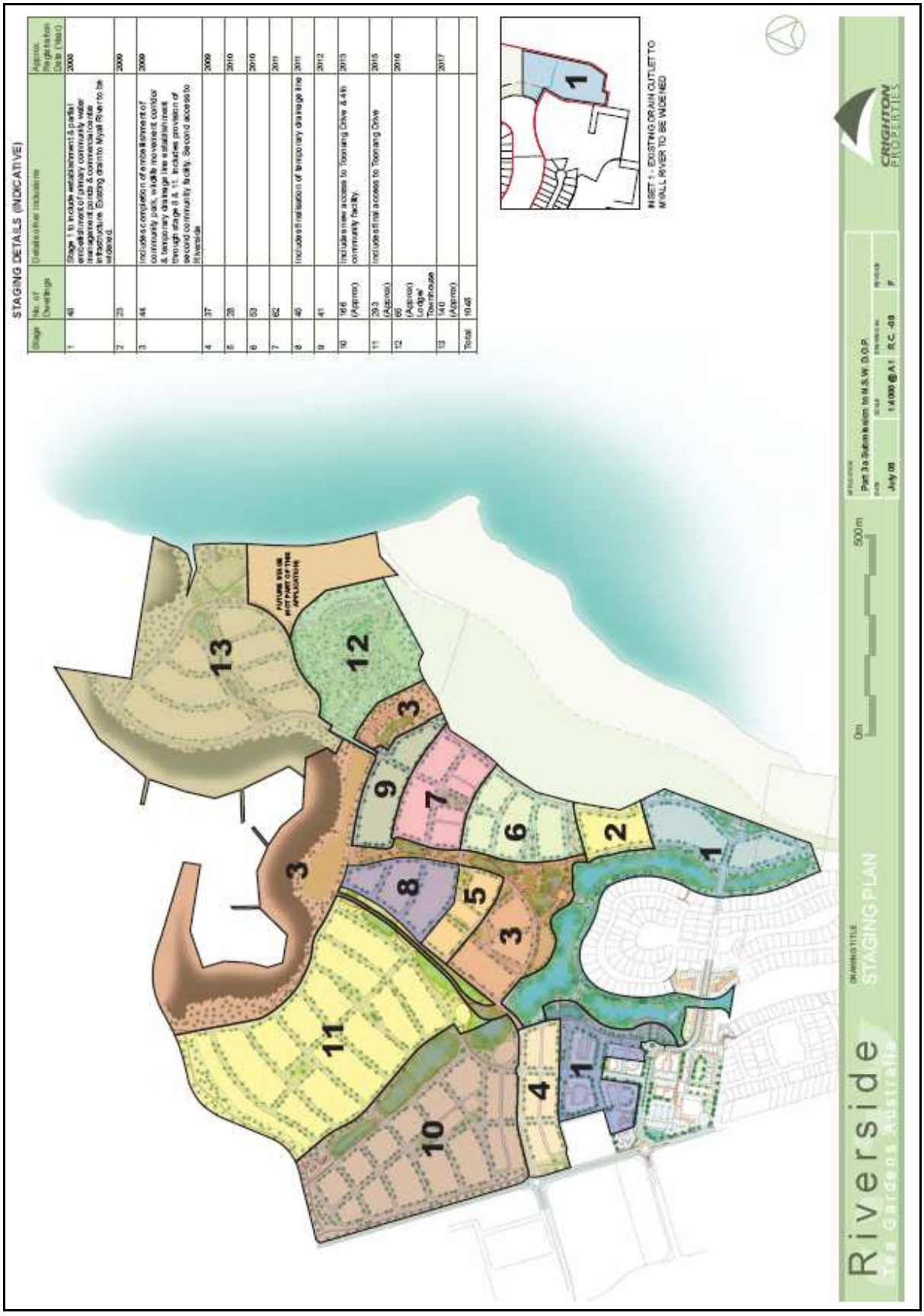
LoS	Average Delay / Vehicle (secs)	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	28 to 42	Satisfactory	Satisfactory but accident study required
D	42 to 56	Operating near capacity	Near capacity, accident study required
E	56 to 70	At capacity, excessive delays: roundabout requires other control mode	At capacity; requires other control mode
F	Exceeding 70	Unsatisfactory, requires additional capacity	Unsatisfactory, requires other control mode

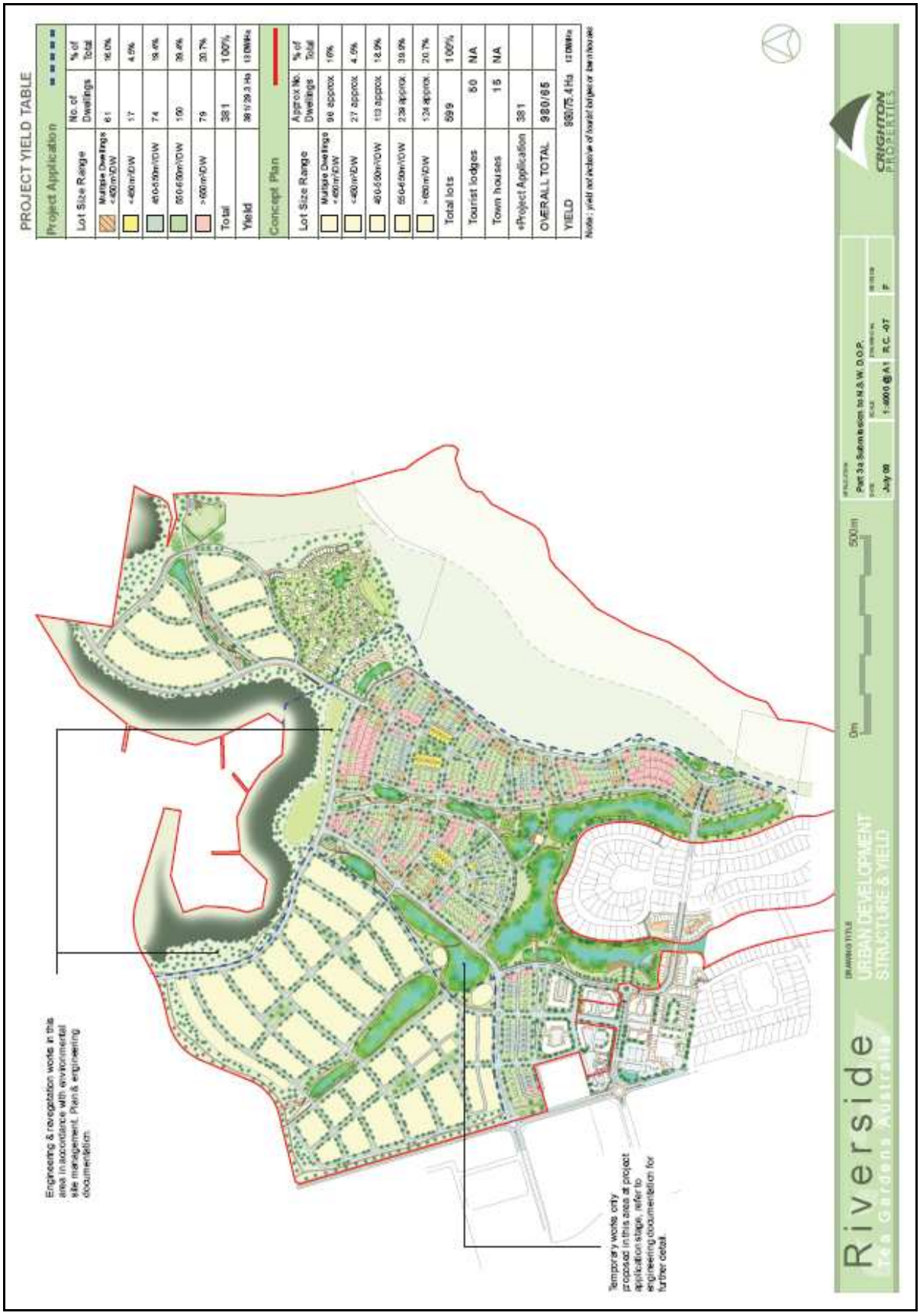
3-Degree of Saturation (D/S)

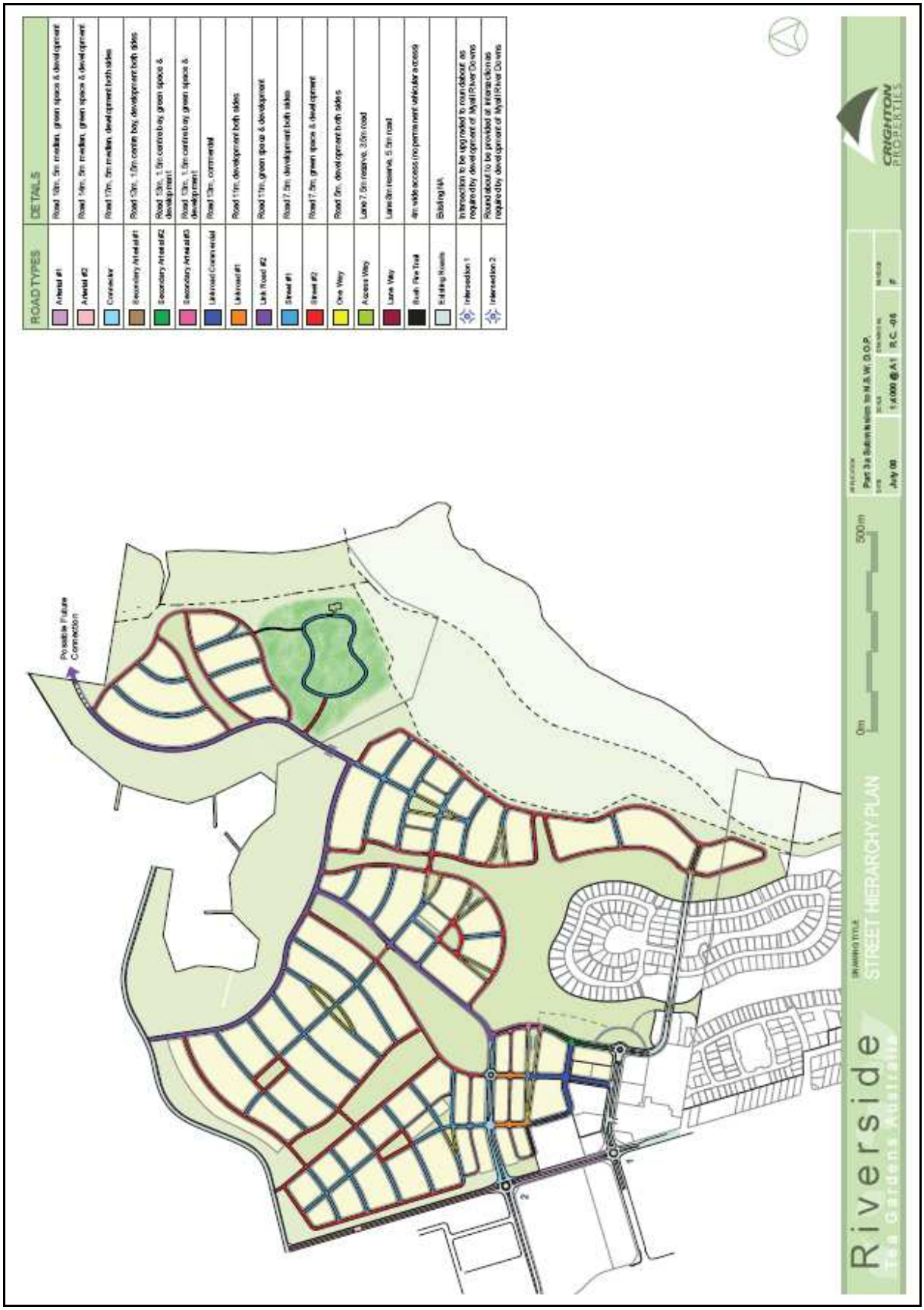
The D/S of an intersection is usually taken as the highest ratio of traffic volumes on an approach to an intersection compared with the theoretical capacity, and is a measure of the utilisation of available green time. For intersections controlled by traffic signals, both queues and delays increase rapidly as DS approaches 1.0. An intersection operates satisfactorily when its D/S is kept below 0.75. When D/S exceeds 0.9, queues are expected.

Appendix D Site Concept Plans


Item Description
1 Extent of concept plan area (Riverside at The Gardens)
2 Existing 7(a) wetland zone
3 Existing 7(b) buffer zone
4 Wildlife movement corridor
5 Water management & open space corridors.
6 Community parks incorporating walking/cycle ways, BBQs, children's play area equipment
7 Community pocket parks.
8 Myall Foreshore park including structured and unstructured open space.
9 Extended lake area for water detention & water quality management (2.0 Ha)
10 Existing detention and water quality area.
11 New fresh water water quality management & detention ponds.
12 Existing residential development.
13 Precinct community facilities.
14 Future precinct community facilities.
15 Site area currently owned by Great Lakes Council.
16 Extension of existing commercial precinct. Waiver received (Dept of Planning)
17 Tourist lodging precinct.
18 Conference & community facilities, associated low rise town house accommodation.
19 Proposed residential lot development to be developed under community title.
20 Future developments site
21 Existing house
22 DCP buffer
23 Location of known middden & buffer
24 Existing drain outlet to Myall River to be addressed.
Land Use Legend
Total Site Ha %
Open Space
- Wetlands (zoned 7a) 39.4 12.4
- Buffer Zones (zoned 7b) 30.6 9.6
- Additional Conservation Buffer 1.4 0.6
- Wildlife Corridors 37.3 11.9
- Myall Foreshore Park 8.6 2.4
- Drainage Corridors, Ponds & Large Parks 35.1 15.4
- Pocket Parks 2.6 1.1
- Existing detention & water quality bylake 6.7 2.9
Total 127.7 Ha 55.7%
Built Upon Area
- Residential (including roads & community facilities) 83.6 36.6
- Tourist/Residential (Lodgings) 8.4 3.7
- Future Development Site 5.0 2.2
- Commercial/Retail 4.3 1.9
Total 101.3 Ha 44.3%
Total 229.0 Ha 100%
Riverside
The Gardens Australia
DRAWING TITLE
CONCEPT PLAN
Part 3a Submission to M.S.W. D.O.P.
July 08
1:4000 @ A1
R.C. 43
CRIGHTON PROPERTIES
0m
500m


STAGING DETAILS (INDICATIVE)
Stage
No. of Dwellings
Industrial/retail industrie
Approx. Registration Date (Year)
1 48 Stage 1 to include establishment & partial embellishment of primary community water management points & commercial/cafe infrastructure. Existing drain to Myall River to be widened. 2008
2 23 2009
3 44 Includes a completion of embellishment of community park, wildlife movement corridor & temporary drainage line establishment through stage 8 & 11. Includes provision of second community facility. Second access to Riverside 2009
4 37 2009
5 28 2010
6 83 2010
7 62 2011
8 46 Includes installation of temporary drainage line 2011
9 41 2012
10 166 (Approx) Includes new access to Toorang Drive & 4th community facility 2013
11 293 (Approx) Includes final access to Toorang Drive 2015
12 66 (Approx) Lodge/ Townhouse 2016
13 140 (Approx) 2017
Total 1045
INSET 1 - EXISTING DRAIN OUTLET TO MYALL RIVER TO BE WIDENED
FUTURE SEWER MAIN PART OF THE APPLICATION
0m
500m
Riversside
Tea Gardens Australia
STAGING PLAN
CRIGHTON PROPERTIES
Part 3a Submission to N.S.W. D.O.P.
July 08
1:4000 @ A1
R.C. -09


PROJECT YIELD TABLE
Project Application
Lot Size Range
No. of Dwellings
% of Total
Multiple Dwellings <450m²/DW
61
16.0%
<450m²/DW
17
4.5%
450-549m²/DW
74
19.4%
550-650m²/DW
150
39.4%
>650m²/DW
79
20.7%
Total
381
100%
Yield
38 ½ / 39.3 Ha
15 DW/Ha
Concept Plan
Lot Size Range
Approx No. Dwellings
% of Total
Multiple Dwellings <450m²/DW
96 approx.
16%
<450m²/DW
27 approx.
4.5%
450-549m²/DW
113 approx.
18.9%
550-650m²/DW
239 approx.
39.9%
>650m²/DW
124 approx.
20.7%
Total lots
599
100%
Tourist lodges
50
NA
Town houses
15
NA
#Project Application
381
OVERALL TOTAL
980/85
YIELD
980/75.4 Ha
13 DW/Ha
Note: yield exclusive of tourist lodges or town houses
CRIGHTON PROPERTIES
Riverside
Tea Gardens Australia
URBAN DEVELOPMENT
STRUCTURE & YIELD
Part 3a Submission to N.S.W. D.O.P.
July 08
1:4000 @ A1
R.C. -07
F
0m
500m
Engineering & revegetation works in this area in accordance with environmental site management, Plan & engineering documentation.
Temporary works only proposed in this area at project application stage, refer to engineering documentation for further detail.


ROAD TYPES
DETAILS
Arterial #1
Road 19m, 5m median, green space & development
Arterial #2
Road 14m, 5m median, green space & development
Connector
Road 17m, 5m median, development both sides
Secondary Arterial #1
Road 13m, 1.0m centre bay, development both sides
Secondary Arterial #2
Road 13m, 1.5m centre bay green space & development
Secondary Arterial #3
Road 13m, 1.0m centre bay green space & development
Local/Commercial
Road 13m, commercial
Local #1
Road 11m, development both sides
Link Road #2
Road 11m, green space & development
Street #1
Road 7.5m development both sides
Street #2
Road 7.5m, green space & development
One Way
Road 5m, development both sides
Access Way
Lane 7.5m reserve, 3.0m road
Lane Way
Lane 6m reserve, 5.0m road
Bush Fire Trail
4m wide access (no) permanent vehicular access
Existing Walk
Existing Walk
Intersection 1
Intersection to be upgraded to roundabout as required by development of Myall River Downs
Intersection 2
Roundabout to be provided at intersection as required by development of Myall River Downs
Possible Future Connection
0m
500m
CRIGHTON PROPERTIES
Riverside
Tea Gardens Australia
STREET HIERARCHY PLAN
Part 3a Submission to N.S.W. D.O.P.
July 08
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R.C.-05

Appendix E Urban Design Principles

Urban Design Principles
Changing Travel Behaviour through Development Practice
Discussion Paper

1. Introduction

1.1 Background

This paper presents a range of transport objectives confronting new land development projects, outlining some solutions that will aid in realising State Government planning objectives of reducing the demand for car based travel by focussing on improved choice in transport alternatives.

It is not the intent that the Riverside development should act on all or any of the these initiatives beyond those documented in the transport report principles, rather the information is presented here to provide an understanding of the complexity of the transport task in our cities and to show that there is no one solution or one organisation that can deliver such a significant change in our travel behaviour.

There are more and more opportunities emerging to achieve a development shift and contribute to the choice to use alternate transport modes, such as the proposal to redevelop the Riverside development.

The commitment of developers to implement a range of initiatives to achieve a development with a difference, including influencing transport behaviour is one of the major challenges to achieving sustainable change.

Transport initiatives relating to development site are discussed and illustrated to demonstrate how a positive focus on alternative transport modes and urban form can be used to provide better choices focussed on alternative transport to the private motor vehicle.

1.2 Masterplan Goals and Principles

The Concept Plan for the Riverside development aims to match the Governments stated general objectives in the areas of Transport, and Air Quality. These objectives and the identified opportunities are described below:

Transport Goal

- "To provide a transport system that provides for the efficient movement of people and goods, which increases transport options and which is based on ecological sustainability."

Opportunities to Improve Development Practice

Principal 1: To utilise linkages to regional public transport.

Principal 2: To maximise the efficiency of the local street network to reduce trip lengths, enhance the viability of public transport and encourage cycling and walking as viable alternatives.

Principal 3: To improve regional and metropolitan linkages.

Air Quality Goal

"To ensure that occupants of the site are not exposed to higher levels of air pollution than elsewhere in the greater metropolitan region; and that the site's use generates air pollution at a significantly lower rate than previous development areas.

Opportunities to Improve Development Practice

Principal 1: To encourage an increased use of alternative modes of transport and reduced reliance on the use of the private car.

Principal 2: To restrict non-transport sources of air pollution.

Both the Transport and Air Quality goals of the Masterplan emphasise alternative transport as a positive measure towards achieving ecological sustainability. There is also a strong emphasis on reducing dependency on the private motor vehicle.

1.3 Integrated Planning

Regional Planning Strategies for the Greater Metropolitan Region (GMR) have been revised and updated. "Cities for the 21st Century" and the complementary "Integrated Transport Strategy" document the integrated strategies which are now being applied at the broader metropolitan scale. Principles include:

- a focus on developing a more compact urban form
- developing sites which can maximise use of existing infrastructure
- developing sites with good access to major transport corridors and employment centres
- greater choice in housing types, especially multi-household dwellings
- reducing dependency on the private motor car.

Again the general philosophy of improved accessibility to alternative transport and reduction of dependency on the private motor vehicle is emphasised.

1.4 Contributing Towards Transport Alternatives

This paper summarises the key transport features providing access to the proposed development of the Riverside development. It has been produced to demonstrate that the proposal is consistent with the State Government's initiatives for transport accessible development, and integrating land use and transport within the Greater Metropolitan Region, and the overall philosophy of reducing car dependency.

Graphical representations of the regional and local context of the development adapted from current planning and transport strategies indicate the strategic fit of the site. On site initiatives are also discussed and illustrated to demonstrate the likely provision for and encouragement of transport alternatives.

Arising from the examination is the development of the local and regional transport links associated with the project

2. Improving Development Practice

2.1 General

Cooperation and integration of transport services are essential to ensure attractive transport alternatives aimed at reducing car dependency. This will require the support of the developer, local councils, state authorities and transport operators to achieve a successful outcome.

The Riverside Development as an example of improved urban development practice will include the following transport initiatives:

- Provision of a pedestrian links catering for movement to and through the site. Possibly also cycle links that may present attractive and real alternatives to using cars for local travel.
- Local buses could use demand responsive and innovative services similar possibly to the "Nepean Nipper" model used in western Sydney, and the Perth CATS, from early in the development cycle to ensure travellers have a viable choice to the private car.
- Provide linkages through the site to external pedestrian and cyclist networks. Linkages may possibly be matched by complimentary facilities developed by Council to complete access to other key sites and activities in the area.

The following pages represent a sample of development practice initiatives that could be an integral part of the Riverside Development. Some will require the cooperation and support of government. Others will require initiation by developer and transport operators.

2.2

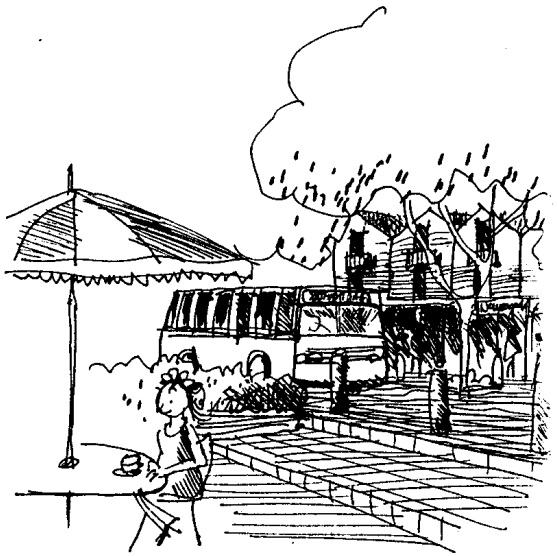
2.2.1 Public Transport Planning

Issues

The planning of public transport services is a matter of operating vehicles on the available infrastructure to meet the requirements of as many users as possible. For rail services, trains are clearly constrained to run where the rails are; the variations are largely limited to frequency, timing and stopping patterns. For road-based services, the flexibility is much greater. This can be a minus as well as a plus, because the complex service patterns that result are not always easy for people to understand.

Principles

- Physical planning should not unduly constrain the public transport operator's power to serve his or her markets.
- Services can and should be tailored to user requirements, which vary not only by area but also by time of day.



2.2.2 Transport Routes

Possible Applications

From the Riverside development perspective, there is some scope for improving infrastructure to support public transport on the road system adjacent to the site.

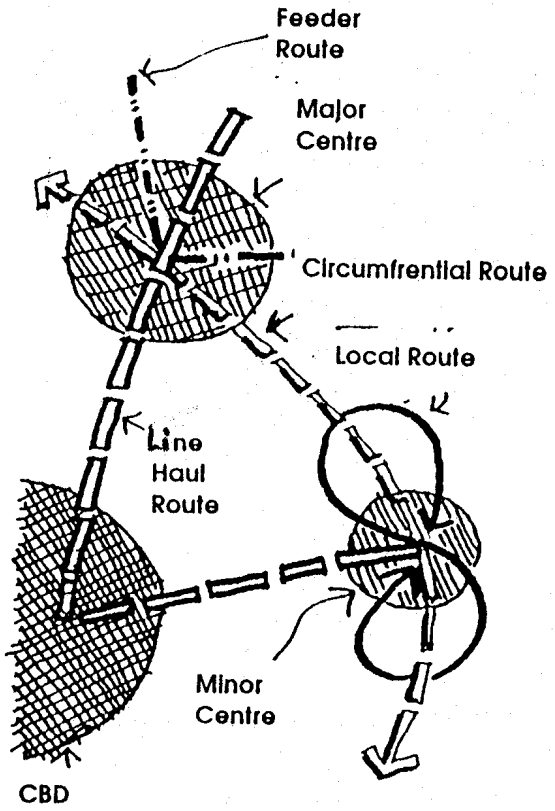
From an operational perspective (by other) there are a wider series of initiatives such as performance based contracts for bus operators that give the operators the freedom to plan their routes provided that the quality criteria specified in the contracts are met or exceeded. The criteria could cover such items as minimum frequencies at different times of day, the minimum proportion of the population to be within reasonable access of bus routes, and maximum fares to be charged. Contracts should not specify routes.

Issues

While some routes are determined by structural corridors (eg. rail lines, or activity corridors along main roads), the planning of the majority of local routes is the prerogative of the operator. Many trade-offs have to be made: between direct routes and routes with large enough catchment; between serving different destinations when demand does not conveniently fall in linear corridors; and between flexibility and "presence". Demand does not usually remain the same all day and there is no reason why public transport services should; but this makes them harder to understand.

Principles

- Maximise the match between travel needs and vehicles.
- Ideally, plan on the basis of area-specific data about travel; but if this is not available population data from the census can be used within a GIS to assist route planning.
- It is not enough to make sure people are within reach of a bus route; the bus must take them somewhere they want to go.



2.2.3 Demand Responsiveness

Possible Applications

The nature of routes will depend on the demand patterns involved. Solutions available include various combinations of line-haul service (to get between two points of demand concentration as quickly as possible), feeder services (to collect and distribute demand over low-density areas and other varieties of local service). Networks can be built up from routes as grids, “hub and spoke” arrangements, figure of eight or whatever configuration local circumstance demands.

The Riverside development is well located adjacent to a new shopping centre and it represents a clear focus for the local area as a transport node. It will be best served by pedestrian routes connecting to Myall Street which performs as the arterial corridor and “Line Haul” Route to other activity centres such as Raymond Terrace and Newcastle.

Issues

The big attraction of the car (if you have access to one) is that it is always there, ready to go anywhere. The principal merit of public transport is its ability to group people in various ways and provide a relatively low-cost common means of transport for the group. The increasing complexity and fragmentation of human behaviour in urban areas poses a challenge for public transport to respond to. Greater responsiveness to personal needs is required in future. This calls for a sharpening of the skills and techniques used by service planners.

Public Transport access to the wider region is available from the nearby Newcastle Station and bus interchange.

2.2.4 Information Systems

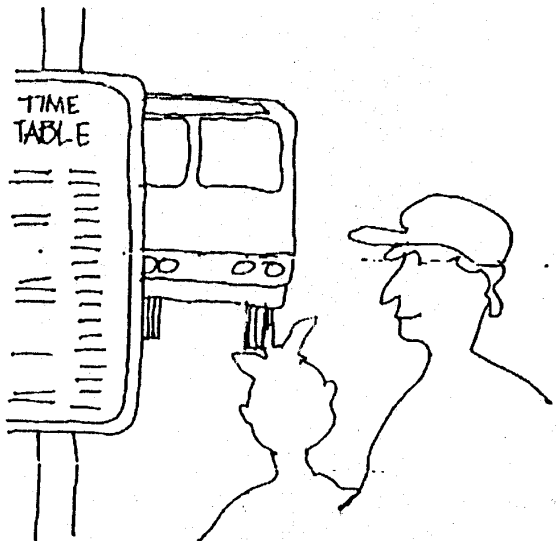
General Applications

- Melding of various communications and control technologies to create “Personal Public Transport” systems, and affordable personalised transit services, has been promoted and feasibility studies are underway in several Australian locations. The control technology already exists within courier and taxi operations, but not in the public communications infrastructure.
- The sharing of taxis in various ways offers more immediate possibilities, where regulations permit.
- “Hail and Ride” services, where buses pick up and set down wherever it is safe to do so rather than at designated stops, is another step towards greater flexibility in meeting user requirements.

Issues

Operating in a way which takes advantage of strategies, maintains the system and, where appropriate, upgrades it is the best way to maximise the benefits of good design and provides a return on substantial capital expenditure.

A reliable and easily understood information system is essential to encourage new users of public transport.



General Applications

- Information must be understandable, many people cannot read timetables. A portion of the population will not be functionally literate, or may not be able to read English.
- Reassurance is important. Reliance on out-of-date information is a common fear. Regular updating even without change to provide higher perception of accuracy.
- Information channels can be used for promotion as well as description of services.
- Addition of premium services at higher rates may be an option, where market opportunities exist.
- Dismantling the traditional barriers between modes, for instance buses and taxis, may lead to a more flexible system, as has happened in other Australian centres.

2.2.5 Monitoring of Transport Demand Patterns

Issues

Two major elements are monitoring user friendliness and transit accessibility performance.

Increasing public transport mode split is often used as a measure of success. However, this does not assess aspects such as private car occupancy for attraction of walk/cycle trips to public transport.

Walking is the more environmentally friendly means of mobility. The greater the proportion of trips that can be undertaken on foot and the more enjoyable the non-motorised and multi-mode trips, the better the opportunity to minimise car dependency.

Possible Applications

Conventional monitoring mechanisms applicable to achievement of better transport accessibility performance could include:

- Increase in proportion of journeys taken by public transport.
- Improvement in **trip quality** on public transport (reduction in waiting and travel times, enhanced travel comfort). This may be measured by user interviews as well as by quantitative service levels.
- Improvements in **trip quality** for non-motorised modes. This may be measured by increase in trips undertaken by non-motorised modes as well as by levels of satisfaction expressed in user interviews.
- Improvement in **quality of place** of transport waiting areas and centres. This may be measured by pedestrian counts as well as by levels of satisfaction expressed through interviews.

The results of these monitoring activities could be fed into an ongoing review of development guidelines to refine the provisions making them both more user friendly and more effective in providing alternatives to car dependency.

2.3 Cycling

2.3.1 Cycle Planning

Issues

Cycling greatly enhances individual mobility and improves personal accessibility. Speeds of 12 - 18 kph are usually achievable without difficulty. Trip lengths may be up to 20 km but are typically short (less than 5 km).

There are no significant adverse environmental effects to bicycle trips. (Cars used for short trips produce high emissions relative to distance).

The costs to the community of providing supporting infrastructure are low.

By involving exercise, cycling brings health and well-being benefits to the user.

Principles

- Recognise that cycling is an important means of transport, not only a recreational activity.
- Accept that cyclists enjoy the same rights and responsibilities as other road users. Traffic should be managed so that these rights can be exercised without undue obstruction of motorists by cyclists and undue endangering of cyclists by motorists.

- Plan and design streets to recognise the needs of cyclists (in general it is neither practical nor desirable to provide fully segregated cycle facilities on the majority of streets).

Possible Applications

Ideally local development of cycling habits will be governed by an Area Bike Plan. This requires the commitment of the local Council, and will integrate four types of approach known colloquially as the "4 E'S".

- **Engineering** works are needed to ensure that on road cycling is safe and where appropriate to provide off-road facilities.

- **Education** is an important component in relation to bicycle safety, particularly for school children.

- **Enforcement** of lawful cycling behaviour by local government and police is necessary to support the Plan.

- Pro-active **Encouragement**, principally within the domain of local government, helps to promote bicycle as a legitimate road vehicle.

The Riverside Development provides a good level of cycling infrastructure, with the potential to be integrated into Council's overall bicycle planning.

2.3.2 Cycle Routes

Issues

While most roads are legally accessible to cyclists, those that will be most favoured for cycle travel will be those which offer both direct routes to significant destinations and safe conditions. It will rarely be possible (or appropriate) to embed a network of direct, dedicated cycle routes between the links of the road network since the roads will in general offer the shortest ways. Child cyclists are a special case, for whom the appropriateness of on-road routes does not apply.

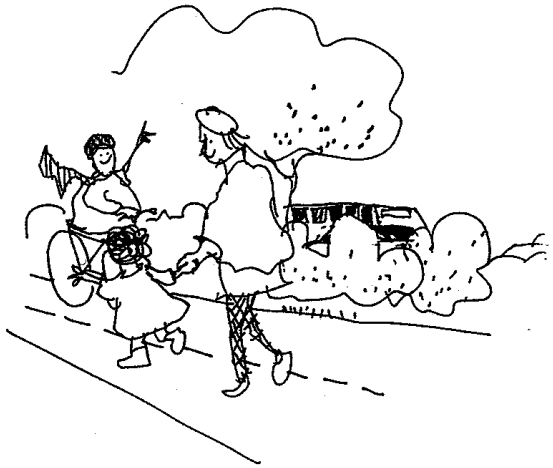
Key Points

1. Cycling needs cannot be met by either a totally off-road system or a totalling on-road system.

2. Cycle routes need to be direct.

3. Cyclists need a smooth surface.

4. Conflict between cyclists and motorist obstructs the motorist and endangers the cyclist.



The development of a comprehensive cycleway system that will link villages and neighbourhoods within our city

Principles

- Cycle routes should correspond to the main transport desire lines.
- Off-road links may be integrated with on-road routes where they improve directness.
- Roads favoured for cycle routes should allow cyclists to travel without unduly obstructing traffic.
- Permeability of local areas to cyclists can be enhanced by allowing shared use of short pedestrian links between streets.
- The planning and design of roads and streets must recognise the needs of cyclists, particularly where there is no alternative to cyclists riding in busy traffic.
- Riding surfaces should be smooth and clean, with widened kerb side lanes where appropriate.
- Clear channels for motor vehicles and bicycles should be provided at intersections.
- Short off-road sections to provide shortcuts or avoid hills are appropriate.

The above principles can be integrated into the Riverside Development.

2.3.3 Cycle Storage

Issues

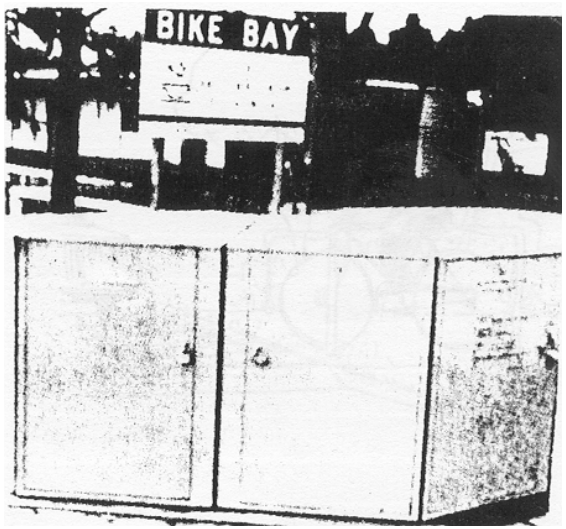
A bicycle is very vulnerable to theft - either of the machine itself or of attachments to it. A resting bicycle cannot be used for storing things the way a car can.

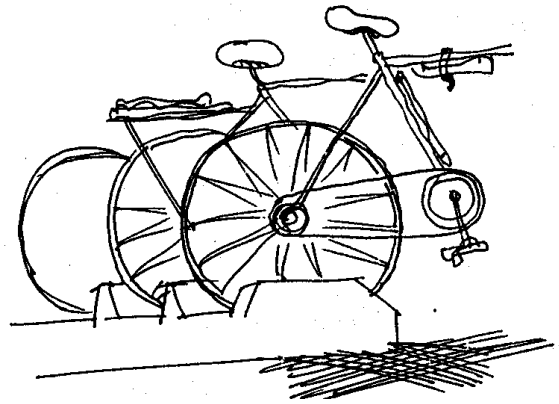
The minimum requirement for security is an immovable object to which the cycle itself can be secured. Where the machine will be left unsupervised for any length of time enclosed storage will be preferred by cyclists to protect pumps, helmets and other property. Cycle lockers are now being introduced at key transport nodes across the GMR.

These are some examples of bicycle storage facilities convenient to transport modes such as installed at Meadowbank in Sydney. Positive promotion, education and perhaps design refinements are needed to encourage effective use.

Key Points

- Storage is needed for accessories (eg. Helmets) as well as bicycles.
- Cycle storage should always be provided where car parking is provided.





2.3.4 Encouragement of Cycling

Principles

At destinations it is important for cyclists to be able to secure not only bicycles but also bicycle accessories.

Dedicated bicycle storage not only helps cyclists but reduce the tendency to inappropriately secure bikes to street furniture.

Where there is no charge for use of car parking, the non-provision of cycle parking discriminates against cycling. An initial modest amount of space can be increased over time if and when cycle use increases.

Possible Applications

Cycle storage is ideally placed undercover in well-lit easily visible areas in major public areas eg. Interchanges - checked bicycles could be controlled similarly to checked luggage.

A variety of storage structures are available for example steel-U-frames or lockers. In countries with high bicycle use, high capacity storage systems can be found.

Security at public transport interchanges is particularly critical as the very presence of the bike advertises that the owner is likely to be absent for a significant time.

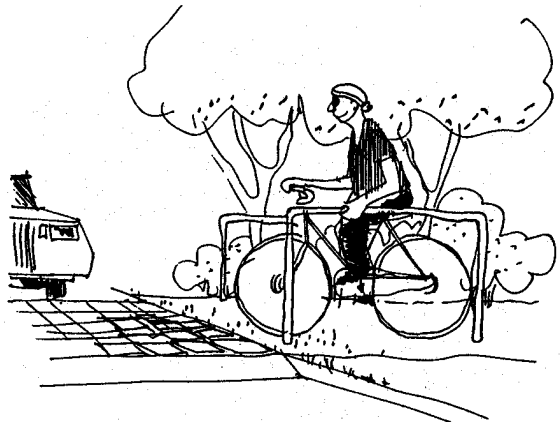
Issues

Barriers to greater use of cycles in urban areas include dangers from traffic or poor road design/condition, low load-carrying capacity, the deterrent effect of bad weather or darkness, hilliness, cycle maintenance impediments, personal hygiene implications, dress constraints and sometimes incompatibility with self-image. Physical planning alone cannot overcome these barriers. The appropriate mixture of measures will vary from area to area. One of the functions of an Area Bike Plan is to identify local priorities and develop the mixture accordingly.

A good litmus test of the cycle-friendliness of an area is the proportion of females in the cycling population. Where cycling is perceived as a hazardous activity, it will be largely the domain of young males. Failure to address cycling safety, the biggest barrier to use, or failure to provide adequate shower and changing facilities at destinations could also be regarded as discrimination against this mode.

Key Points

- Many types of facilities and activities can encourage cycling.



- The number of female cyclists tends to be more affected by cycle friendliness than that of males

Principles

- A holistic approach to cycling is required, because of the non-physical nature of many of the constraints.

- The nature and magnitude of barriers will vary from area to area and therefore local circumstances must be considered when developing strategies.

Possible Applications

A wide range of possible measures include:

- Incentives for developers to include shower rooms/lockers in commercial buildings housing significant employment.

- Short term bicycle maintenance campaigns part-funded from local/public funds.

- Promotion of fitness and appearance benefits to cyclists.

- Proficiency schemes aimed at specific groups, including middle-aged adults.

2.3.5 Cycle Planning for Schools

Issues

It is desirable to reduce motorised journeys to school where possible. Car trips require not only a vehicle on the road contributing to peak congestion and emissions (short journeys contribute a disproportionate amount of pollution), but also an adult driver who may have no role other than chauffeur. Public transport to school is dominated by bus services. These cater for two intensive travel peaks per day, one of which coincides with the peak for travel to work. School bus trips are expensive for the community to provide and limit the ability of the transport operator to provide services for other market segments. For some people, aversion to public transport in later life may stem from experiences in crowded transport to and from school. It is natural that children's social networks develop centred on schools. Non-school car journeys by children (and hence adults) can be reduced if friends living beyond walking distance can be safely and independently reached out of school hours.

Segregated cycle networks giving safe access to schools potentially bring broad transport benefits.

Principles

- The segregation of school cycle paths is highly desirable as many parents would not give their children "licence" to cycle to and from school in traffic.

- Segregated cycle networks give access to schools (especially secondary schools whose catchment areas are relatively large) for older children. This should reduce the motorised transport mode's share of journeys to and from school.

Possible Applications

- Out of school hours, segregated cycle networks centred on schools allow some substitution of chauffeured car travel by providing independent mobility for children's social trips.

- Such networks would also encourage adult use of cycling for local trips for those apprehensive about traffic.

- Extension of such cycle paths to recreational areas will further encourage adult use.

2.4 Walkability and Pedestrian Movement

2.4.1 Pedestrian Planning

Issues

Good pedestrian planning is crucial to the concept of reduced car dependence. "Walkable" towns, neighbourhoods and developments are ones where people **choose** to walk. Safe, short walking routes take people directly to where they wish to go, including the public transport stops.

Key Points

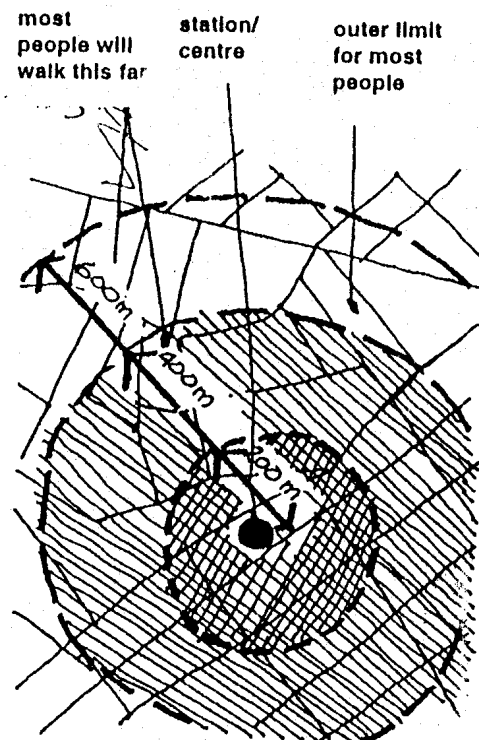
- Services should be close to housing.

- 400m is at the upper limits of walking for many people.

Principles

- Locate as many services, including public transport stops, as close as possible to housing.

- Areas closest to services should contain higher density housing to maximise the number of people who have proximity.



- Walkable distance is not exact. Different people can walk different distances in 5 minutes. In particular, locate homes for the elderly - many of whom have neither access to a car nor the ability to walk far - close to services.

- Proximity is a measure of actual distance that needs to be walked and will not necessarily be a straight line.

Possible Applications

A common Australian measure of walkable distance is 400m. If the other techniques under this section are applied, this is probably reasonable. Otherwise it is optimistic and certainly 400m is the outer limit for many people to carry heavy parcels.

2.4.2 Connectivity/Permeability

Issues

People are more likely to choose to walk if the route goes **directly** to where they wish to go.

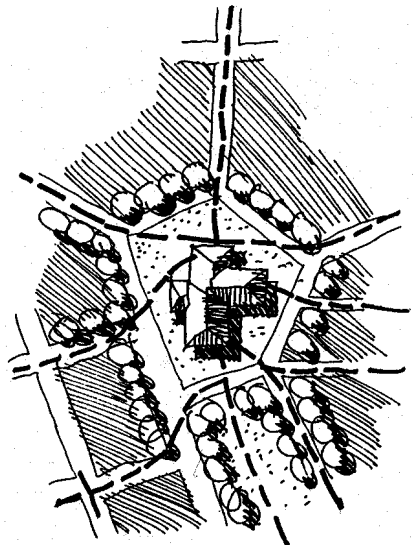
Principles

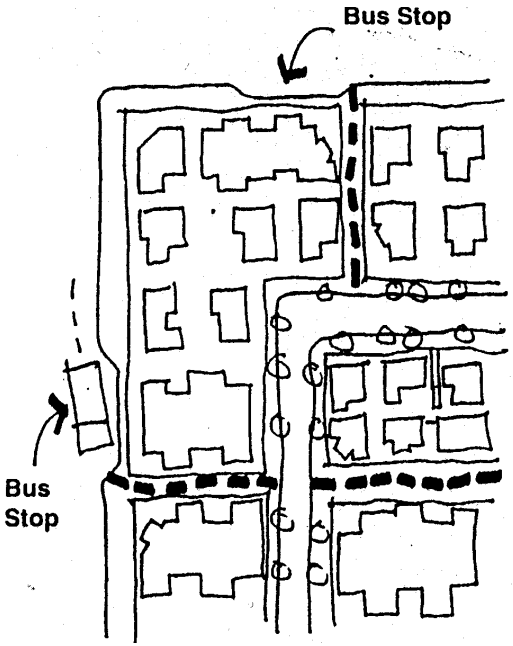
- Try to cater directly for straight-line movement between origins and planes of interest within the design where possible.

- Provide continuous pedestrian routes; avoid dead-ends.

- In intense areas such as centres, provide a "fine grain" or scale of connections so that there are many ways to get through the area.

- Ensure that barriers such as creeks or freeways are crossed at reasonable frequency and that pedestrian access patterns focus naturally on these crossing points.





- Pedestrian connections can be created more frequently than vehicle connections. If it is apparent to drivers that walking to local services is more direct than driving they may be tempted out of the car. In residential areas, however, separation of pedestrian and vehicle routes is generally inappropriate. Vehicle routes can provide more activity, interest and surveillance provided traffic behaviour is "calmed".

Possible Applications

Examples include:

- Measure how many people within say, 400m of a centre are actually within 400m walk. The percentage who are not, gives an index of how "impermeable" the area is. This will then indicate how effective creating new links will be.

- Street layout which allow pedestrian connection, whether or not they allow vehicle connection. See illustration for example.

2.4.3 Surveillance and Activity

Issues

People are more likely to choose to walk or let their children walk if the available routes are perceived as being interesting and safe. It has been shown that, if a route is overlooked by houses or shops, those occupants are more likely to have a sense of ownership of the space and to take responsibility for it. Perceptions (and the reality) of "stranger danger" are thus much reduced. These principles have been articulated in a number of "safety audits" in Australia in recent times. Meanwhile, many surveys show residents "fear" their streets as alien places, even if they are beautiful or superficially attractive.

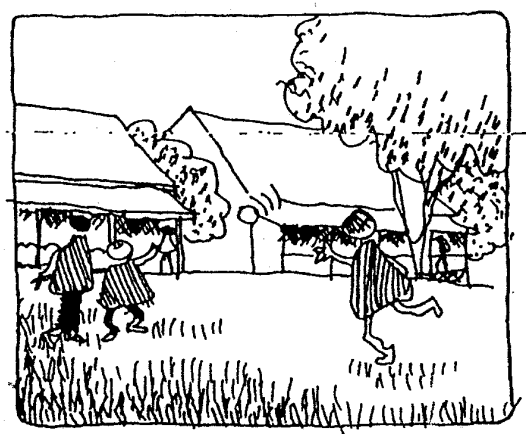
Key Points

- Perceptions of personal safety encourage walking and cycling.

- Active frontage of land uses adjoining footpaths increases the perception of personal safety.

Principles

- Pedestrian routes should, wherever possible, link and pass through locations of more intense activity.



- All pedestrian routes should be adequately lit.

- In low intensity areas particularly, vehicles in a street also provide another level of activity and surveillance and therefore separation of pedestrian and vehicle routes should generally be avoided.

- Where pedestrian links are adjacent to non-vehicular facades of houses or other activities, these activities should be designed so that they "face or address" the pedestrian area.

Possible Applications

- Pedestrian routes which pass along the **active fronts** of adjoining uses such as shopfronts, front doors and living/kitchen windows of houses. This often, but not always, means coinciding with vehicular streets.

- Parks that are overlooked by houses (see illustration), provided that the house is designed to be oriented to the park eg. Requiring central living area windows to face the park.

2.4.4 Vehicle Safety

Issues

Conflict between vehicles and pedestrians "favours" the vehicle; the pedestrian comes off worse. In residential streets children are particularly vulnerable. Busier vehicle routes become barriers to pedestrian movement. Walkability cannot be said to exist unless these conflicts and barriers are reduced to the point where people can make rational and confident decisions, for themselves or their children, to walk to where they wish to go.

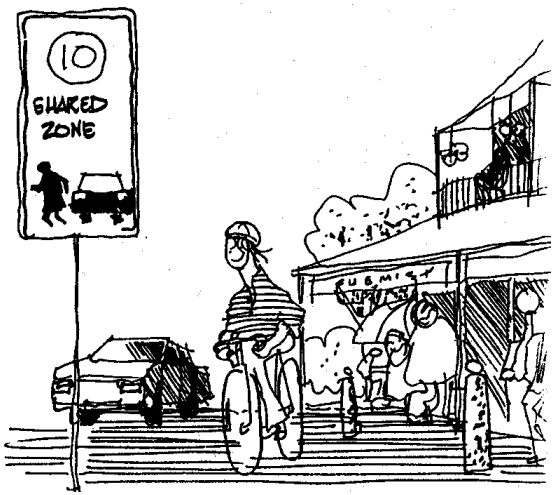
Principles

- Pedestrians can use the same space as vehicles when speeds and volumes to a lesser extent, are very low.

- Pedestrians can share (eg. on adjoining footpath) street space with vehicles where vehicle speed and volume is reasonably low.

- On all streets carrying less than 3,000 vpd, it should be assumed that people will cross at any point.

- On higher volume roads, crossing opportunities will need to be concentrated and catered for.



- In summary, the local street system should be treated so that it serves pedestrian, cyclists, and cars, not cars exclusively.

Possible Applications

- Legislation for shared spaces based on the Dutch Woonerf allows highly active, short central area streets to be “shared” between pedestrian and vehicle with maximum speed 10kph. This has been applied now at locations in NSW, Victoria and Queensland.

- There are many good examples of traffic calming to keep vehicle speed below 40-50 kph and volumes below 2,000 vpd. Increasingly, new areas have these characteristics designed in. AMCORD (The Australian Model Code of Residential Development), and other manuals provide advice on how to achieve this.

2.5 Road Management

2.5.1 Road and Street Design and Hierarchy

Issues

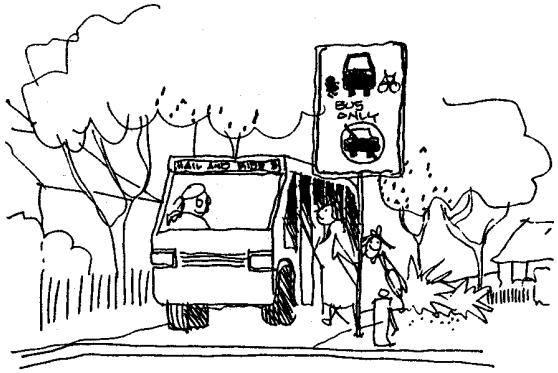
The road or street has more functions than to carry vehicles. In general three types of street environment exist. At one extreme, the vehicle function is dominant - typically, on arterial roads with major through-traffic. But even when dominant, it is not the only function (freeways excepted). For the “lower order” streets in centres or housing areas, the on-street activity is most important, and the third environment is in between, where both functions must be satisfied - typically main streets in rural towns or sub-arterial urban roads.

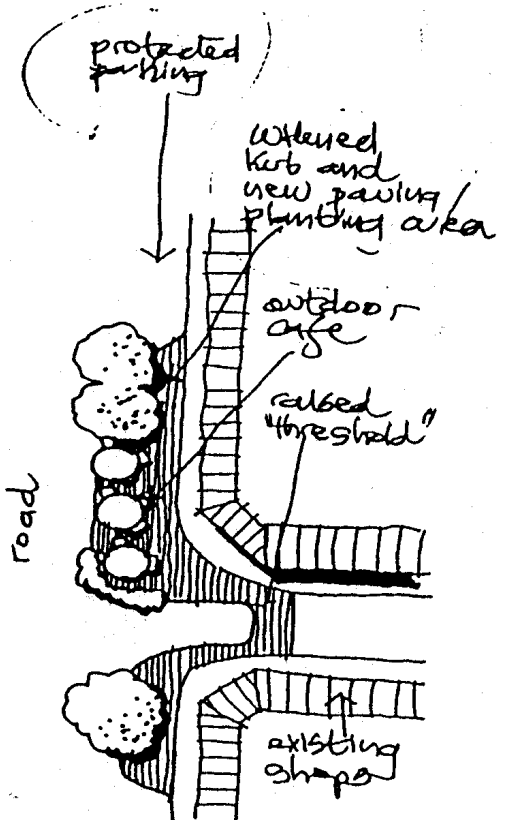
Principles

- Streets to offer a connected network for pedestrian, cyclists, and public transport.

- Provide “calm traffic” conditions on the street network in centres and residential areas.

- The measures needed to make streets safe for drivers also tend to make them boring for pedestrians - or conversely stimulating pedestrian environments require more care to traverse by car.





- Roads that carry public transport must ensure that all stops are easily accessible on foot from both sides of the road.

- Traffic engineering should have all uses in mind. Vehicle "slip lanes" (eg. Turn left at any time") can, for example undermine pedestrian crossing opportunities.

Possible Applications

- A number of detailed guides to suitable traffic engineering practice exist, for instance "Queensland Streets" (IMEAQ), "Towards Traffic Calming (FORS/WSROC) and
"Sharing the Main Street" (RTA/FORS).

- Raised platforms for pedestrian crossings of streets have been found to reduce accidents by about 90 percent. Pedestrian refuges, in general, do not reduce pedestrian accidents, although they are more effective on wider or busier roads.

- By opening the ends of the dead-end streets" with pedestrian or cycle links or bus-only connections, overall accessibility is much improved.

2.5.2 Road Demand Management

Issues

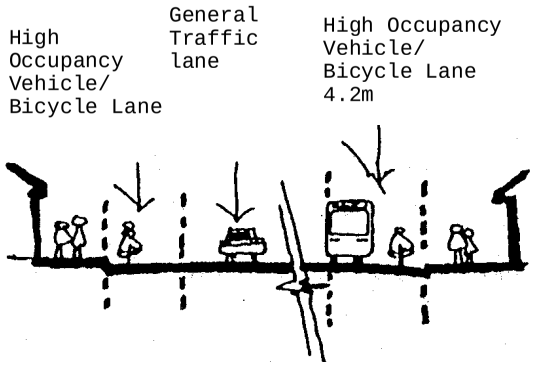
"Demand management" is not a new idea. In the past, travel demand has been managed in a way which favours the use of private motor vehicles over all other means of transport. Changes in demand management are sometimes described as the "carrot and stick" approach to reducing car dominance. This paper suggests some "carrots" which can be offered through design measures.

A basic aim is to ensure that walking, cycling and public transport appear as attractive as possible both in their own right and, where appropriate, relative to private transport.

Principles

- Judge the efficiency and effectiveness of transport infrastructure by how it moves people or goods, not how it moves vehicles.

- Ensure that any advantages through infrastructure design that one transport mode may enjoy are provided by intention rather than default. (The default option invariably favours the motor car).



Capacity constraint to low capacity vehicle, may be provided by inclusion of HOV and bicycle lanes on arterial roads

Possible Applications

- Road corridors experiencing high traffic volumes should be regarded first as demand corridors rather than traffic corridors. The most appropriate mix of transport will then depend on the mix of demand. How much power and mass does it take to move one human being? Once certain styles of transport come to prevail individual cars of high horse power and heavy mass create a traffic context in which alternative softer means of movement are less feasible and less safe.

- A variety of physical road treatments are possible. Reductions in speed limits on minor roads will increase the safety and feasibility of alternative modes, but only if they are accepted as appropriate by the community and obeyed.

Volume 3B: Bushfire Protection Assessment

BUSHFIRE PROTECTION ASSESSMENT REPORT

RIVERSIDE
TEA GARDENS

AUGUST 2008
(REF: 8020BF)

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BUSHFIRE PROTECTION ASSESSMENT REPORT

RIVERSIDE
TEA GARDENS

AUGUST 2008

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PREFACE

A Bushfire Protection Assessment Report has been prepared by *Conacher Environmental Group* at the request of Crighton Properties for the proposed development at Myall Road, Tea Gardens.

This report provides an assessment of the bushfire protection measures required for the development to guard against the potential impact of bushfires. Recommendations have been made in respect to fuel management, construction standards / building protection, access, bushfire education and land ownership responsibility.

PROJECT TEAM

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TABLE OF CONTENTS

SECTION 1 INTRODUCTION 1
1.1 AIMS OF THE ASSESSMENT 1
1.2 PLANNING RELATIONSHIPS 1
1.3 INFORMATION COLLATION 2
1.4 PROJECT SYNOPSIS 2
1.5 SITE DESCRIPTION 3

SECTION 2 BUSHFIRE THREAT AND PROTECTION ASSESSMENT 4
2.1 BUSHFIRE ATTACK ASSESSMENT 4

SECTION 3 SPECIFIC PROTECTION ISSUES 6
3.1 ASSET PROTECTION ZONES 6
3.2 BUILDING PROTECTION 6
3.3 HAZARD MANAGEMENT 7
3.4 EVACUATION SAFETY 7
3.5 AVAILABILITY OF FIRE FIGHTING SERVICES 7
3.6 ACCESS FOR FIRE FIGHTING OPERATIONS 7
3.7 WATER SUPPLIES 7
3.8 COMMUNICATIONS 8

SECTION 4 CONCLUSION AND RECOMMENDATIONS 9
4.1 CONCLUSION 9
4.2 RECOMMENDATIONS 9

REFERENCES 10

SECTION 1

INTRODUCTION

1.1 AIMS OF THE ASSESSMENT

Conacher Environmental Group has been engaged by Crighton Properties to provide a Bushfire Protection Assessment for the proposed residential subdivision of land at Myall Road, Tea Gardens.

The aims of the bushfire protection assessment are to:

- Review the bushfire threat to the property
- Review the capability of the property to provide a safe development
- Review the potential to carry out hazard management over the landscape
- Provide advice on mitigation measures including the provision of asset protection zones and construction standards in accordance with '*Planning for Bushfire Protection, 2006*'
- Advise on specific fire management issues

1.2 PLANNING RELATIONSHIPS

This report has been prepared having regard to the following legislative and planning requirements.

1.2.1 Legislation

As the development is to be assessed under the provisions of Part 3A of the *Environmental Planning and Assessment Act, 1979* by the *Department of Planning* the development and this report is therefore not subject to assessment under the provisions of Section 100B of the Rural Fires Act in this case.

Management of hazardous fuels is required to be undertaken in accordance with the *Rural Fires Act, 1997* - Sections 63 (2). This requires owners or occupiers to take all practicable steps to prevent the occurrence of bushfires on, and to minimise the danger of the spread of bushfires.

Construction of buildings in a bushfire prone area is assessed under the *Environmental Planning and Assessment Act, 1979* - Section 79 BA. This requires Councils to be satisfied that developments in bushfire prone areas comply with *Planning for Bushfire Protection, 2006* before granting development consent.

1.2.2 Planning Policies

Planning for Bushfire Protection – 2006 (PBP 2006) – This document was prepared by the Rural Fire Service and provides planning controls and bushfire protection guidance for development within a designated bushfire prone area.

1.3 INFORMATION COLLATION

To achieve the aims of this report, a review of the information relevant to the property was undertaken prior to the initiation of field surveys.

Information sources reviewed include the following:

- Proposed development plan prepared by Crighton Properties
- Port Stephens 1:25,000 Topographic Map (9332-4S, second edition).
- DLWC 1:25,000 Port Stephens Aerial Photograph
- Planning for Bushfire Protection 2006'.
- Australian Standard 3959 'Construction of Buildings in Bush Fire Prone Areas'

An inspection of the proposed development site and surrounds was undertaken to assess the topography, slopes, aspect, drainage, vegetation and adjoining land uses. The identification of existing bush fire protection advantages and a visual appraisal of bush fire hazard and risk were also undertaken. (Bush fire protection advantages are those landscape features which act to suppress or mitigate a fire e.g. escarpments, creeks, roads and fire breaks etc).

1.4 PROJECT SYNOPSIS

It is proposed to develop the subject site at Myall Road, Tea Gardens for residential and tourist development.

The proposed development is for a mixed use commercial and residential development. According to the Concept Masterplan the proposal will include the following:

- Residential lot development totalling 1045 lots over 3 precincts to be developed as Community Title,
- The 1045 residential lot development includes 108 home based business dwellings,
- The 1045 residential lot development includes a tourist precinct of 50 tourist lodges and 15 townhouses,
- Wildlife movement corridors
- Water management corridors
- Open space corridors
- Lake areas for water quality management
- Public Reserve areas
- Community park incorporating walking trails, gazebo and other facilities

The proposed tourist development is classified as a Special Fire Protection Purpose development for bushfire hazard assessment purposes as identified in '*Planning for Bushfire Protection, 2006*' (RFS 2006).

The proposed residential subdivision will connect with adjacent existing residential areas. The subject site does not contain any existing dwellings or structures that would require removal as a part of the future development of the site.

1.5 SITE DESCRIPTION

Location and Surrounding Land Use

The subject site is situated to the east of Myall Road and South of Toonang Drive with approximately 1.2 kilometre frontage along Myall Road. The site will link an existing rural residential settlement to the north with Leeward Circuit and Shoreline Drive in the south. The Myall River forms the eastern boundary to the subject site.

The subject site covers approximately 220 hectares and will be subdivided into residential urban lots, with some areas of the site developed as an eco-style tourist resort.

Topography and Drainage

The proposed development is located on flat land to the west of the Myall River. Drainage lines flow from the north into the subject site in a general southerly direction towards the river. An artificial lake on the southern boundary will be extended partly into the development. This lake is connected to the Myall River and is subject to regular tidal movements.

The land rises towards the existing rural residential settlement in the north. This forms the highest point in the area with the remainder of the site having slopes of less than five degrees.

Vegetation

The majority of the proposed development site consists of cleared pastureland with scattered trees. To the north and north-west is dry sclerophyll forest which extends along the northern hill slope. Forested Wetlands and Saltmarsh (saline wetland) are located to the east within land zoned for conservation which acts as a buffer to the SEPP14 wetlands. Saltmarsh is present to the south-east of the site.

Managed vegetation will remain within the residual areas in the form of grassed drainage reserves with scattered trees. Vegetation will be retained within the conservation zoned land and SEPP14 wetland to the east. A Wildlife Corridor is to be retained in the central to north-east part of the site linking the Open Forest of the northern slopes with the Forested Wetlands and Saltmarsh/Rushland areas adjoining the Myall River.

Bushfire Categories

The subject site is mapped as Bushfire Prone Land as identified in the Great Lakes Council Bushfire Prone Land Mapping. The site is within the North Coast areas categorised as having a Forest Fire Danger Index (FDI) of 80. Therefore Table A3.4 of *'Planning for Bushfire Protection, 2006'* is the appropriate table to use for determining the category of bushfire attack and appropriate asset protection zones.

SECTION 2

BUSHFIRE THREAT AND PROTECTION ASSESSMENT

2.1 BUSHFIRE ATTACK ASSESSMENT

'*Planning for Bushfire Protection'* (Rural Fire Service, 2006) provides concepts for building in bushfire prone areas and guidance on the planning and development control processes in relation to bushfire protection measures. This document also provides a methodology for determining asset protection zones. Tables 1 & 2 provide a summary of this assessment.

'*Planning for Bushfire Protection 2006'* also provides a methodology for assessing bushfire attack at construction stage for a building within a designated bushfire prone area. This identifies the 'Construction Level' required for a site and relates to AS3959.

Tables 1 & 2 provide a summary of Bushfire Attack and the construction standards required for both residential dwellings and tourist units.

Table 1
Bushfire Attack and APZ requirements for Residential Development

Direction	Vegetation within 140m	Effective Slope Gradient	Minimum APZ (m) (Table A2.5)	Bushfire Attack APZ Range (m) Construction Standard (Table A3.4)		
				Level 3 (High)	Level 2 (Medium)	Level 1 (Low)
North west	Pasture Managed Grassland	0-5 ^{U}	No requirement	-	-	-
North-west	Dry Sclerophyll Forest	0-5 ^{U}	20	17-25	25-35	35-100
North to North-east	Dry Sclerophyll Forest	0-5 ^{U}	20	17-25	25-35	35-100
East	Forested Wetlands	0-5 ^{D}	20	17-24	24-34	34-100
South to South-east	Saline Wetlands	0-5 ^{D}	No requirement	-	-	-
South	Residential	0-5 ^{D}	No requirement	-	-	-
West	Pasture Industrial	0-5 ^{D}	No requirement	-	-	-

*Construction Standard AS 3959
^{U} = Upslope
^{D} = Downslope

Table 2 Bushfire Attack Assessment Tourist Units (Special Fire Protection Purposes)			
Direction	**Vegetation within 140m of Development**	**Effective Slope Gradient**	**APZ (m)required**
North to North-east	Managed Lands/ Residential development	0-5 ^{U}	Nil
East	Saline Wetlands	0-5 ^{D}	Nil
South	Forested Wetlands	0-5 ^{D}	60 metres*
North-west	Forest	0-5 ^{U}	60 metres*
West	Managed Lands/ Residential development	0-5 ^{U}	Nil

*24m APZ required for residential dwellings (Level 2) if constructed within APZ for Special Fire Protection Purposes)

SECTION 3

SPECIFIC PROTECTION ISSUES

3.1 ASSET PROTECTION ZONES

For Residential Dwellings

'*Planning for Bushfire Protection, 2006'* provides a methodology for determining the setback requirements (asset protection zones) and construction standards for habitable buildings in special protection developments that are located within a designated bushfire prone area. The following recommendations are provided in direct accordance with *'Planning for Bushfire Protection, 2006'*.

For the proposed development, an asset protection zone (APZ) is not required to the residential land to the south. No APZ is required for the grassland and offsite industrial areas to the west. A minimum APZ of 25 metres (Level 2 Construction Standard) is required to the Forest to the northwest, north and northeast. An APZ of 24 metres is required to the Forested Wetland vegetation to the east while no APZ is required to the Saline Wetlands to the south-south east.

Asset protection zones to the proposed residential dwellings are able to be provided in accordance with or greater than the requirements of '*Planning for Bushfire Protection, 2006*'. The above APZ widths are based on a Level 2 Construction Standard (AS3959).

For Tourist Development

Class 9 structures as defined by the Building Code of Australia and Special Fire Purpose Protection buildings as defined by the RFS are required to be provided with asset protection zones in accordance with Table A2.6 of *PBP 2006.* In this case the maximum heat flux of 10 K/W m can be accommodated by providing APZ's of 60 metres from the forest vegetation in the north west and 60 metres to the Forested Wetlands in the south.

3.2 BUILDING PROTECTION

For Residential Dwellings

The Bushfire Attack Assessment (Table 1) identifies that the north-west, north to north-east and east present a theoretical medium to low level of threat of bushfire attack to the proposed residential areas. The south and west will not be exposed to a level of bushfire attack due to the presence of residential and industrial areas in these locations.

In accordance with the provisions of *'Planning for Bushfire Protection, 2006'* the future residential development should be constructed to a Level 1 or 2 construction standard to protect against the level of bushfire attack depending on the width of the APZ utilized. This arrangement is in compliance with *'Planning for Bushfire Protection, 2006'* in respect of building construction standards.

For Tourist Development

The Bushfire Attack Assessment (Table 2) identifies that the predominant bushfire risk is from the Forested slopes of the south west and west and Forested Wetlands to the south.

3.3 HAZARD MANAGEMENT

The managers/owners the lot/s will have an ongoing liability to ensure the management of the Asset Protection Zones within the property to prevent the build up of combustible fuel.

Section 63(2) of the *Rural Fires Act* requires that '*it is the duty of the owner or occupier (including Councils) of land to take the notified steps (if any) and any other practicable steps to prevent the occurrence of fires on, and to minimise the danger of the spread of fires on or from that land*'.

There is no physical reason that should constrain hazard management in any potential asset protection zone from being successfully carried out by normal means e.g. landscaping / mowing / slashing following initial clearing works.

3.4 EVACUATION SAFETY

Evacuation from the proposed development is possible during a bushfire event via multiple direct and indirect routes to Myall Road. From Myall Road safe egress can then be obtained in a northerly or southerly direction whereby existing residential development and associated clearing provides adequate separation from the surrounding bushfire threats.

3.5 AVAILABILITY OF FIRE FIGHTING SERVICES

There is a Rural Fire Brigade located at Tea Gardens approximately 3km (by road) to the property in a southeasterly direction. Tea Gardens Rural Fire Brigade would have a response time of approximately 10-15 minutes to service the development if they are not assisting elsewhere.

There is an additional Rural Fire Service located at Bulahdelah to the north. The Rural Fire Service would have a response time of approximately 30 - 45 minutes to service the development if they are not assisting elsewhere.

3.6 ACCESS FOR FIRE FIGHTING OPERATIONS

The internal road network of the proposed development will provide adequate access / egress for emergency vehicles. The connection of the internal road network within the proposed subdivision with the existing road networks in adjacent residential settlements will provide adequate access for fire fighting operations and simultaneous egress for residents.

All access requirements are to comply with the provisions of '*Planning for Bushfire Protection, 2006*'.

3.7 WATER SUPPLIES

Town reticulated water supply is available to the proposed residential subdivision, therefore an additional supplementary water supply will not be necessary for fire fighting purposes. A hydrant supply should be installed in accordance with Australian Standard AS2419-1 (1994). Access points for reticulated water supply are to incorporate a ring main system for all internal roads.

AS2419.1 recommends that hydrants be separated by no more than 120 metres (Source AS 2419.1 2005 Appendix B, B2) for residential development.

This water supply arrangement is to be in compliance with 'Planning for Bushfire Protection 2006' in respect of water supply.

3.8 COMMUNICATIONS

Telephone communications will be provided for this development to aid in communications during a bushfire incident.

SECTION 4

CONCLUSION AND RECOMMENDATIONS

4.1 CONCLUSION

The proposed development is classified as residential development within a bushfire prone area and therefore the requirements of 'Planning for Bushfire Protection 2006' apply.

The following recommendations are provided to ensure that the development is safe and in accord or greater than the requirements of 'Planning for Bushfire Protection 2006'.

4.2 RECOMMENDATIONS

Recommendation 1 - The future development should be sited as indicated on Figure 1 'Bushfire Protection Measures'.

Recommendation 2 - Asset protection zones should be provided to the proposed development area and shall be measured from the building line of development. The asset protection zones shall be as nominated in Table 1 and Table 2 and also as depicted in Figure 1.

Recommendation 3 - Fuel management within the asset protection zones should be maintained by regular maintenance in accordance with a site specific fuel management plan as generally described in '*Planning for Bushfire Protection, 2006*' and / or other publications by the RFS.

Recommendation 4 - The application of construction standards of the Australian Standard AS3959 'Construction of Buildings in Bush Fire Prone Areas' should apply to the future development, as detailed in Section 4.2 – Building Protection.

Recommendation 5 - The public roads within the subdivision shall comply with the design criteria required by 'Planning for Bushfire Protection 2006'. With either an eight metre minimum (kerb to kerb) width two-way urban road or a 6.5 metre wide two-way public road with allocated parking bays or turning circles.

Recommendation 6 - A hydrant supply should be installed in accordance with Australian Standard AS2419-1 (1994).

Recommendation 7 – A Bushfire Evacuation Plan should be prepared for the proposed tourist units and Community Title allotments. This Evacuation Plan can be incorporated into the Community Management Statement to be prepared for the proposed development.

REFERENCES

NSW Rural Fire Service (2006)- *'Planning for Bush Fire Protection - A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners*. NSW Rural Fire Service

Walker, J. (1984) Fuel Dynamics in Australian Vegetation. In "Fire and the Australian Biota" Australian Academy of Science.

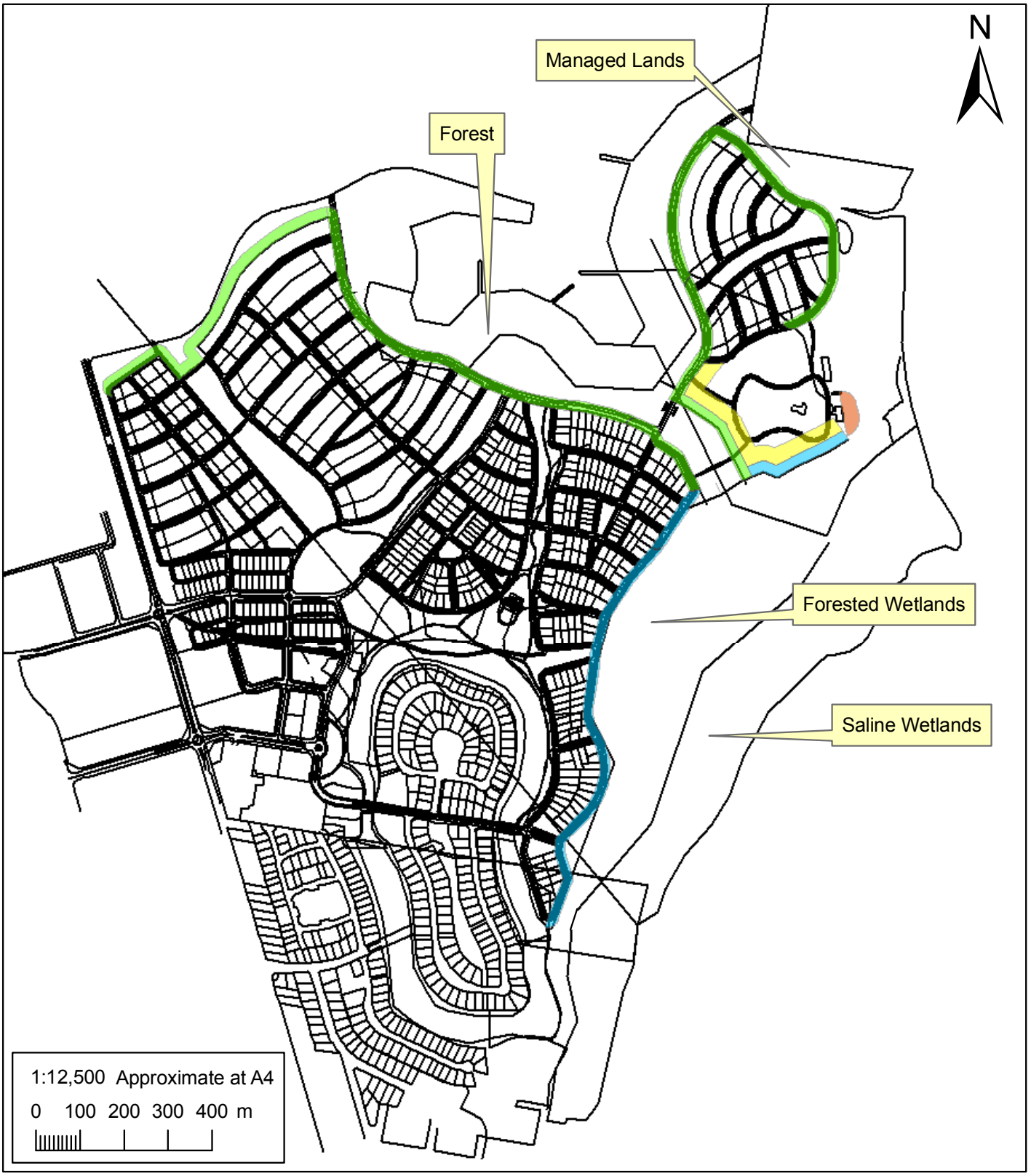
McArthur, (1967). A.G. Leaflet 107 Fire Behaviour in Eucalypt Forest A.G.McArthur, Canberra. Commonwealth of Australia Department of National Development. Forestry and Timber Bureau. (and reprinted later by) CSIRO Div. Forestry - Bush Fire Research Unit.1967.

Australian Building Codes Board (1996) – Building Code of Australia, Class 1 and Class 10 Buildings Housing Provisions Volume 2.

Councils of Standards Australia AS3959 (1999) – Australian Standard Construction of buildings in bush fire-prone areas.

FIGURE 1

PLAN OF BUSHFIRE PROTECTION MEASURES



Original plan produced in A4 colour. Plan for indicative purposes only, not for detailed measurement.
Subject site boundary subject to final survey.

Legend

- 60m Special Protection APZ
- 25m Asset Protection Zone
- 35m Asset Protection Zone
- 24m Asset Protection Zone

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Figure 1
Bushfire Protection Measures
Riverside - Tea Gardens

Ver.F1 By.JM
18/08/08
Ref.No.8020

Source: Aerial © Department of Lands (2007)

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