

**ECOLOGICAL SITE ASSESSMENT INFORMATION
FOR LOCAL ENVIRONMENTAL STUDY**

**“PARKSIDE”
KINGS AVENUE
TERRIGAL**

**DECEMBER 2010
(REF: 10050v1)**

www.cegconsult.com

Suite E, 78 York Street, East Gosford NSW 2250
PO Box 4300, East Gosford NSW 2250

• Ph (02) 4324 7888 • Fax (02) 4324 7899

• Email cegconsult@bigpond.com

ABN 62 274 841 042

**ECOLOGICAL SITE ASSESSMENT INFORMATION
FOR LOCAL ENVIRONMENTAL STUDY**

**“PARKSIDE”
KINGS AVENUE
TERRIGAL**

DECEMBER 2010

Conacher Environmental Group

Environmental and Land Management Consultants

Suite E, 78 York Street, East Gosford NSW 2250
PO Box 4300, East Gosford NSW
Phone: 02 4324 7888 Fax: 02 43247899

This document is copyright ©
Conacher Environmental Group ABN 62 274 841 042

PREFACE

This Ecological Site Assessment has been prepared by *Conacher Environmental Group* to identify the ecological characteristics for land at Kings Avenue, Terrigal. This report will form part of the information required for a Local Environmental Study for land known as "Parkside" at Terrigal. This Local Environmental Study is to be prepared in regard to the Draft Local Environmental Plan for the proposed rezoning of Lot 2 DP 1111392, Lots 8 and 9 DP 876102, Lot 202 DP 831864, Lot 4 DP 37914 and Lot 1 DP 381971 Kings Avenue Terrigal.

The information within this report has been prepared to address the specifications provided by the NSW Department of Planning for completion of a Local Environmental Study. This is to be completed in accordance with Section 57 of the *Environmental Planning and Assessment Act (1979)*.

Surveys and reports completed by:

PHILLIP ANTHONY CONACHER B.Sc. (Hons), Dip.Urb Reg Planning, M.Nat.Res.
NPWS Scientific Licence Number: S10618
Director
Conacher Environmental Group

PAUL GERARD SHELLEY Grad. Cert. Appl Sc. (Ornithology)
NPWS Scientific Licence Number: S10618
Fauna Technician
Conacher Environmental Group

JACOB MANNERS B.Sc.
NPWS Scientific Licence Number: S10618
Ecological Consultant
Conacher Environmental Group

TABLE OF CONTENTS

EXECUTIVE SUMMARY

SECTION 1 INTRODUCTION

1.1	INTRODUCTION.....	1
1.2	SITE DETAILS	1
1.3	DEVELOPMENT AND BIODIVERSITY CONSERVATION PROPOSALS	2
1.4	ADJOINING AREAS RELEVANT TO ECOLOGICAL ISSUES	6

SECTION 2 BIODIVERSITY CHARACTERISTICS OF THE SITE

2.1	FLORA AND FAUNA SURVEY DETAILS	8
2.2	VEGETATION CHARACTERISTICS.....	8
2.3	FAUNA CHARACTERISTICS.....	8
2.4	THREATENED BIODIVERSITY	9
2.5	VEGETATION/HABITAT CONNECTIVITY.....	15
2.6	RIPARIAN AREAS	16

SECTION 3 MATTERS FOR CONSIDERATION & ASSESSMENT

3.1	POTENTIAL ECOLOGICAL IMPACTS ON BIODIVERSITY	17
3.2	THREATENED SPECIES CONSERVATION ACT (1995)	19
3.3	WATER MANAGEMENT ACT	20
3.4	ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT	20
3.5	GOSFORD COUNCIL'S RAINFOREST POLICY	21
3.6	GOSFORD COUNCIL'S BIODIVERSITY STRATEGY.....	21
3.7	STATE ENVIRONMENT PLANNING POLICIES.....	22

SECTION 4 CONCLUDING COMMENTS

4.1	ECOLOGICAL SITE MANAGEMENT	24
4.2	CONCLUSIONS.....	24

APPENDIX 1	FLORA & FAUNA SURVEY DETAILS
APPENDIX 2	THREATENED BIODIVERSITY ASSESSMENT
APPENDIX 3	ASSESSMENT OF PROPOSAL AGAINST RELEVANT RECOVERY PLANS
APPENDIX 4	HOLLOW BEARING TREE SURVEY
APPENDIX 5	ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION ACT
APPENDIX 6	STATE ENVIRONMENTAL PLANNING POLICY No 19 ASSESSMENT
APPENDIX 7	RIPARIAN, BUFFER ZONE & PRIVATE CONSERVATION VEGETATION .. MANAGEMENT PLAN
APPENDIX 8	MANAGEMENT PLAN FOR LANDS PROPOSED FOR TRANSFER TO COUNCIL

EXECUTIVE SUMMARY

A proposal has been developed for the subject site at Terrigal which provides for the retention of areas with high biodiversity values while limiting development to areas of the site which have been previously cleared or disturbed through a history of agricultural land use.

The subject site covers approximately 54 hectares of land. Development will be limited to approximately 17.38 hectares (32.5% of the site) with the remainder of the site (36.15ha) retained within various conservation zones. It is proposed to transfer 27.28 hectares to Council for inclusion in the Coastal Open Space System as an extension to the adjoining Kincumba Mountain Reserve.

No threatened flora species were identified on the site. One endangered ecological community (Lowland Rainforest) is present within areas proposed to be retained and conserved.

Detailed seasonal ecological surveys identified the following threatened fauna species within the site:

- Little Eagle
- Little Lorikeet
- Powerful Owl
- Sooty Owl
- Yellow-bellied Glider
- Grey-headed Flying-fox
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Greater Broad-nosed Bat
- Little Bentwing-bat
- Yellow-bellied Sheath-tail-bat
- Eastern Freetail-bat

The forest habitats which form the principal habitat areas for these species will be retained and conserved.

The development proposal and the biodiversity conservation proposals have been considered in relation to the improvement or maintenance of biodiversity values. It was concluded that the proposal would not result in a significant negative impact on threatened biodiversity and that an improvement and maintenance of biodiversity values would be achieved.

SECTION 1

INTRODUCTION

1.1 INTRODUCTION

Conacher Environmental Group has been engaged to complete an Ecological Site Assessment for the proposed rezoning of land at Kings Avenue, Terrigal. This report provides details on the vegetation, fauna and habitat present on the site in relation to the local area. This report also provides details on the likely impacts of the proposal on threatened species, vegetation and habitats within the local area.

This Ecological Site Assessment 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, and state and local council planning policies in relation to ecological and biodiversity issues.

The text sections of this report are supported by detailed appendices which supply supplementary information on flora and fauna survey methods, survey results, threatened species details and ecological site management issues.

The information within this report has been prepared to address the specific ecological survey and assessment requirements provided by Gosford City Council and the NSW Department of Planning in their specifications for a Local Environmental Study.

This report provides details on all the ecological surveys and assessments completed within or adjacent to the site in forming the basis for the ecological assessment information.

This report provides a revision and update of the May 2010 report which was submitted to Gosford Council as part of the documentation for the rezoning application. Comments provided from a peer review by Cumberland Ecology have been incorporated into the relevant sections of the report. An update revision of assessments in relation to threatened species has also been undertaken to ensure that any species or ecological communities added to the schedules of the Threatened Species Conservation Act since October 2008 and May 2010 have been appropriately considered and assessed within this revised report.

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. Figure 1 shows the location of the subject site in context of the surrounding local area.

TABLE 1.1 SITE DETAILS	
Location	Lot 2 DP 1111392, Lots 8 and 9 DP 876102, Lot 202 DP 831864, Lot 4 DP 37914 and Lot 1 DP 381971 Kings Avenue Terrigal.
Area	54ha approximately
Topographic Map	Gosford 1:25000
Grid Reference	352500E 6298000E
Local Government Area	Gosford City Council
Existing Land Use	Vacant/Pastoral
Zoning	7(c)2 and 7(a)
Proposed Development	Rezoning as part of draft LEP for residential and open space purposes

TABLE 2.2 SITE CHARACTERISTICS	
Elevation	20-70m metres AHD
Topography	Gently to moderately undulating land on local hills sloping towards creek lines
Slope	5-10% and 10-25%
Aspect	Predominantly north to north-west
Soil Type	Erina soil landscape
Catchment	Terrigal Lagoon
Drainage	Overland flow into unnamed drainage lines which flow into Terrigal Lagoon
Vegetation	Mosaic of Open forest, riparian vegetation and cleared areas with scattered trees

1.3 DEVELOPMENT AND BIODIVERSITY CONSERVATION PROPOSALS

Following detailed ecological surveys and site analysis a variety of biodiversity conservation outcomes have been incorporated into the proposal. These biodiversity conservation outcomes are based on the 'maintain or improve' criteria determined for the site.

The general biodiversity conservation principles on which the proposal is based included recommendations for:

- Retention and restoration of riparian vegetation;
- Retention of areas of endangered ecological communities;
- Retention and protection of areas of vegetation in good condition with high biodiversity values;
- Retention of habitat linkages to conservation reserves (Kincumba Mountain Reserve);
- Retention of habitat for threatened fauna species;
- Implementation of Water Quality Management Strategy;
- Preparation of Ecological Site Management Plan;
- Transfer of land to public reserve (Coastal Open Space System) managed by Gosford City Council.

Specific details on how these principles have been incorporated into the proposal are outlined below.

Riparian Areas

Riparian areas are identified in Figure 2. The riparian areas of the central and western drainage lines are to be retained within a non-developable area. A core riparian zone and 10 metre buffer zone has been identified and a Vegetation Management Plan has been prepared which details measures for the revegetation of the buffer zone, weed removal and habitat enhancement and creek bank stabilization works are also outlined in the Vegetation Management Plan.

The eastern drainage line is proposed to be retained and revegetated to compliment the riparian vegetation located downstream (off-site) to the north of the areas proposed for restoration.

Lowland Rainforest – Endangered Ecological Community

Areas of Lowland Rainforest are present within the western drainage line and sheltered southern slopes of the site (Figure 2). Lowland Rainforest is listed as an Endangered Ecological Community in the Threatened Species Conservation Act. These areas of Lowland Rainforest are to be retained intact and with surrounding vegetation also retained to buffer these areas of Lowland Rainforest from any impacts of future development.

The northern area of Lowland Rainforest within the drainage line has been incorporated into the area covered within the Vegetation Management Plan while the areas of Lowland Rainforest occurring on the southern slopes is concluded within an area proposed to be transferred to Gosford City Council for inclusion into the Coastal Open Space System via an extension to Kincumba Mountain Reserve.

Biodiversity Values

Areas of vegetation with high biodiversity values are proposed to be retained within conservation areas with some of these areas transferred to Council for inclusion in the adjoining Kincumba Mountain Reserve. These areas are shown in Figure 3 and Figure 4.

Areas with high biodiversity values include vegetation with a well developed canopy and intact understorey, riparian areas, endangered ecological communities and areas which provide connective habitat to off-site reserves or other vegetated areas.

Development has been proposed to be located within areas of low to moderate biodiversity values. These include cleared areas and open forest with a pasture or managed understorey or areas of regenerating vegetation. Some areas of moderate biodiversity value are proposed for weed removal and revegetation with some of these areas proposed to be transferred to Council.

Hollow bearing habitat trees are disturbed throughout all vegetation communities within the site.

Examples of all vegetation types will be retained within the site. The most intact areas of vegetation along the southern slopes are proposed to be conserved and transferred to Council.

Habitat Connectivity and Enhancement

Habitat Connectivity will be maintained between the site and the adjoining Kincumba Mountain Reserve to the west (along the 580 metre long common boundary). Vegetation and habitat connectivity to the ridge line vegetation to the east will be maintained through the existing vegetative link which is 100 metres wide. The southern part of the site will also retain full connectivity to the fragmented patches of moist gully forest within Picketts Valley. Details of habitat connectivity are provided in Figure 3.

The central and western riparian areas will retain connectivity with the vegetated riparian areas located to the south of the riparian areas. The eastern riparian area will retain connectivity to the riparian areas to the north of the site. The vegetation and fauna habitats within these riparian areas are proposed to be enhanced through the implementation of Vegetation Management Plans incorporated into the Ecological Site Management Plan.

Threatened Fauna Species and Habitat

The site contains a range of habitat for threatened fauna species. The threatened fauna species observed are generally forest fauna species and utilise the open forest habitats of the site and adjoining areas. These species include:

- Little Eagle
- Little Lorikeet
- Powerful Owl
- Sooty Owl
- Yellow-bellied Glider
- Grey-headed Flying-fox
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Greater Broad-nosed Bat
- Little Bentwing-bat
- Yellow-bellied Sheath-tail-bat
- Eastern Freetail-bat

All of these species forage throughout the open forest habitats of the site and have been recorded throughout the local area. With the exception of the Little Eagle and the Grey-headed Flying-fox the above species also utilise tree hollows for roosting or breeding purposes.

The areas of habitat proposed to be retained and conserved within the Lowland Rainforest, riparian areas, Coastal Narrabeen Moist Forest and Coastal Narrabeen Blackbutt Forest provide foraging breeding and roosting habitat for these threatened fauna species.

Conservation Lands and Riparian Areas

The proposal area incorporates several parcels of land within the 7(a) Conservation Zone. The southern area of 7(a) land covering approximately 27.28 hectares is proposed to be transferred to Council for inclusion in the Kincumba Mountain Reserve. The remaining two areas of 7(a) Conservation land are to be retained in private ownership and subject to a Management Plan. No rezoning or residential subdivision is proposed in the 7(a) zoned land. Part of the eastern portion of cleared 7(a) zoned land is proposed to be rezoned and dedicated to Council.

The riparian areas (including core riparian zones and adjoining buffer zones) have been incorporated into areas excluded from development. These areas are subject to the recommendations of a Vegetation Management Plan which has been prepared for the riparian areas.

Water Quality Management

A water quality management strategy has been developed to reduce the level of nutrients flowing into the aquatic areas of the site. This strategy includes the use of filtration swales, water quality treatment ponds and detention ponds integrated into the drainage system of areas to be developed. This will ensure protection of water quality both within aquatic habitats of the site and downstream areas.

Ecological Site Management Plan

A detailed Ecological Site Management Plan is to be prepared to accompany any future development application for the site. This plan will detail the specific measures to be

implemented for the conservation and management of specific areas within the site. The scope of the Ecological Site Management Plan covers:

- Riparian Zone Management Plan;
- Measures to minimize impacts of construction and associated activities;
- Habitat enhancement;
- Hollow bearing tree clearing protocols.

Improvement or Maintenance of Biodiversity Values

The proposal will result in a number of positive outcomes in relation to the improvement or maintenance of biodiversity values. While vegetation and fauna habitats will be removed to accommodate future development the areas of proposed development are limited to areas of the site which have been cleared or contain disturbed vegetation which does not contain high biodiversity values.

Private Conservation Area 7(c2)

Areas of the site with high biodiversity values and with good connectivity to other areas of moderate to high biodiversity values located in the western part of the site have been recommended for conservation. This area comprises approximately 1.5 hectares within the current 7(c2) zoning of the site and incorporates a 50 metre buffer area around the identified rainforest vegetation.

These areas will be retained and managed through private covenant, community management statement or the like to improve or maintain biodiversity values.

Parklands

Areas of parklands along road edges or pathways within the site have not been incorporated into the 'improve or maintain' assessment as the biodiversity value of any retained trees or vegetation in these areas is considered to be low. These areas have been included within the overall development area.

Development Proposal

Outside of the areas to be conserved, "The Development Area" (as shown on Figure 3) is proposed to be developed for the purpose of a home based business park. The form of development proposed is outlined within Figure 5 and consists of:

- Subdivision of lots, residential in size within a community title scheme;
- Development of residential / home office structures upon these lots for the purposes of business and residential occupation;
- Development of communal amenity and home office support services upon commonly held land within the development area;
- Roads, infrastructure and services to service the development;
- A reclaimed water reticulation system and plant;
- A communal management structure and a revenue raising mechanism responsible for ongoing upkeep and maintenance in accordance with the various management plans.

For the purpose of this assessment, the "Development Area" shown in Figure 3, has been assessed as "Urban Development" and a management and revenue raising structure capable of carrying out ongoing land management in accordance with various management

plans which may be developed, has been assumed to exist within the resulting development.

Whilst an area of retained vegetation is proposed within a park in the centre of the development portrayed in Figure 5, this vegetation has been assessed as "cleared" for the purpose of this assessment, as it is of not high biodiversity value, and has limited connectivity - the retention of this area should be considered as an amenity to the development, not as a "biodiversity asset".

1.4 ADJOINING AREAS RELEVANT TO ECOLOGICAL ISSUES

The subject site is joined to the north and north-east and north-west by existing urbanised areas as shown in Figure 1. Rural residential areas comprising a mosaic of cleared areas and patches of open forest are located to the south and east. Patches of open forest (moist understorey) extend from the south and south east to larger areas of vegetation surrounding Avoca Lake.

The southern parts of the site contain areas of open forest and temperate rainforests which have a continuous connection to the forested areas of the eastern parts of Kincumba Mountain Reserve. This connection between areas of good quality vegetation and fauna habitat is approximately 450 metres wide with a further connection (150 metres wide) of disturbed open forest.

This southern part of the site has been identified as a high priority area for inclusion into the Coastal Open Space System and as an extension of the Kincumba Mountain Reserve. This area of the site covers approximately 27 hectares of land containing a mixture of vegetation types including open forest dominated by *Eucalyptus pilularis*, temperate rainforest and disturbed open forest.

In a comprehensive study of the Coastal Open Space System lands (Manidis Roberts 2002) this area of land was found to contain the following important fauna species:

- Little Eagle
- Little Lorikeet
- Powerful Owl
- Sooty Owl
- Yellow-bellied Glider
- Grey-headed Flying-fox
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Greater Broad-nosed Bat
- Little Bentwing-bat
- Yellow-bellied Sheath-tail-bat
- Eastern Freetail-bat

Due to the habitats present, fauna species observed and connectivity provided to Kincumba Mountain Reserve, this area of the site was identified as a priority area for acquisition to the Coastal Open Space System lands. The current proposal provides the opportunity for this parcel of land to be included in an eastward extension of Kincumba Mountain Reserve.

The residential areas to the north, north-east and north-west separate the site from any large areas of bushland or reserves. Canopies of large eucalyptus on sheltered slopes to the north of these residential areas provide some canopy habitat for birds and bats. The drainage line

to the north of the site comprises sections of constructed channel, (concrete, rock lined) with some patches of aquatic and riparian vegetation along the drainage line.

The presence of these developed areas to the north, north-west and north-east provide a restriction to wildlife movement from the site to these directions. The discontinuous nature of the riparian vegetation along the drainage line flowing from the northern parts of the site reduces the connectivity value of the riparian vegetation in these areas.

SECTION 2

BIODIVERSITY CHARACTERISTICS OF THE SITE

2.1 FLORA AND FAUNA SURVEY DETAILS

Detailed flora and fauna surveys have been undertaken within the subject site over a period of approximately 10 years by a variety of fauna survey ecologists. A comprehensive spring/summer fauna survey was completed between October 2007 and February 2008 with some ongoing surveys in September October 2008, and May June 2009 as detailed in Appendix 1. The latest surveys utilised the survey methodologies for Threatened Biodiversity Surveys (Department of Environment and Conservation 2004) in order that the survey methodology followed accepted guidelines. Results from previous site surveys and local area vegetation surveys have also been utilised to provide details of the fauna species present and vegetation communities present in a manner that comparison can be made to the biodiversity in adjoining and nearby areas.

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. Five vegetation communities have been described within the subject site. These communities are:

- 1) Coastal Warm Temperate Rainforest within the more sheltered sections of the drainage lines;
- 2) Coastal Narrabeen Moist Forest which predominately occurs within the drainage lines;
- 3) Narrabeen Coastal Blackbutt Forest which extends throughout the slopes and ridges of the central and southern parts of the site;
- 4) Disturbed/Regeneration Open Forest of the central slopes;
- 5) Grassland with Scattered Trees which occur throughout the site with the exception of the southern part of the site.

A description of these communities is provided below. Their distribution throughout the site is shown in Figure 2.1 (Appendix 1). A list of fauna species recorded from these communities is provided in the Flora and Fauna Survey Report provided in Appendix 1.

2.3 FAUNA CHARACTERISTICS

2.3.1 Fauna Habitats Present

The following fauna habitats were present within the subject site:

- Blackbutt Open Forest providing flower, nectar and seed producing tree species;
- Coastal Narrabeen Moist Forest;
- Drainage lines with dams and associated aquatic habitats;
- Hollow bearing trees;
- Cleared pasture areas.

The fauna habitats within the 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, increased nutrient level in dams and watercourses, and damage to drainage line embankments from watering stock.

The Blackbutt Open Forest areas of the subject site contain only a sparse understorey due to trampling and grazing by stock. They do however, provide suitable foraging habitat within the flowering eucalypts for a number 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.

A total of 49 hollow bearing trees were identified within the central and northern parts of the site during detailed surveys. The majority of these trees were *Eucalyptus pilularis* occurring on the mid to upper slopes of the northern/central parts of the subject site. Hollow bearing trees also occurred within the riparian vegetation and in the vegetation communities of the southern slopes. Details of the types of trees present, size classes and number of tree hollows observed is provided in Table 2.1. A further 74 hollow bearing trees were identified within the southern area of the subject site however these trees were not subjected to detail survey.

TABLE 2.1 HOLLOW BEARING TREE DETAILS (Northern and central areas)						
Tree species	Diameter at Breast Height – (cm) *					Total hollow trees by species
	25-50	51-75	76-100	101-125	126-150	
<i>Eucalyptus deanii</i>		1				1
<i>Eucalyptus pilularis</i>			9	5	5	20
<i>Eucalyptus saligna</i>	2	1		1		4
<i>Eucalyptus spp.</i>			1			1
<i>Eucalyptus umbra</i>		1	1	2		4
<i>Syncarpia glomifera</i>		2	4	3	1	10
Stag	1	8				9
Total hollow trees by DBH	3	13	15	11	6	49

* Multi stems were added to give one DBH size for the tree.

The Coastal Narrabeen Moist Forest Community within the drainage lines contain high levels of weed infestation in particular *Lantana camara* (Lantana) and *Ligustrum sinense* (Small-leaved privet). These two weed species dominate the understorey of large areas of the vegetation surrounding the dams and drainage lines reducing their habitat value for larger native fauna species, but increasing the protective shelter for small bird and terrestrial mammal species. Although disturbed this habitat area still offers suitable foraging within the nectar and fruit producing tree and shrub species and within the leaf litter for terrestrial and arboreal mammals, birds such as fruit doves, and foraging and shelter amongst the fallen logs and embankments for terrestrial mammals, reptiles and amphibians.

The subject site contains large areas of cleared pasture currently being utilised for stock grazing. These areas offer only a low quality of habitat mainly for terrestrial herbivorous mammals and bird species.

2.4 THREATENED BIODIVERSITY

2.4.1 Threatened Flora Species

A search of the Atlas of NSW Wildlife (DECCW 2010) was undertaken to identify records of threatened flora species located within 10km of the subject site. Targeted searches for these species were then undertaken to determine whether they were present on site.

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).

- *Caladenia tessellata*
- *Cryptostylis hunteriana*
- *Melaleuca biconvexa*
- *Syzygium paniculatum*

None of these species were observed during detailed targeted searches.

2.4.2 Threatened Fauna Species

A search of the Atlas of NSW Wildlife (DECCW 2010) was undertaken to identify records of threatened fauna species located within 10km of the subject site. This revealed a number of threatened species that may be present in the area. 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 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).

- | | |
|--------------------------------------|----------------------------------|
| • Giant Burrowing Frog | • Barking Owl |
| • Stuttering Frog, Giant Barred Frog | • Powerful Owl |
| • Red-crowned Toadlet | • Masked Owl |
| • Golden Bell Frog | • Sooty Owl |
| • Green Thighed Frog | • Regent Honeyeater |
| • Rosenberg's Goanna | • Varied Sittella |
| • Pale-headed Snake | • Scarlet Robin |
| • Stephens' Banded Snake | • Spotted-tailed Quoll |
| • Black-necked Stork | • Eastern Pygmy-possum |
| • Australasian Bittern | • Yellow-bellied Glider |
| • Black Bittern | • Squirrel Glider |
| • Square-tailed Kite | • Parma Wallaby |
| • Little Eagle | • Grey-headed Flying-fox |
| • Black-breasted Buzzard | • Yellow-bellied Sheath-tail-bat |
| • Bush Stone-curlew | • Eastern Freetail-bat |
| • Wompoo Fruit-dove | • Large-eared Pied Bat |
| • Superb Fruit-dove | • Eastern False Pipistrelle |
| • Rose-crowned Fruit-dove | • Eastern Bentwing-bat |
| • Glossy Black-Cockatoo | • Little Bentwing-bat |
| • Gang-gang Cockatoo | • Southern Myotis |
| • Little Lorikeet | • Greater Broad-nosed Bat |
| • Swift Parrot | • Giant Dragonfly |
| • Turquoise Parrot | |

The following threatened species as listed within Schedule 1, Part 2 of the *Threatened Species Conservation Act (1995)* were observed on site during surveys.

- Little Eagle
- Little Lorikeet
- Powerful Owl
- Sooty Owl
- Yellow-bellied Glider
- Grey-headed Flying-fox
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Greater Broad-nosed Bat
- Little Bentwing-bat
- Yellow-bellied Sheath-tail-bat
- Eastern Freetail-bat

Details in relation to the ecology of these species and their potential utilisation of the site and local areas is provided below.

Little Eagle (*Hieraaetus morphnoides*)

This species forages in a variety of habitats including woodland open forest, partially cleared areas, along watercourses and around wetlands, avoiding large areas of dense forest. This species nests in mature living trees in open forest, woodland and remnant areas including farmland and areas close to urban development (Marchant and Higgins 1993).

Suitable foraging and roosting habitat for this species is present across the subject site. This species was observed during surveys soaring above the southern open forest areas of the subject site.

The large majority of the subject site is highly disturbed and of low habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

Little Lorikeet (*Glossopsitta pusilla*)

Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Lorikeets are gregarious, usually foraging in small flocks, often with other species of lorikeet. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including, melaleucas and mistletoes (Courtney & Debus 2006).

Suitable foraging and roosting habitat for this species is present within the forested areas of the subject site. This species was observed foraging within the subject site during surveys.

The large majority of the subject site is highly disturbed and of low habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

Powerful Owl (*Ninox strenua*)

The Powerful Owl breeds in open or closed sclerophyll forests and woodlands, including wet sclerophyll forest and dry sclerophyll forest and woodlands. They nest in hollows in large old trees; usually living Eucalyptus, within or below canopy – rarely in dead stags, stumps or broken-off trunks (Higgins 1999). Powerful Owls are sedentary within home ranges of about 1,000 hectares within open eucalypt, casuarina or *Callitris* pine forest and woodlands, though they often roost in denser vegetation, including rainforest or exotic pine plantations (Garnett & Crowley 2000). Powerful Owls feed mainly on those medium-sized species of arboreal marsupials that are most readily available at any given locality (Lavazanian *et.al.* 1994).

Suitable foraging and roosting habitat is present within the open and closed forest, and woodland areas of the subject site. This species was observed during surveys.

The large majority of the subject site is highly disturbed and of low habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

Sooty Owl (*Tyto tenebricosa*)

The Sooty Owl is generally associated with tall, dense, wet closed and open forests (Schodde & Tidemann 1986). Available evidence indicates narrow habitat requirements for nesting, with very large hollows being essential (Hyem 1979). The large majority of the subject site is highly disturbed and of low habitat value for this species.

The Sooty Owl was observed within the subject site after responding to owl call playback in August 2004. It is likely that the presence of this species within the area indicates that the subject site forms part of the home range of a local Sooty Owl or pair.

The rezoning and subsequent development will include the retention of suitable vegetated riparian and closed forest habitat areas for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

Yellow-bellied Glider (*Petaurus australis*)

The Yellow-bellied Glider is an arboreal tree-dwelling mammal. It is restricted to tall mature eucalypt forests found within high rainfall regions of temperate through to sub-tropical eastern Australia (Russell 1988). The bulk of the diet of the Yellow-bellied Glider consists of plant and insect exudates including sap, nectar, honeydew and manna while arthropods and pollen are also eaten (Goldingay and Kavanagh 1991). Yellow-bellied Gliders occupy large exclusive home ranges between 30 and 65 hectares in size (Goldingay and Kavanagh 1991).

The Yellow-bellied Glider was observed during surveys completed in 2004 within the western boundary of the subject site and within Kincumba Mountain Reserve. The Yellow-bellied Gliders observed during surveys are likely to be part of a local population known to inhabit Kincumba Mountain Reserve and other connected bushland areas. The subject site contains suitable foraging habitat for this species. The Yellow-bellied Glider was observed within and adjacent to the subject site during surveys.

The large majority of the subject site is highly disturbed and of decreased habitat value for this species. The rezoning and subsequent development will include the retention of suitable vegetated habitat areas for this species particularly along the drainage lines and reserve areas. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks,

coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

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 an important resource where mating, birth and rearing of young occur as well as providing refuge (Strahan, 1995).

The subject site contains suitable foraging habitat however no roost or camp sites were present on the subject site. This species was observed on a number of occasions flying over the subject site from camp sites to the north and is likely to forage periodically within the site.

The large majority of the subject site is highly disturbed and of decreased habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System

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. The Eastern 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 Eastern Bentwing-bat was observed foraging within the subject site during surveys in 1998. It is likely that this species would forage throughout the extensive areas of bushland within the local area.

The large majority of the subject site is highly disturbed and of decreased habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

The Eastern False Pipistrelle inhabits warm to cool temperate moist and dry open forests (Strahan 1995). The Eastern False Pipistrelle roosts mainly in tree hollows, occasionally utilising caves and abandoned buildings (Parnaby 1992; Phillips *et al.* 1985).

The Eastern False Pipistrelle was observed foraging within the subject site during surveys in 1998. It is likely that this species would forage throughout the extensive areas of bushland adjacent to the subject site and within the local area.

The large majority of the subject site is highly disturbed and of decreased habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

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 occasional old buildings (Hoye & Richards 1995).

The Greater Broad-nosed Bat was observed foraging within the subject site during surveys in March 2004. It is likely that this species would forage throughout the extensive areas of bushland within the local area.

The large majority of the subject site is highly disturbed and of decreased habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

Little Bentwing-bat (*Miniopterus australis*)

The Little Bentwing-bat forages below the canopy within open forests and woodlands, feeding on small insects. This species roosts in caves, tunnels, tree hollows and occasionally old buildings (Dwyer 1995b).

The Little Bentwing-bat was observed foraging within the subject site during surveys in February 2004. It is likely that this species would forage throughout the extensive areas of bushland adjacent to the subject site and within the local area.

The large majority of the subject site is highly disturbed and of decreased habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)

The Yellow-bellied Sheath-tail Bat inhabits open country, mallee, eucalypt forests, rainforests, heathland and waterbodies (Richards 1988). 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. The Yellow-bellied Sheath-tail-bat was observed within the site during surveys in September 2007.

The large majority of the subject site is highly disturbed and of decreased habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

Eastern Freetail-bat (*Mormopterus norfolkensis*)

The Eastern Freetail-bat forages above and within the canopy of open forests and woodlands, feeding on small insects (Allison & Hoye 1995). The Eastern Freetail-bat is thought to roost predominantly in tree hollows and occasionally in buildings (Allison & Hoye 1995).

The subject site contains suitable foraging and roosting habitat for this species. The Eastern Freetail-bat was observed within the site during surveys in September 2007.

The large majority of the subject site is highly disturbed and of decreased habitat value for this species. There are large areas of suitable habitat for this species adjacent to the subject site and within the local area including habitats reserved within Brisbane Waters and Bouddi

National Parks, coastal lagoons and wetlands, Kincumba Mountain Reserve and other ridgeland reserves of the Coastal Open Space System.

Stephens' Banded Snake (*Hoplocephalus stephensi*)

This species was not detected within the site during surveys however this species was identified as a species of interest by Council due to unconfirmed reports of its local presence. Stephens' Banded Snake is predominately a nocturnal, partially arboreal snake of moist forest and rainforest edges. It forages throughout the canopy and groundcover for small reptiles, amphibians, mammals and bird nestlings. It shelters under bark or in logs or tree hollows.

The riparian vegetation and the areas of denser moist forest of the southern slopes would be the preferred macrohabitat types on the site for this species if it were to occur. These habitats are proposed to be retained and included in conservation reserves or protected areas as part of the proposal.

2.4.3 Endangered Populations

No endangered flora or fauna populations as listed in the *TSC Act 1995* have been identified in the local area.

2.4.4 Endangered Ecological Communities

The Endangered Ecological Communities known within the Gosford LGA are:

- Kincumber Scribbly Gum Forest;
- Coastal Saltmarsh;
- Freshwater Wetlands;
- River-flat Eucalypt Forest;
- Sydney Freshwater Wetlands (SFW);
- Swamp Sclerophyll Forest (SSF);
- Swamp Oak Floodplain Forest;
- Littoral Rainforest;
- Lowland Rainforest;
- Umina Coastal Sandplain Woodland.

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

Lowland Rainforest has been identified as occurring with the riparian areas of the western drainage line and in several locations on the sheltered southern slopes of the site. The Lowland Rainforest EEC corresponds to the Coastal Warm Temperate Rainforest shown in Figure 2.1 (Appendix 1).

2.5 VEGETATION/HABITAT CONNECTIVITY

2.5.1 Connectivity and Local Distribution of Fauna Habitats

The vegetation within the site is part of a fragmented local landscape. The vegetation and habitats within the site are the north-eastern most extent of large areas of similar habitat to the south-west within the reserve lands of Kincumba Mountain. The site is isolated to the north by arterial roads and residential development. The site also shows some low level connectivity to Open Forest vegetation to the east which continues further east to Avoca Lake.

There are large areas of similar habitat to those on the subject site contained within the local area. The majority of these occur within the Kincumba Mountain Reserve and the lands of Gosford Councils Coastal Open Space System. The connectivity to Kincumba Mountain Reserve is predominantly through the presence of the contiguous vegetation in the southern parts of the site. These areas are proposed to be transferred to Council for inclusion in the Kincumba Mountain Reserve.

2.6 RIPARIAN AREAS

Three drainage lines which contain aquatic habitats and areas of riparian vegetation are present on the subject site. The eastern drainage line is highly disturbed with occasional trees and shrubs present. A large dam is located within this drainage line.

The central and western drainage lines converge to form a larger western drainage line which contains areas of aquatic habitat and riparian vegetation. Parts of the riparian vegetation contain a mesophyllus shrub component and form small area of lowland rainforest. To the north of the site these drainage lines flow into a constructed drain then into the creekline which ultimately flows to Terrigal Lagoon via a series of vegetated channels, rock lined channels, culverts and pipes.

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 Vegetation Management Plan (VMP) has been prepared for the western drainage line in accordance with the guidelines issued by the Department of Water and Energy. Ongoing consultations have been undertaken with the Department of Water and Energy regarding this VMP with the form and content of the VMP receiving in principal support from representatives of the Department of Water and Energy. Details of the Riparian Areas Vegetation Management Plan and correspondence from the Department of Water and Energy are provided in Appendix 7. The final version of the Vegetation Management Plan should form part of any Ecological Site Management Plan prepared for the site.

SECTION 3

MATTERS FOR CONSIDERATION AND ASSESSMENT

3.1 POTENTIAL ECOLOGICAL IMPACTS ON BIODIVERSITY

Vegetation Removal

Future development of the site is likely to require the removal of the majority of vegetation from the areas of the site which are to be developed as depicted by the light blue areas of Figure 3. All riparian areas Coastal Narrabeen Moist Forest will be retained, protected and restored as part of the proposal. This will include the establishment of riparian buffers and active vegetation management programs to protect and restore vegetation and habitats within these riparian and buffer areas.

The removal of vegetation from the subject site will result in a net loss in the amount of vegetation within the local area. The removal of vegetation, particularly mature trees within the Narrabeen Coastal Blackbutt Forest vegetation communities will decrease the amount of vegetation and habitats within the locality. This may also have impacts upon local biodiversity.

To offset the loss of vegetation from the areas of the site proposed for development areas of the site are proposed to be retained as a riparian protection area (either RE2 (Private Recreation) or E2 (Environmental Conservation) with a further 27.28 hectares of land transferred to Council for inclusion in the Kincumba Mountain Reserve. The areas of land proposed for conservation are shown in Figure 3.

Habitat Removal

Future development of the subject site will require removal of native trees that provide suitable foraging, breeding and refuge habitat for locally occurring fauna species. The subject site also contains a number of trees with hollows for use as den, roost or breeding sites, the removal of which will have impacts upon resident fauna species.

The removal of habitats may result in local decreases in the number of fauna using the area due to the decrease in habitat extent and type. The removal of habitats may result in the displacement of fauna and movement of fauna to adjacent areas and to those riparian areas to be retained within the site.

The removal of habitats may also have local biodiversity effects in the proportions and types of those species currently present within the site. The removal and modification of habitats may result in successional changes and species shifts toward those species more able to adapt to more disturbed environments.

The areas of proposed habitat retention within the riparian zones and privately managed conservation areas and the 27.28 hectares of land proposed to be transferred to Council contain habitats for the locally occurring fauna species. Total loss of habitats will not occur within the site.

Habitat Fragmentation

The site is part of a fragmented local landscape. The habitats and vegetation within the site are part of the bushland/urban transition zone between the higher quality bushland to the south within Kincumba Mountain Reserve and the residential areas associated with Terrigal to the north, east and west of the site. The removal of vegetation from the site is not likely to result in further fragmentation within the local landscape. The removal of vegetation from the

site is not likely to isolate or interrupt any current linkages between areas of vegetation or habitat.

The removal of vegetation and habitats and partial fragmentation within the site increases the risk of edge effects upon those riparian areas to be retained within the site. The establishment of active vegetation and habitat management strategies for these riparian areas will aid in controlling and minimising any potential edge effects.

The proposal has retained and will enhance habitat connectivity to adjoining vegetated areas to the west, south and east. This will contribute to the provision of long term habitat connectivity.

Impacts and Modification of Off-Site Habitats

Modification of off-site habitats can result from a change of land use, particularly when the land use activity is intensified. Off-site impacts are generally typified by:

- increased edge effects
- changed hydrological regimes
- decreased water quality

Increased edge effects are likely to be an issue for the retained riparian areas and adjacent bushland areas. To decrease edge effects buffers are often used as a form of impact minimisation from adjacent use. Managed buffer areas will be established along the retained riparian areas in accordance with the requirements of the Department of Environment, Climate Change and Water (Office of Water) and detailed in the Riparian Areas Vegetation Management Plan (Appendix 7). Bushland within adjacent land will be buffered by the potential impacts of adjacent development by the establishment of managed asset protection zones as part of bushfire protection measures between the bushland edges and residential areas.

Changed hydrological regimes and decreased water quality (increased nutrients) in surface water runoff can be controlled through the appropriate use of stormwater controls, water retention basins and artificial wetlands. These measures are generally incorporated into the landscaping and stormwater design plans for future developments.

The protection and restoration of the creekline/riparian areas within the site will also aid in the minimisation of potential impacts upon downstream aquatic habitat areas.

Consideration of Corridors and Management Issues

The riparian corridors within the site will be retained, protected and restored as part of the site specific ecological design and management strategies. This will provide for contiguous vegetation and habitat areas within the site and also aid in retaining riparian and aquatic connectivity within the local area. Additional areas of private land important for linkages will be conserved and managed.

The development has been designed to retain important habitats and movement areas within and through the post development landscape as identified in Figure 3. The southern part of the site (27.28ha) is proposed to be transferred to Council for inclusion in Kincumba Mountain Reserve.

The retention of this area will ensure habitat linkages are maintained through the areas of the site with high biodiversity values to other vegetated ridge lines and valleys to the east and south of the site.

3.2 THREATENED SPECIES CONSERVATION ACT (1995)

3.2.1 Threatened Species Assessment

No threatened flora species were observed on the subject site. Five threatened flora species, *Caladenia tessellata*, *Cryptostylis hunteriana*, *Melaleuca biconvexa* and *Syzygium paniculatum*, were identified as having suitable or sub-optimal habitat present within the subject site.

Twelve threatened fauna species as listed in Schedule 1 or 2 of the *TSC Act* (vulnerable or endangered species), Little Eagle, Little Lorikeet, Powerful Owl, Sooty Owl, Yellow-bellied Glider, Grey-headed Flying-fox, Yellow-bellied Sheath-tail Bat, Eastern Bentwing-bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Little Bentwing-bat and Eastern Freetail Bat were observed on the subject site during the various surveys conducted over the years.

A detailed assessment of the significance of the potential impact on threatened species, endangered ecological communities and their habitats is provided in Appendix 2 of this report.

One Endangered Ecological Community, Lowland Rainforest, as listed in Schedule 3 of the *TSC Act* (1995), is present on the subject site. This community is proposed to be retained within the riparian vegetation within the site.

No endangered populations listed in Schedule 2 of the *TSC Act* are present on the subject site.

The assessment concludes that the proposed development is unlikely to have a significant adverse impact on any threatened fauna or flora species or their habitat such that any viable local population is likely to be placed at risk of extinction.

3.2.2 Consideration of Relevant Recovery Plans

Threatened species recovery plans prepared in accordance with the provisions of the *TSC Act* are relevant to the subject site. These recovery plans are:

- i) Recovery plan for the Yellow-bellied Glider;
- ii) Recovery plan for Large Forest Owls (which covers the Powerful Owl, Masked Owl and Sooty Owl).
- iii) Draft National Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*) (DECCW 2009).

A detailed consideration of these recovery plans in relation to the proposed development is included in Appendix 3.

The proposal includes retention of the principal areas of habitat for the Yellow-bellied Glider, Powerful Owl and Sooty Owl either within the riparian vegetation or the open forest/moist forest proposed for addition to Kincumba Mountain Reserve.

The considerations of the recovery plans in Appendix 3 has concluded that the proposal is not inconsistent with the objectives or actions of the Yellow-bellied Glider, Large Forest Owl Recovery Plans or Grey-headed Flying-fox.

3.3 WATER MANAGEMENT ACT

Due to the presence of the drainage lines and riparian areas the provisions of the *Water Management Act* apply to the proposal. Any works within or adjacent to the drainage line are considered to be controlled activities requiring approval from the Office of Water (DECCW). In relation to the riparian vegetation present in the central and western drainage lines a Vegetation Management Plan has been prepared (Appendix 7) which has received 'in principal' support from Officers of the Office of Water (DECCW). Any works within the drainage line including crossing, infrastructure, pipelines restoration works or the like are required to satisfy the specific Guidelines for Controlled Activities issued by the Department of Water and Energy.

3.4 ENVIRONMENT 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 Sustainability, Environment, Water, Population & Communities (SEWPAC).

No threatened flora species as listed in the *EPBC Act (1999)* were observed on the subject site. Five threatened flora species (*Caladenia tessellata*, *Cryptostylis hunteriana*, *Melaleuca biconvexa* and *Syzygium paniculatum*) as listed in the *EPBC Act (1999)* were identified as having suitable or sub-optimal habitat present within the subject site.

One threatened fauna species, the Grey-headed Flying-fox, as listed in the *EPBC Act (1999)*, was observed within the subject site. The proposal was assessed as not likely to have a significant effect on an important population of this species.

No Endangered Ecological Communities as listed in Schedule 3 of the *TSC Act* were present on the subject site. An assessment in relation to the *EP&BC Act* is provided in Appendix 5 of this Report.

It is considered that a referral of this project to the Department of Sustainability, Environment, Water, Population and Communities 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 GOSFORD COUNCILS RAINFOREST POLICY

Vegetation within the subject site is not mapped as Rainforest in Attachment 1 of Gosford Council's Rainforest Policy. That policy states that a vegetation community is classed as rainforest if it is mapped as rainforest on Attachment 1 of the policy document.

The majority of the riparian vegetation is considered to be most representative of the local vegetation community – Coastal Narrabeen Moist Forest. While sharing many of the characteristics of “Rainforest” vegetation communities, this vegetation community is distinct from the Rainforest vegetation – Coastal Warm Temperate Rainforest as identified and mapped by Bell (2004). The Coastal Warm Temperate Rainforest occurs in a small area of the western drainage line and in larger patches on the sheltered southern slopes of the site.

The vegetation of the site is not mapped as Rainforest in Attachment 1 of Gosford Council's Rainforest Policy and the proposal will not significantly impact or require the removal of any of the locally identified Rainforest communities (Bell 2004). Areas of the site containing Warm Temperate Rainforest are proposed to be retained with surrounding vegetation these communities to be managed as a 50 metre buffer area to the rainforest vegetation in accordance with Councils Rainforest Policy.

The above mitigation and management measures have been identified to minimise potential impacts of future development on both the riparian and rainforest vegetation communities.

3.6 GOSFORD COUNCIL BIODIVERSITY STRATEGY

Biodiversity Strategy

Gosford City Council's Biodiversity Strategy is a broad document prepared and adopted by Council to ...*“provide a framework and guide for the management of biodiversity in the Gosford Local Government Area that is consistent with regional, state, national and international strategies”*.

The biodiversity strategy identifies the following key strategies to protect and promote biodiversity.

- 1) Protect and Conserve Biodiversity and Maintain Ecological Processes;
- 2) Integrate Biodiversity Conservation and Natural Resource Management;
- 3) Educate and involve/consult the Community;
- 4) Collect information and Improve Knowledge and Research;
- 5) Identify, Prevent and Mitigate the Cause of Bio-threatening Processes;
- 6) Allocate Resource and Develop a Biodiversity Operational Plan.

In relation to the subject site and proposed rezoning the first strategy (Protect and Conserve Biodiversity and Maintain Ecological Processes) is the most appropriate. In this regard the following actions identified for this strategy are relevant.

- 1) Enable biodiversity conservation to be taken into consideration in Council's strategic planning;
- 2) Environmental zoned lands need to be retained with current minimum lots area standards to enable the lot sizes to allow sufficient space for land uses to occur without loss of biodiversity;
- 3) The land zoning and permitted land uses within identified vegetation and wildlife corridors and riparian habitats need to reflect the biodiversity values;
- 4) Consider biodiversity criteria for conserving areas of high biodiversity working towards maintenance and enhancement of existing biodiversity as a key priority with the aim of no net loss in development assessments and future LEP's;

- 5) Council to consider the development of an offset policy in accordance with Department of Environmental and Climate Change – biobanking;
- 6) Identify, protect and manage wildlife and vegetation corridors to maintain biodiversity.

These actions have been incorporated into the assessments undertaken and consideration of the impacts on biodiversity. The current proposal endeavours to retain areas of higher biodiversity value and concentrate development within areas of low to moderate biodiversity values. Areas of the site which have been recognised as a priority area for inclusion in the Coastal Open Space System are proposed to be transferred to Council for extension of the Kincumba Mountain Reserve.

3.7 STATE ENVIRONMENTAL PLANNING POLICIES

SEPP 14 –Coastal Wetlands

The site is not within an area mapped as SEPP 14 – Coastal Wetlands.

SEPP 19 – Bushland in Urban Areas

The site adjoins Kincumba Mountain Reserve which is an area of land zoned for public open space. As identified in Clauses 9 & 10 of SEPP 19 the public authority must take into account and have regard to the aims of SEPP 19 and the effect of the proposed development on bushland zoned or reserved for public open space.

An assessment of the proposal in relation to the aims and objectives of SEPP 19 has been undertaken and is included in Appendix 6. This assessment has concluded that:

- the proposed development will not compromise the values of the adjoining bushland areas in relation to the aims of SEPP 19;
- the proposal will benefit the value of the Kincumba Mountain Reserve through transfer of land to the reserve.

SEPP 44 – Koala Habitat Assessment

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

- i. A search of the Atlas of NSW Wildlife (DECCW 2010) was undertaken to identify records of Koalas in the area.
- ii. The site was surveyed on foot with any species of 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 any trees showing signs of Koala use was calculated for the whole of the site. Additionally the location and density of droppings if found were documented.
- iii. Koalas were also targeted during spotlight surveys.
- iv. Identification and assessment of the density of tree species listed as Koala food trees in State Environmental Protection Policy No. 44 - Koala Habitat Protection was undertaken across the site. A count of all tree stems with a DBH (Diameter at Breast Height) >150mm was made across the whole of the site. An estimate of the percentage density of each tree species across the site was determined by averaging the percentage of stems counted.

One Koala food tree species (*Eucalyptus punctata*) as listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection was found on the site. No Koalas were observed during the fauna survey and no evidence of Koala habitation, such as scats, claw and scratch marks, was found on site. The Atlas of NSW Wildlife (DECCW 2010) had recent records of this species from bushland at Katandra Reserve, within 5km of the subject site.

The density of Koala food trees is less than 15% within the subject site and as such the site does not constitute potential Koala habitat as defined by the provisions of SEPP No. 44.

Due to the absence of Koala scats, claw and scratch marks (indicating no previous activity within surveyed areas), and lack of observations of Koalas on the site during this survey, the site is not considered to form Core Koala Habitat within the provisions of SEPP No 44.

SECTION 4

CONCLUDING COMMENTS

4.1 ECOLOGICAL SITE MANAGEMENT

The following ecological site management strategies will be completed within the site as part of minimising the impacts identified in Section 4.1.

- Retention, protection and restoration of all riparian areas;
- Preparation of an Ecological Site Management Plan incorporating;
 - vegetation management
 - weed management
 - fauna and habitat management
 - ecological management during site works
 - protocol for inspecting and clearing hollow bearing trees
 - bushfire management
 - establishment and management of buffers
 - erosion and sediment control
 - stormwater quality and management
 - community education
 - access, signage and fencing
 - feral species
 - monitoring and reporting
- Community title initiatives.

4.2 CONCLUSIONS

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

- i. The majority of the subject site is of reduced quality for locally occurring flora and fauna species due to a history of disturbance.
- ii. Twelve threatened fauna species as listed in the *TSC Act* (vulnerable or endangered species) (Little Eagle, Little Lorikeet, Powerful Owl, Sooty Owl, Eastern Bentwing-bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Grey-headed Flying-fox, Little Bentwing-bat and Yellow-bellied Glider, Yellow-bellied Sheath-tail-bat, Eastern Freetail-bat) were observed on the subject site. Habitat for these species is proposed to be retained on the site and in adjoining reserve areas;
- iii. One Endangered Ecological Community, Lowland Rainforest, as listed in Schedule 3 of the *TSC Act*, is present on the subject site;
- iv. No threatened flora species or endangered populations were observed on the site;
- v. The proposal includes the retention, protection and restoration of higher quality habitats within riparian areas and habitat linkage areas (These areas total 9.7 hectares) to provide an offset and to minimise impacts upon locally occurring flora and fauna;

- vi. A total of 27.28 hectares of land will be transferred to Council to increase the area of coastal open space land and extent of Kincumba Mountain Reserve;
- vii. A detailed Ecological Site Management Plan should be prepared to detail management requirements for retained vegetation and fauna habitats and accompany any proposal for development;
- viii. That the proposed development is not likely to have a significant effect upon threatened species, endangered ecological communities or their habitats;
- ix. A referral of this project to the Department of Sustainability, Environment, Water, Population and Communities;
- x. The proposal will result in an improvement or maintenance of biodiversity values as a result of the various biodiversity conservation proposals to be implemented as part of the rezoning proposal.



Plan for indicative purposes only. Not for detailed measurement. *Subject Site boundary subject to final survey.
Original plan produced in A4 colour

Legend

 Subject Site Boundary



ABN: 62 274 841 042
PO Box 4033
78 York Street
East Gosford NSW 2250
Ph: (02) 4324 7888
Fax: (02) 4324 7899
cegconsult@bigpond.com

Ver: FK By: JM
13/05/10
Ref No: 10/050

Figure 1
Location of Subject Site in Context of Local Area
Kings Avenue, Terrigal

Source: Aerial © Department of Lands (2007)

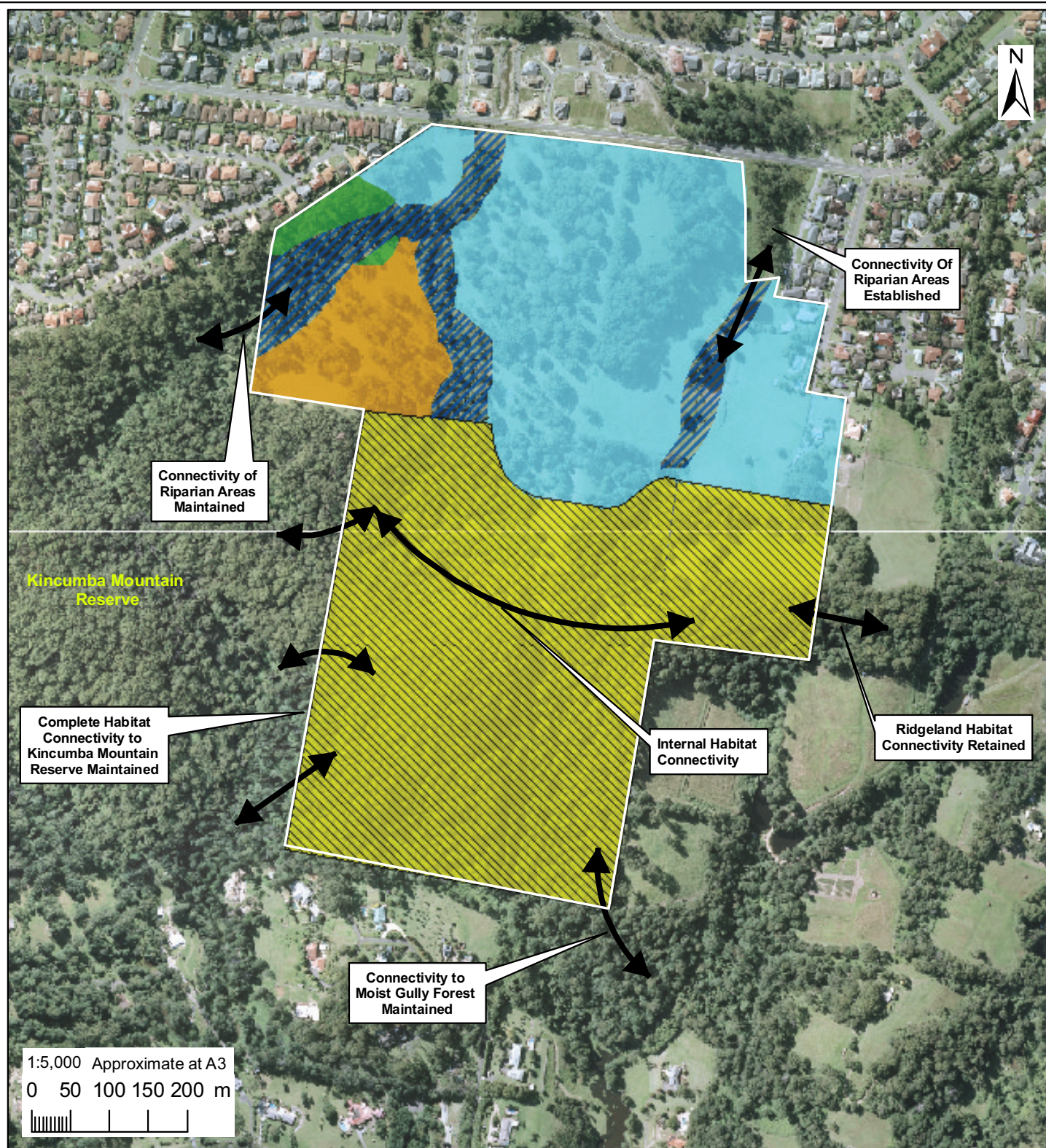


*Subject Site boundary subject to final survey.
Survey locations are approximate and have not been fixed by land survey. Plan for indicative purposes only.
Not for detailed measurement.
Original plan produced in A3 colour.

Vegetation Mapping
Derived from BELL 2004

Legend

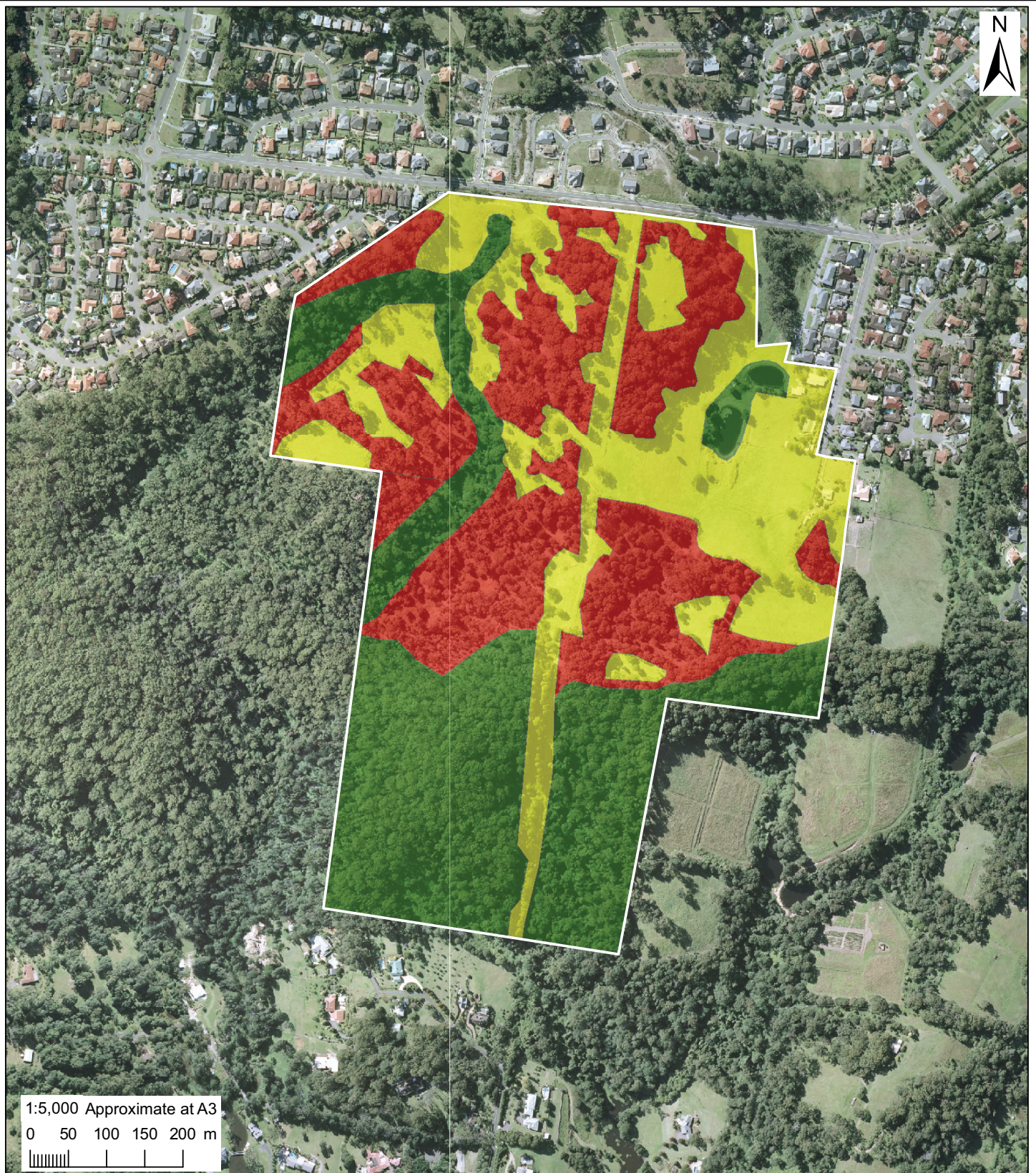
- | | | | |
|-----------------------|----------------------------------|-----------------------------------|--|
| Subject Site Boundary | Lowland Rainforest (EEC) | Remnant Forest (Weed Understorey) | Disturbed Forest (Cleared Understorey) |
| Riparian Areas | Acacia Forest (Weed Understorey) | Cleared Land (Low Condition) | |



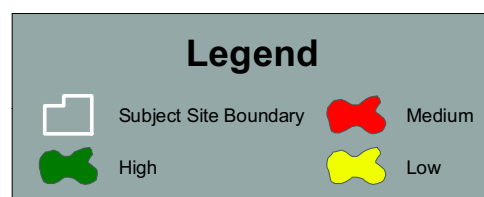
*Subject Site boundary subject to final survey.
Survey locations are approximate and have not been fixed by land survey. Plan for indicative purposes only.
Not for detailed measurement. Original plan produced in A3 colour.

Legend

	Subject Site Boundary		Area Subject to Management Plan		Development Area
	Connectivity Opportunities		Buffer to Rainforest Vegetation		Environment Conservation
			Transfer to Council		Riparian/Drainage Reserve



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



APPENDIX 1

FLORA AND FAUNA SURVEY REPORT



FLORA AND FAUNA SURVEY REPORT

“PARKSIDE” KINGS AVENUE TERRIGAL

**DECEMBER 2010
(REF: 10134)**

www.cegconsult.com

Suite E, 78 York Street, East Gosford NSW 2250
PO Box 4300, East Gosford NSW 2250

• Ph (02) 4324 7888 • Fax (02) 4324 7899

• Email cegconsult@bigpond.com

ABN 62 274 841 042

FLORA AND FAUNA SURVEY REPORT

**“PARKSIDE”
KINGS AVENUE
TERRIGAL**

DECEMBER 2010

Conacher Environmental Group

Environmental and Land Management Consultants

Suite E, 78 York St, East Gosford NSW 2250
PO Box 4300, East Gosford NSW 2250
Phone: 02 4324 7888 Fax: 02 43247899
Ph: 02 6622 7522 Fax: 02 6622 7533

This document is copyright ©
Conacher Environmental Group ABN 62 274 841 042

TABLE OF CONTENTS

SECTION 1 INTRODUCTION

1.1	INTRODUCTION.....	1
1.2	PREVIOUS STUDIES	1
1.3	THREATENED BIODIVERSITY DETAILS.....	1

SECTION 2 FLORA CHARACTERISTICS

2.1	FLORA SURVEY METHODOLOGY	13
2.2	FLORA COMMUNITIES	15
2.3	FLORA SPECIES LISTS	20
2.4	LOCAL DISTRIBUTION OF VEGETATION	26
2.5	CONSERVATION STATUS OF VEGETATION COMMUNITIES	27

SECTION 3 FAUNA CHARACTERISTICS

3.1	BACKGROUND.....	29
3.2	FAUNA SURVEY METHODOLOGY	34
3.3	THREATENED FAUNA OBSERVED ON THE SITE	43
3.4	SURVEY RESULTS	48
3.5	FAUNA SURVEY RESULTS	56

SECTION 1

INTRODUCTION

1.1 INTRODUCTION

This Report provides details of the surveys undertaken on the subject site and the results of those surveys. The specific methods of survey utilized are detailed in Section 2 (Flora) and Section 3 (Fauna). As this Report is a Survey Report only, no analysis of the proposal in relation to threatened biodiversity has been included in this Report. These assessments are provided as a separate report to this Flora and Fauna Survey Report.

This Report provides background details of threatened biodiversity (including threatened flora, threatened fauna and endangered ecological communities) known to occur in the locality. Figures showing the location of fauna survey sites, location of threatened fauna species observations and vegetation communities are also provided.

1.2 PREVIOUS STUDIES

Detailed flora and fauna surveys have been undertaken on the subject site since January 1998 following initial preliminary surveys in March 1996 (Integrated Site Planning and Management 1998). Further detailed surveys were completed by Conacher Travers in 2002 and 2004 with the later surveys encompassing a seasonal survey in February, March and April 2004.

The site was also included within the survey area for the Terrigal Trunk Drainage System by Environmental Appraisal (1997) and surveys of Kincumba Mountain and adjoining areas by Integrated Site Planning and Management (1998), Mitchell McCotter (1994) and Ecotone (2001).

These previous surveys employed a variety of survey methods and were completed by a range of ecologists. To standardise the survey methods and to ensure that the current survey methods identified in Gosford Council Flora and Fauna Survey Guidelines (Murray et al 2002) and the Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities, (working draft), (Department of Environment and Conservation 2004) were applied, further detailed surveys have been completed and are reported on in this Report.

1.3 THREATENED BIODIVERSITY DETAILS

1.3.1 Threatened Flora Species

A search of the Atlas of NSW Wildlife database (NPWS 2010) was undertaken to identify records of threatened flora species located within the local area. This allowed for a specific search for threatened flora to be undertaken to determine if any threatened flora species were present within the study site. 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 Table 1.1.

TABLE 1.1 THREATENED FLORA SPECIES OF THE AREA				
Species	TSC Act	EPBC Act	Growth Form and Habitat Requirements	Comments
<i>Acacia pubescens</i>	V	V	Spreading shrub 1-4 m high growing in open sclerophyll forest and woodlands on clay soils. Distribution limits N-Bilpin S- Georges River.	No suitable habitat present. Not observed during flora survey.
<i>Astrotricha crassifolia</i>	V	V	Shrub to 2.4 m high. Grows in dry sclerophyll woodland on sandstone. Distribution limits N- Patonga S- Royal NP	No suitable habitat present. Not observed during flora survey.
<i>Caladenia tessellata</i>	E1	V	Terrestrial orchid. Clay-loam or sandy soils. Distribution limits N-Swansea S- south of Eden.	Suitable habitat present. Not observed during flora survey.
<i>Chamaesyce psammogeton</i>	E1	-	Prostrate herb. Coastal dunes. Distribution limits N- Tweed Heads S- Jervis Bay	No suitable habitat present. Not observed during flora survey.
<i>Cryptostylis hunteriana</i>	V	V	Saprophytic terrestrial herb lacking leaves with erect flowers to 45cm tall. Grows in swamp heath on sandy soils south from Gibraltar Range. Flowers Dec to Feb.	Suitable habitat present. Not observed during flora survey.
<i>Darwinia glaucophylla</i>	V	-	Spreading prostrate shrub occurring in heath and woodlands often associated with sandstone rock platforms. Confined to the Gosford area.	No suitable habitat present. Not observed during flora survey.
<i>Dendrobium melaleucaphilum</i>	E	-	Epiphytic orchid growing frequently on <i>Melaleuca stypheloides</i> , less commonly on rainforest trees or on rocks in coastal districts. Flowers July-Oct. Distribution N – Queensland S - Lower Blue Mountains.	Suitable habitat present. Not observed during flora survey.
<i>Diuris praecox</i>	V	V	Terrestrial orchid. Grows in sclerophyll forest near the coast. Distribution limits N - Nelson Bay S - Ourimbah.	No suitable habitat present. Not observed during flora survey.
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	V	-	Occurs in Sydney Sandstone Gully Forest (HOUSE, 1997) and scrub with periodically poorly drained clay soil on sandstone or shale (Benson and McDougall 1996).	No suitable habitat present. Not observed during flora survey.
<i>Eucalyptus camfieldii</i>	V	V	Stringybark to 10 m high. Grows on coastal shrub heath and woodlands on sandy soils derived from alluviums and Hawkesbury sandstone. Distribution limits N - Norah Head S - Royal NP.	No suitable habitat present. Not observed during flora survey.
<i>Eucalyptus glaucina</i>	V	V	Tree to 30m growing in grassy woodland on deep, moderately fertile and well-	No suitable habitat present.

TABLE 1.1 THREATENED FLORA SPECIES OF THE AREA				
Species	TSC Act	EPBC Act	Growth Form and Habitat Requirements	Comments
			watered soil. Distribution near Casino and from Taree to Broke.	Not observed during flora survey.
<i>Hibbertia procumbens</i>	E1	-	Prostrate shrub with linear leaves which occurs in heath on sandy soils but is only known from Mangrove Mountain.	No suitable habitat present. Not observed during flora survey.
<i>Lindsaea fraseri</i>	E	-	A small rhizome creeping fern covered with narrow golden-brown scales. Grows in swamp forest or open forest. Known primarily from the Far North Coast of NSW.	No suitable habitat present. Not observed during flora survey.
<i>Melaleuca biconvexa</i>	V	V	A shrub to small tree with papery bark growing in poorly drained places from Jervis Bay to Port Macquarie.	Suitable habitat present. Not observed during flora survey.
<i>Persoonia hirsuta</i>	E1	E	Spreading to decumbent shrub with young branchlets moderately to densely hairy. Associated with low woodland to scrub / heath on sandstone with a clay influence in the shale sandstone ecotone (NPWS 1997).	No suitable habitat present. Not observed during flora survey.
<i>Prostanthera askania</i>	E1	E	Erect shrub. Grows in sclerophyll forest on ridges in or adjacent to Rainforest. Distribution limits Strickland SF region.	No suitable habitat present. Not observed during flora survey.
<i>Prostanthera junonis</i>	E	E	Small shrub. Grows in sclerophyll forest and heath in shallow soil on sandstone. Distribution limits Somersby region.	No suitable habitat present. Not observed during flora survey.
<i>Senecio spathulatus</i>	E		Small spreading shrub growing on coastal dunes.	No suitable habitat present. Not observed during flora survey.
<i>Syzigium paniculatum</i>	E	V	Small tree. Subtropical and littoral rainforest on sandy soil. Distribution limits N - Forster S - Jervis Bay.	Suitable habitat present. Not observed during flora survey.
<i>Tetratheca glandulosa</i>	V	V	Spreading shrub to 0.2 m high. Sandy or rocky heath or scrub. Distribution limits N - Mangrove Mountain S - Sydney.	No suitable habitat present. Not observed during flora survey.
<i>Tetratheca juncea</i>	V	V	Prostrate shrub to 1 m high. Dry sclerophyll forest and heath. Distribution limits N - Bulahdelah S - Port Jackson.	No suitable habitat present. Not observed during flora survey.
E = Endangered Species V = Vulnerable Species				

It is considered that suitable habitat is present on the subject site for *Caladenia tessellata*, *Cryptostylis hunteriana*, *Dendrobium melaleucaphilum*, *Melaleuca biconvexa* and *Syzygium paniculatum*. Specific surveys targeting these species were undertaken on the subject site as detailed in Section 2 of this Report.

Endangered Flora or Fauna Populations

No flora or fauna species have been listed as an endangered population in the local area on Part 2 of Schedule 1 of the *TSC Act* (1995).

Endangered Ecological Communities

There are ten Endangered Ecological Communities known within the Gosford LGA. Descriptions and details on the diagnostic species and habitat requirements of these ecological communities are provided in Table 1.2.

TABLE 1.2 ENDANGERED ECOLOGICAL COMMUNITIES OF THE AREA		
Name	Habitat Requirements	Comments
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions (CS)	Geology / Soils: Estuarine mud flats. Topography: Intertidal zone on the shores of estuaries and lagoons often inland of Mangrove stands. Characteristic Species: Variable with elevation; Lowest- <i>Sarcocornia quinqueflora</i> ; Mid- <i>Sporobolus virginicus</i> ; Upper- <i>Juncus kraussii</i> & <i>Baumea juncea</i>	Not observed during surveys.
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion (FWCF)	Geology / Soils: Silts, muds or humic loams. Topography: in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Characteristic Species: <i>Carex appressa</i> , <i>Paspalum distichum</i> , <i>Baumea caniculata</i> , <i>Phylidrum lanuginosum</i> , <i>Ludwigia peploides</i> ssp. <i>montevidensis</i> and <i>Myriophyllum</i> spp.	Not observed during surveys.
Kincumber Scribbly Gum Woodland in the Sydney Basin Bioregion (KSGW)	Characteristic Species: <i>Eucalyptus racemosa</i> , <i>Angophora costata</i> , <i>Corymbia gummifera</i> , <i>Syncarpia glomulifera</i> , <i>Eucalyptus piperita</i> , <i>Allocasuarina littoralis</i> , <i>Glochidion ferdinandi</i> .	Not observed during surveys.
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Geology / Soils: Coastal dune soils, shallow soils over bedrock, deep clay soils. Topography: Located near coastline in sheltered positions. Often found on coastal dunes, headlands or riparian locations. Characteristic Species: Rainforest type species; <i>Cupaniopsis anacardioides</i> , <i>Syzygium leuhmannii</i> , <i>Acacia hemilampra</i> , <i>Lophostemon confertus</i> , <i>Ficus</i> sp., <i>Livistona australis</i> .	Not observed during surveys.
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	Geology / Soils: Typically of high nutrient geological substrates, notably basalts and fine-grained sedimentary rocks. Topography: Lower slopes and ranges below 600m above sea level in its northern range and below 350m sea level within the Sydney basin. Characteristic Species: Lowland Rainforest encompasses stands which fall principally within the following subtropical alliances and suballiances of Floyd	Not observed during surveys.

TABLE 1.2 ENDANGERED ECOLOGICAL COMMUNITIES OF THE AREA		
Name	Habitat Requirements	Comments
	(1990): <i>Argyrodendron trifoliatum</i> alliance 1. <i>Argyrodendron trifoliatum</i> suballiance 5. <i>Castanospermum australe</i> – <i>Dysoxylum muelleri</i> suballiance 6. <i>Archontophoenix</i> – <i>Livistonia</i> suballiance <i>Dendrocnide excelsa</i> – <i>Ficus</i> spp. alliance 14. <i>Doryphora sassafras</i> – <i>Daphnandra micranthus</i> – <i>Dendrocnide excelsa</i> – <i>Ficus</i> spp. – <i>Toona</i> suballiance 15. <i>Ficus</i> spp. – <i>Dysoxylum fraserianum</i> – <i>Toona</i> – <i>Dendrocnide</i> suballiance <i>Drypetes australasica</i> – <i>Araucaria cunninghamii</i> alliance 21. <i>Araucaria cunninghamii</i> suballiance 22. <i>Flindersia</i> spp. – <i>Araucaria</i> suballiance	
River-Flat Eucalypt Forest on Coastal Floodplains of the North Coast, Sydney basin and South East Corner bioregions (REFCF)	Geology / Soils: Silts, clay-loams and sandy loams. Topography: Periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains with a recurring flood interval of less than 1 in 100 years. Characteristic Species: <i>Eucalyptus tereticornis</i>, <i>E. amplifolia</i>, <i>E. botryoides</i>, <i>E. grandis</i>, <i>E. benthamii</i>, <i>Angophora floribunda</i>, <i>A. subvelutina</i>, <i>Melaleuca decora</i>, <i>M. stypheloides</i>, <i>Backhousia myrtifolia</i>, <i>Casuarina cunninghamiana</i> and <i>Casuarina glauca</i>.	Not observed during surveys.
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SOFF)	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: <i>Casuarina glauca</i>.	Not observed during surveys.
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SSFCF)	Geology / Soils: Waterlogged or periodically inundated humic clay loams and sandy loams. Topography: Alluvial flats and drainage lines of coastal floodplains. Characteristic Species: includes species such as <i>Eucalyptus robusta</i>, <i>Melaleuca quinquenervia</i> and <i>Eucalyptus botryoides</i>.	Not observed during surveys.
Sydney Freshwater Wetlands in the Sydney Basin Bioregion (SFW)	Geology / Soils: Generally on the Warriewood and Tuggerah Soil Landscapes (Chapman and Murphy 1989). Topography: Swales and depressions on sand dunes and sandplain sites. Characteristic Species: <i>Eleocharis sphacelata</i>, <i>Baumea juncea</i>, <i>B. rubignosa</i>, <i>B. articulata</i>, <i>Gahnia sieberiana</i>, <i>Ludwigia peploides</i> and <i>Persicaria</i> sp.	Not observed during surveys.
Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion (UCSW)	Geology / Soils: Coastal sands on the Woy Woy Soil Landscape (Chapman and Murphy 1989). Topography: Marine and aeolian sandplain. Characteristic Species: <i>Eucalyptus botryoides</i>, <i>Angophora floribunda</i>, <i>Banksia integrifolia</i>, <i>Banksia serrata</i>, <i>Monotoca elliptica</i>, <i>Macrozamia communis</i>, <i>Acacia ulicifolia</i>, <i>Platysace lanceolata</i>, <i>Acacia suaveolens</i>, and <i>Allocasuarina littoralis</i>.	Not observed during surveys.

1.3.3 Threatened Fauna Species

A search of the Atlas of NSW Wildlife (NPWS 2010) was undertaken to identify records of threatened fauna located within 10 kilometres of the subject site. This revealed a number of threatened species that may be present in the area. Details on threatened fauna species (Schedule 1 or 2), which are known or considered likely to occur within the area, are provided in Table 1.3.

TABLE 1.3 RECORDED THREATENED FAUNA OF THE AREA				
Common name <i>Scientific name</i>	Preferred habitat	Comments	TSC Act	EPBC Act
Wallum Froglet <i>Crinia tinnula</i>	Found in acidic paperbark swamps and wallum country with dense groundcover. Breeds in temporary and permanent pools and ponds of high acidity.	No suitable habitat present.	V	-
Giant Burrowing Frog <i>Heleioporus australiacus</i>	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks.	Suitable foraging and breeding habitat present. Not detected during surveys.	V	V
Stuttering Frog <i>Mixophyes balbus</i>	Terrestrial inhabitant of rainforest and wet sclerophyll forests.	Suitable foraging and breeding habitat present. Not detected during surveys.	V	V
Giant Barred Frog <i>Mixophyes iteratus</i>	Terrestrial inhabitant of rainforest and open forests.	Suitable foraging and breeding habitat present. Not detected during surveys.	E	E
Red-crowned Toadlet <i>Pseudophryne australis</i>	Prefers sandstone areas, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non-breeding periods.	Suitable foraging and shelter habitat present. Not detected during surveys.	V	-
Green and Golden Bell Frog <i>Litoria aurea</i>	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris.	Suitable foraging and breeding habitat present. Not detected during surveys.	E1	V
Green Thighed Frog <i>Litoria brevipalmata</i>	Found in rainforests and open forests within or at the edge of streams, swamps, lagoons, dams and ponds.	Suitable foraging and breeding habitat present. Not detected during surveys.	V	-
Rosenberg's Goanna <i>Varanus rosenbergi</i>	Hawkesbury sandstone outcrop specialist. Inhabits woodlands, dry open forests and heathland sheltering in burrows, hollow logs, rock crevices and outcrops.	Suitable foraging and shelter habitat present. Not observed during surveys.	V	-
Pale-headed Snake <i>Hoplocephalus bitorquatus</i>	Occurs in a range of habitats from rainforest to open woodland. Usually occurs in hollow trees and beneath loose bark along watercourses. Partly arboreal and may use hollows in trees.	Suitable foraging and roosting habitat present. Not observed during surveys.	V	-

TABLE 1.3 RECORDED THREATENED FAUNA OF THE AREA				
Common name Scientific name	Preferred habitat	Comments	TSC Act	EPBC Act
Stephens' Banded Snake <i>Hoplocephalus stephensii</i>	Inhabits coastal rainforests and wet sclerophyll forests, nesting in hollows.	Suitable foraging and roosting habitat present. Not observed during surveys.	V	-
Magpie Goose <i>Anseranas semipalmata</i>	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.	No suitable habitat present.	V	-
Wompoo Fruit-Dove <i>Ptilinopus superbus</i>	Inhabits large undisturbed patches of lowland and adjacent highland rainforest and moist eucalypt forests where it feeds on fruit.	Suitable foraging and roosting habitat present. Not observed during surveys.	V	-
Superb Fruit-dove <i>Ptilinopus superbus</i>	Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits.	Suitable foraging and roosting habitat present. Not observed during surveys.	V	-
Rose-crowned Fruit-dove <i>Ptilinopus regina</i>	Occurs in dense rainforests with a substantial understorey where it feeds entirely on fruit.	Suitable foraging and roosting habitat present. Not observed during surveys.	V	-
Black-necked Stork <i>Ephippiorhynchus asiaticus</i>	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats.	Suitable foraging and roosting habitat present. Not observed during survey.	E	-
Australasian Bittern <i>Botaurus poiciloptilus</i>	Inhabits shallow freshwater or brackish wetlands with tall dense beds of reeds, sedges or rush species and swamp edges.	Suitable foraging and roosting habitat present. Not observed during survey.	E	-
Black Bittern <i>Ixobrychus flavicollis</i>	Freshwater & brackish streams & ponds.	Suitable foraging and roosting habitat present. Not observed during survey.	V	-
Osprey <i>Pandion haliaetus</i>	Utilizes waterbodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding.	No suitable habitat present.	V	-
Square-tailed Kite <i>Lophoictinia isura</i>	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.	Suitable foraging and roosting habitat present. Not observed during survey	V	-

TABLE 1.3 RECORDED THREATENED FAUNA OF THE AREA				
Common name <i>Scientific name</i>	Preferred habitat	Comments	TSC Act	EPBC Act
Black-breasted Buzzard <i>Hamirostra melanosternon</i>	Utilizes variety of open habitats from riverine and tropical eucalypt woodlands to shrub steppes, arid scrubs, grassy plains and sandy deserts.	Suitable foraging and roosting habitat present. Not observed during survey	V	-
Little Eagle <i>Hieraaetus morphnoides</i>	Inhabits a variety of habitats including woodland open forest, partially cleared areas, along watercourses and around wetlands.	Suitable foraging and roosting habitat present. Observed during surveys.	V	-
Bush Stone-curlew <i>Burhinus grallarius</i>	Utilises open forests and savanna woodlands, sometimes dune scrub, savannah and mangrove fringes.	Suitable roosting and foraging habitat present. Not observed/ detected during survey.	E1	-
Pied Oystercatcher <i>Haematopus longirostris</i>	Inhabits coastal beaches and estuarine flats.	No suitable habitat present.	V	-
Sooty Oystercatcher <i>Haematopus fuliginosus</i>	Exclusively coastal in distribution foraging along rocky coastlines and estuaries.	No suitable habitat present.	V	-
Glossy Black-Cockatoo <i>Calyptorhynchus lathamii</i>	Open forests with <i>Allocasuarina</i> species and hollows for nesting.	Suitable foraging habitat present. Not observed /detected during surveys.	V	-
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	Prefers wetter forests and woodlands from sea level to > 2000m on Divide, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens.	Suitable foraging and roosting habitat present. Not observed during surveys.	V	-
Little Lorikeet <i>Glossopsitta pusilla</i>	Inhabits forests and woodlands feeding mostly on nectar and pollen particularly in profusely-flowering eucalypts.	Suitable foraging and roosting habitat present. Observed during surveys.	V	-
Swift Parrot <i>Lathamus discolor</i>	Inhabits eucalypt forests and woodlands with winter flowering eucalypts.	Suitable foraging habitat present. Not observed during surveys. Surveys conducted outside of migratory period.	E1	E

TABLE 1.3 RECORDED THREATENED FAUNA OF THE AREA				
Common name <i>Scientific name</i>	Preferred habitat	Comments	TSC Act	EPBC Act
Turquoise Parrot <i>Neophema pulchella</i>	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands.	Suitable foraging and roosting habitat present. Not observed during surveys.	V	-
Powerful Owl <i>Ninox strenua</i>	Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting.	Suitable foraging and roosting habitat present. Observed during surveys.	V	-
Barking Owl <i>Ninox connivens</i>	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting.	Suitable foraging and roosting habitat present. Not observed/ detected during surveys.	V	-
Sooty Owl <i>Tyto tenebricosa</i>	Tall, dense, wet forests containing trees with very large hollows.	Suitable foraging and roosting habitat present. Observed during surveys.	V	-
Masked Owl <i>Tyto novaehollandiae</i>	Open forest & woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting.	Suitable foraging and roosting habitat present. Not observed/ detected during surveys.	V	-
Speckled Warbler <i>Pyrholaemus sagittatus</i>	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast.	No suitable habitat present.	V	-
Regent Honeyeater <i>Xanthomyza phrygia</i>	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts.	Suitable foraging habitat present. Not observed / recorded within subject site.	CE	E
White-fronted Chat <i>(Epthianura albifrons)</i>	Found in estuarine and marshy and damp open grassland habitats on the coast and open grassy plains, saltlakes and salt pans that are along the margins of rivers and waterways in inland areas.	No suitable habitat present.	V	-

TABLE 1.3 RECORDED THREATENED FAUNA OF THE AREA				
Common name <i>Scientific name</i>	Preferred habitat	Comments	TSC Act	EPBC Act
Grey-crowned Babbler <i>Pomatostomus temporalis temporalis</i>	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Also found in farmland habitats with isolated trees.	No suitable habitat present.	V	-
Varied Sittella <i>Daphoenositta chrysoptera</i>	Prefers open eucalypt woodlands and forests, mallee, inland acacia, coastal tee-tree scrubs, parks and gardens.	Suitable foraging and shelter habitat present. Not observed during surveys.	V	-
Scarlet Robin <i>Petroica boodang</i>	Dry eucalypt forest and woodlands with open understorey during breeding season, dispersing during autumn–winter into open habitats including urban areas.	Suitable foraging and shelter habitat present. Not observed during surveys.	V	-
Diamond Firetail <i>Stagonopleura guttata</i>	Found in Eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys.	No suitable habitat present.	V	-
Spotted-tailed Quoll <i>Dasyurus maculatus</i>	Dry and moist open forests containing rock caves, hollow logs or trees. Distribution Limit- N-Mt Warning National Park S-South of Eden.	Suitable foraging and shelter habitat present. Not observed during surveys.	V	V
Southern Brown Bandicoot <i>Isoodon obesulus</i>	Utilises a range of habitats containing thick ground cover - open forest, woodland, heath, cleared land, urbanised areas and regenerating bushland. Distribution Limit - N-Kempsey. S-South of Eden.	No suitable habitat present. Not observed during surveys.	E1	E
Koala <i>Phascolarctos cinereus</i>	Inhabits both wet & dry eucalypt forest on high nutrient soils containing preferred feed trees. Distribution Limit - N-Tweed Heads. S-South of Eden.	No suitable habitat present. Not observed during surveys.	V	-
Eastern Chestnut Mouse <i>Pseudomys gracilicaudatus</i>	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.	No suitable habitat present. Not observed during surveys.	V	-
Eastern Pygmy Possum <i>Cercartetus nanus</i>	Inhabits a variety of environments, both coastal and higher elevations south of Newcastle and at higher elevations north of Newcastle.	Suitable foraging and shelter habitat present. Not observed during surveys.	V	-

TABLE 1.3 RECORDED THREATENED FAUNA OF THE AREA				
Common name Scientific name	Preferred habitat	Comments	TSC Act	EPBC Act
Yellow-bellied Glider <i>Petaurus australis</i>	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. Detected during surveys.	V	-
Squirrel Glider <i>Petaurus norfolcensis</i>	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. Distribution Limit - N-Tweed Heads S-Albury.	Suitable foraging and shelter habitat present. Not observed during surveys.	V	-
Long-nosed Potoroo <i>Potorous tridactylus</i>	Coastal heath and dry and wet sclerophyll forests. Distribution Limit - N-Mt Warning National Park. S-South of Eden.	No suitable habitat present. Not observed during surveys.	V	V
Parma Wallaby <i>Macropus parma</i>	Inhabits rainforests and wet and dry sclerophyll forests with a dense understorey and associated grassy patches. Distribution Limit - N-Border Ranges National Park. S-Morton National Park.	Suitable foraging and shelter habitat present. Not observed during surveys.	V	-
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	Occurs primarily along the eastern coastal plains of NSW. It is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, Melaleuca swamps and Banksia woodlands (NPWS, 2000).	Suitable foraging and roosting habitat present. Observed during surveys.	V	V
Yellow-bellied Sheath-tail- bat <i>Saccolaimus flaviventris</i>	Rainforests, sclerophyll forests and woodlands. Distribution Limit - N-North of Walgett. S-Sydney.	Suitable foraging and roosting habitat present. Observed during surveys.	V	-
Eastern Freetail-bat <i>Mormopterus norfolkensis</i>	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. Observed during surveys.	V	-
Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	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 National Park. S-Wollongong.	Suitable foraging and roosting habitat present. Not detected during surveys.	V	V
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	Recorded roosting in caves, old buildings and tree hollows. Distribution Limit- N-Border Ranges National Park S-Pambula.	Suitable foraging and roosting habitat present. Detected during surveys.	V	-
Little Bentwing-bat <i>Miniopterus australis</i>	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 and roosting habitat present. Detected during surveys.	V	-

TABLE 1.3 RECORDED THREATENED FAUNA OF THE AREA				
Common name <i>Scientific name</i>	Preferred habitat	Comments	TSC Act	EPBC Act
Eastern Bentwing-bat <i>Miniopterus schreibersii oceansis</i>	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 and roosting habitat present. Detected during surveys.	V	-
Southern Myotis <i>Myotis macropus</i>	Rainforests and sclerophyll forests near creeks and lakes over which it feeds. Roosts in tree hollows, caves, mines and tunnels. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Suitable foraging and roosting habitat present. Not detected during surveys.	V	-
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>	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. Detected during surveys.	V	-
Giant Dragonfly <i>Petalura gigantea</i>	Inhabits large relatively deep permanent swamps and bogs with high water quality and moss or other soft vegetation along the edge for egg laying. It occurs in the far NE NSW, south to Kempsey, & in a patch between Gosford & Nowra.	Suitable habitat present. Not observed during surveys.	E	-
CE = Critically Endangered E = Endangered V = Vulnerable				

SECTION 2

FLORA CHARACTERISTICS

2.1 FLORA SURVEY METHODOLOGY

To determine the likely and actual occurrence of flora species and plant communities on the subject site field survey work was undertaken to supplement literature reviews and previous flora surveys of the area. The flora survey methods applied within the subject site were completed in accordance with the Lower Hunter Central Coast Region - Flora and Fauna Survey Guidelines (LHCCREMS, 2002).

Literature Review

A review of available literature for the area was undertaken to obtain reference material and background information for this study. Two local vegetation survey and mapping projects, (House 2003, Bell 2004) have been completed within and adjoining parts of the subject site. The vegetation mapping and corresponding vegetation types from these studies were used to represent the distribution of vegetation communities within the local area.

A search of the Atlas of NSW Wildlife (NPWS 2010) was undertaken to identify records of threatened flora species located within 10km of the site. This enabled the preparation of a predictive list of threatened flora species that could possibly occur within the habitats found on the site. The results of this database search are provided in Table 1.1.

Aerial Photograph Interpretation (API)

The site's vegetation community boundaries were initially identified using API of vegetation within the subject site from an aerial photo. Analysis of this photo identified past land use practices, disturbances, native vegetation regrowth, changes in vegetation structure and floristics throughout the subjects site represented by changes in colour, patterns and height of the vegetation. This analysis provided an initial split of the vegetation communities within the subject site into simple structural and disturbance classifications.

Field Survey

Detailed field surveys were undertaken on the 24 September 2007, and 13, 14 February 2008.

The field surveys consisted of a meandering transect surveys (Cropper 1993), targeted threatened species searches and sampling of systematically placed 20 x 20 metre flora quadrats within vegetation communities identified by aerial photo interpretation or subsequently during the field validation to occur within the area of impact. The transect survey assisted in the ground truthing of the vegetation community boundaries and identification of the dominant floristic species observed within each vegetation community.

Quadrat Survey

The locations of the flora quadrats were generally restricted to the areas of direct or indirect impacts from the proposed development ('the study area') and gave consideration to important influencing environmental variables such as geographic location; geology, soil type and/or physiographic location. The quadrat survey was completed to assist in identifying the dominant floristic characteristics of each vegetation community and provided detailed information on community's structure and their complete floristic assemblage.

A total of nine (9) 20 X 20 metre quadrat plots were completed within the subject site.

Physical attributes of quadrats

The following physical attributes of each quadrat location were recorded and incorporated into the community description:

- topographic position;
- slope;
- aspect;
- general soil type (for example, clay, sand, loam, skeletal).

Structural attributes of quadrats

Each 20 x 20m plot survey recorded the presence of vascular plant taxa and assigned a cover abundance estimate for each species based on a modified Braun-Blanquet 1-6 scale. The cover abundance values for each 1 to 6 class is provided in Table 2.1.

Determination of species composition as well as structural descriptions of the vegetation on the site according to Specht *et. al.* (1995) was also carried out.

TABLE 2.1 COVER ABUNDANCE SCALE USED IN FLORISTIC SURVEY		
Class	Cover Abundance	Notes
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: < 5 individuals Shrubs and small trees: < 5 individuals
2	Many individuals (less than 5% cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 –20% cover	
4	20 –50% cover	
5	50 –70% cover	
6	70 – 100% cover	

Floristic attributes of quadrats

All vascular plants observed within the quadrat identification. Specimens of plants not readily identified in the field were collected for identification. Vascular plants were identified using keys and nomenclature in Harden (1990a, 1991, 1992 and 1993), Harden and Murray (2000) and Harden, G.J. (2002). Wherever they were known, changes to nomenclature and classification according to Plantnet (2010) or the relevant literature have been incorporated into the results.

Seasonality

The flora surveys have been completed during various seasons over the past few years. These surveys have been completed within the flowering period of the cryptic threatened flora species listed in Table 2.2.

TABLE 2.2 FLOWERING TIMES OF THREATENED CRYPTIC FLORA		
Species	Flowering Period	Surveyed
<i>Caladenia tessellata</i>	September – October	24 September 2007 18 September 2008 30 October 2008
<i>Cryptostylis hunteriana</i>	November – February	13, 14 February 2008

Vegetation Community Nomenclature

The vegetation communities identified within the site were classified according to according to a modified Walker and Hopkins (1990) methodology, however within these descriptions the dominant canopy species are listed after the structural description. For each vegetation community identified within the subject site, corresponding vegetation communities identified within the local area by House (2003) and Bell (2004) are also provided.

Corresponding Endangered Ecological Communities listed on both the *TSC Act* and *EPBC Act* are also provided.

Survey Limitations

The floristic survey was affected by limitations in time, existing levels of disturbance and seasonal influences. Identification to the species level of several specimens recorded in the survey was also limited by the availability of flowering and/or fruiting material. The subject sites diversity of annual herbs and grasses was expected to be underrepresented within the recorded ground flora. These layers were likely to have been underrepresented in sampling due to grazing regimes and slashing that has occurred throughout the majority of the subject site.

2.2 FLORA COMMUNITIES

The vegetation communities present on the subject site are:

1. Coastal Warm Temperate Rainforest- (*Archontophoenix cunninghamiana*, *Acmena smithii* and *Livistona australis*);
2. Coastal Narrabeen Moist Forest – (*Eucalyptus saligna*, *Eucalyptus pilularis* and *Syncarpia glomulifera*);
3. Narrabeen Coastal Blackbutt Forest - (*Eucalyptus pilularis*);
4. Disturbed Vegetation (Regenerating);
5. Grassland with Scattered Trees.

A flora species list is provided in Table 2.3 while a general description of the vegetation communities is provided below. Figure 2.1 shows the distribution of the vegetation on the site.

1. Coastal Warm Temperate Rainforest- (*Archontophoenix cunninghamiana*, *Acmena smithii* and *Livistona australis*).

This vegetation is most similar to Map-unit 1 – Coastal Wet Gully Forest as described by House (2003) and Map-unit 1a – Coastal Warm Temperate Rainforest as described by Bell (2004).

Structure:

Emergent Canopy: To 30 metres in height, with a variable Projected Foliage Cover (PFC) of 5-25%.

Canopy: To 20 metres in height, with a variable 70-80% PFC.

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

Groundlayer: To 2 metres in height, with a variable 15-70% PFC.

Floristics:

(Main Species Present)

Emergent Canopy: *Eucalyptus saligna* (Sydney Blue Gum).

Canopy: *Archontophoenix cunninghamiana* (Bangalow Palm), *Acmena smithii* (Lillypilly), *Doryphora sassafras* (Sassafras), *Alphitonia excelsa* (Red Ash), *Livistona australis* (Cabbage Tree Palm), *Cryptocarya microneura* (Murrogun) and *Acacia schinoides*.

Shrubs: *Lantana camara* (Lantana), *Claoxylon australe* (Brittlewood), *Cyathea cooperi* (Straw Treefern), *Ficus coronata* (Sandpapper Fig), *Rubus rosifolius* (Forest Bramble), *Baloghia inophylla* (Brush Bloodwood) and *Wilkiea heugeliana* (Wilkiea).

Groundlayer: *Adiantum hispidulum* (Rough Maidenhair), *Blechnum cartilagineum* (Gristle Fern), *Carex longibracteata*, and *Viola hederacea* (Ivy-leaved Violet).

Vines: *Ripogonum fawcettianum* (Small Supplejack), *Morinda jasminoides*, *Smilax australis* (Lawyer Vine), *Smilax glycyphylla* (Sarsaparilla), *Flagellaria indica* (Whip Vine), *Stephania japonica* var. *discolor* (Snake Vine).

Disturbance:

This community has been disturbed by past logging, grazing and weed invasion. High levels of edge effects from the surrounding cleared agricultural land have also affected this community and some minor evidence of gully erosion.

Weed Invasion:

This community exhibits a moderate to high level of exotic weed invasion throughout, primarily in the shrub layer.

Variation:

The main variations within this community are associated with levels of disturbance or weed invasion and the broad transitions with the adjoining Coastal Narrabeen Moist Forest.

Location and Distribution:

This vegetation community is restricted to the bed of the steep well defined gully in the western drainage line of the subject site.

2. Coastal Narrabeen Moist Forest – (*Eucalyptus saligna*, *Eucalyptus pilularis* and *Syncarpia glomulifera*);

This vegetation is most similar to Map-unit 1 – Coastal Wet Gully Forest as described by House (2003) and Map-unit 6a – Coastal Narrabeen Moist Forest as described by Bell (2004).

Structure:

Canopy: To 30 metres in height, with a variable Projected Foliage Cover (PFC) of 25-50%.

Secondary: To 20 metres in height, with a variable 60-80% PFC.

Shrubs: To 5 metres in height, with a variable 40% PFC.

Groundlayer: To 2 metres in height, with a variable 50% PFC.

Floristics:

(Main Species Present)

Canopy: *Eucalyptus saligna* (Sydney Blue Gum), *Eucalyptus pilularis* (Blackbutt) and *Syncarpia glomulifera* (Turpentine).

Secondary: *Ligustrum sinense* (Small-leaved Privet), *Acmena smithii* (Lillypilly), *Doryphora sassafras* (Sassafras), *Acacia schinoides*, *Acacia prominens* (Gosford Wattle), *Alphitonia excelsa* (Red Ash), *Callicoma serratifolia* (Black Wattle), *Cryptocarya microneura* (Murrogun) and *Cinnamomum camphora* (Camphor Laurel).

Shrubs: *Lantana camara* (Lantana), *Citriobatus pauciflorus* (Orange Thorn), *Cyathea cooperi* (Straw Treefern), *Polyscias sambucifolia* (Elderberry), *Panax*, *Rubus rosifolius* (Forest Bramble), *Trochocarpa laurina* (Tree Heath) and *Wilkiea heugeliana* (Wilkiea).

Groundlayer: *Adiantum hispidulum* (Rough Maidenhair), *Blechnum cartilagineum* (Gristle Fern), *Carex longibracteata*, *Cissus hypoglaucia* (Water Vine), *Doodia aspera* (Rasp Fern), *Entolasia marginata* (Bordered Panic), *Gahnia aspera* (Saw Sedge), *Ehrharta erecta* (Panic Veldtgrass), *Gymnostachys anceps* (Settlers Flax), *Hypolepis Muelleri* (Harsh Ground Fern), *Oplismenus imbecillis* (Basket Grass), *Smilax australis* (Lawyer Vine), *Smilax glycyphylla* (Sarsaparilla), *Stephania japonica* var. *discolor* (Snake Vine) and *Viola hederacea* (Ivy-leaved Violet).

Disturbance:

This community has been disturbed by past logging and more recently underscrubbing within the southwest portions. High levels of edge effects from the surrounding cleared agricultural land have also affected this community. There are some minor disturbances associated with construction of a bridge within the northwest of the site and some minor evidence of gully erosion.

Weed Invasion:

This community exhibits a moderate to very high levels of exotic weed invasion throughout, primarily in the shrub and ground layer.

Variation:

The main variations within this community are associated with levels of disturbance. The recently underscrubbed parts of this community in the southwest of the subject site have very little foliage cover within the secondary tree and shrub layers while portions of the central drainage line have very little of the canopy cover remaining.

Location and Distribution:

This vegetation community occurs along the drainage lines of the site.

3. Narrabeen Coastal Blackbutt Forest - (*Eucalyptus pilularis*)

This vegetation is most similar to a mixture of Map-unit 6 – Coastal Narrabeen Moist Forest and Map-unit 22 – Coastal Narrabeen Shrub Forest as described by House (2003) and a mixture of Map unit Xr - Disturbed Land – Canopy only, Map-unit 6a – Coastal Narrabeen Moist Forest and Map-unit 22a – Narrabeen Coastal Blackbutt Forest as described by Bell (2004).

Structure:

Canopy: To 30 metres in height with 45-55% PFC.

Shrubs: To 15 metres in height with 5-20% PFC.

Ground-layer: To 1.5 metres high with 60% PFC.

Floristics:

(Main Species Present)

Canopy: *Eucalyptus saligna* (Sydney Blue Gum), *Eucalyptus pilularis* (Blackbutt), *Syncarpia glomulifera* (Turpentine), *Angophora floribunda* (Rough-barked Apple) and *Allocasuarina torulosa* (Forest Oak).

Shrubs: *Lantana camara* (Lantana), *Acacia floribunda* (Sally Wattle), *Breynia oblongifolia* (Coffee Bush), *Synoum glandulosum* (Scentless Rosewood), *Glochidion ferdinandi* (Cheese Tree) and *Ligustrum sinense* (Small-leaved Privet).

Groundlayer: *Doodia aspera* (Rasp Fern), *Entolasia marginata* (Bordered Panic), *Imperata cylindrica* var. *major* (Blady Grass), *Oplismenus imbecillis*, *Dianella caerulea* var. *producta* (Blue Flax Lily), *Hypolepis Muellieri* (Harsh Ground Fern), *Smilax australis* (Lawyer Vine) *Themeda australis* (Kangaroo Grass), *Viola hederacea* (Ivy-leaved Violet), *Ageratina adenophorum* (Crofton Weed), *Bidens pilosa* (Cobbler's Pegs), *Ehrharta erecta* (Panic Veldtgrass), *Pennisetum clandestinum* (Kikuyu), *Rubus anglocandicans* (Blackberry), *Senecio madagascariensis* (Fireweed), *Sida rhombifolia* (Paddy's Lucerne), *Trifolium repens* (White Clover) and *Verbena bonariensis* (Verbena bonariensis).

Variation:

There are two significant variants of this community associated with the degree of underscrubbing, grazing and topographical location.

3a - The area of this community occurring on the western slope of the central north-south running ridge line has been affected by grazing pressures, underscrubbing and past clearing. This variant has a considerably more open canopy and sparse understorey cover.

3b - The variant of this community located on the eastern slope of the central ridge line has a more closed canopy, fewer disturbances and shares many of the mesic shrub and understorey species identified in community 2 – Coastal Narrabeen Moist Forest.

Disturbance:

The majority of this community has been highly disturbed by agricultural practices, including stock grazing and under-scrubbing. There are also a number of vehicle tracks, and a cleared powerline easement running north-south through the centre of the site. The majority of this community has been highly infested by exotic weed species.

Weed Invasion:

Weed invasion is high within this vegetation community.

Location and Distribution:

This community is located in the central, northern and southern parts of the subject site associated with the lower to upper slopes.

4. Disturbed Vegetation (Regenerating)

This vegetation is most similar to a disturbed variant of Map-unit 6 – Coastal Narrabeen Moist Forest as described by House (2003) and a mixture of Map-unit Xs – Disturbed Regrowth and Map-unit 6a – Coastal Narrabeen Moist Forest as described by Bell (2004).

Structure:

Canopy: To 20 metres high with 25-45% PFC

Shrubs: To 10 metres high with 15-20% PFC

Groundlayer: To 2 metres high with 80% PFC

Floristics:

(Main Species Present)

Canopy: *Alphitonia excelsa* (Red Ash), *Cinnamomum camphora* (Camphor Laurel), *Cryptocarya microneura* (Murrogun) and *Syncarpia glomulifera* (Turpentine).

Shrubs: *Acacia binervia* (Coast Myall), *Glochidion ferdinandi* (Cheese Tree), *Lantana camara* (Lantana), *Ligustrum sinense* (Small-leaved Privet) and *Solanum mauritianum* (Wild Tobacco).

Groundlayer: *Ageratina adenophorum* (Crofton Weed), *Ehrharta erecta* (Panic Veldtgrass), *Microlaena stipoides* var. *stipoides* (Weeping Rice Grass), *Oplismenus imbecillis*, *Pennisetum clandestinum* (Kikuyu), *Plantago lanceolata* (Plantago lanceolata),

Weeds: *Ageratina adenophorum* (Crofton Weed), *Cinnamomum camphora* (Camphor Laurel), *Ehrharta erecta* (Panic Veldtgrass), *Lantana camara* (Lantana), *Ligustrum sinense* (Small-leaved Privet), *Pennisetum clandestinum* (Kikuyu), *Plantago lanceolata* (Plantago lanceolata), *Senecio madagascariensis* Fireweed), *Sida rhombifolia* (Paddy's Lucerne), *Solanum mauritianum* (Wild Tobacco), *Trifolium repens* (White Clover) and *Verbena bonariensis* (Verbena bonariensis).

Variation:

There is very little variation within his community.

Disturbance:

This community has been highly disturbed by underscrubbing and very high levels of exotic weed invasion. A large portion of this community has been cleared in the past, probably for agricultural uses.

Weed Invasion:

Weed invasion within this community is high and present in all structural layers.

Location and Distribution:

This community occurs in the southern portions of the site and is associated with the upper slopes.

5. Grassland With Scattered Trees**Structure:**

Groundlayer: To 1 metre high with variable 75-95% PFC.

Floristics:

(Main Species Present)

Groundlayer: *Ageratina adenophorum* (Crofton Weed), *Chloris gayana* (Rhodes Grass), *Cynodon dactylon* (Common Couch), *Ehrharta erecta* (Panic Veldtgrass), *Microlaena stipoides* var. *stipoides* (Weeping Rice Grass), *Oplismenus imbecillis*, *Paspalum dilatatum* (Paspalum), *Pennisetum clandestinum* (Kikuyu), *Plantago lanceolata* (Plantago lanceolata), *Senecio madagascariensis* Fireweed), *Sida rhombifolia* (Paddy's Lucerne), *Solanum mauritianum* (Wild Tobacco), *Trifolium repens* (White Clover) and *Verbena bonariensis* (Verbena bonariensis).

Disturbance:

The entire community has been disturbed by previous land clearing, grazing and high levels of exotic weed invasion.

Weed Invasion:

This community exhibits a high level of exotic weed invasion throughout.

Variation:

There is very little variation throughout this community.

Location and Distribution:

This vegetation community occurs in patches throughout the entire subject site.

2.3 FLORA SPECIES LIST

Flora species observed during the flora surveys are listed in Table 2.3.

TABLE 2.3 FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
TREES		
Araliaceae	<i>Polyscias murrayi</i>	Pencil Cedar
Arecaceae	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm
	<i>Livistona australis</i>	Cabbage Tree Palm
Casuarinaceae	<i>Allocasuarina torulosa</i>	Forest Oak
	<i>Casuarina glauca</i>	Swamp Oak
Cunoniaceae	<i>Callicoma serratifolia</i>	Black Wattle
	<i>Ceratopetalum apetalum</i>	Coachwood
	<i>Schizomeria ovata</i>	Crab Apple
Cyatheaceae	<i>Cyathea cooperi</i>	Straw Treefern
Dicksoniaceae	<i>Dicksonia antarctica</i>	Tree Fern
Elaeocarpaceae	<i>Sloanea australis</i>	Maidens Blush
	<i>Elaeocarpus reticulatus</i>	Blueberry Ash
Euphorbiaceae	<i>Claoxylon australe</i>	Brittlewood
Euphorbiaceae	<i>Glochidion ferdinandii</i>	Cheese Tree
Lauraceae	<i>Cinnamomum camphora</i> *	Camphor Laurel
	<i>Cryptocarya microneura</i>	Murrogun
	<i>Endiandra sieberi</i>	Corkwood
Meliaceae	<i>Synoum glandulosum</i>	Scentless Rosewood
Mimosaceae	<i>Acacia irrorata</i> subsp. <i>irrorata</i>	Green Wattle
	<i>Acacia maidenii</i>	Maiden's Wattle
	<i>Acacia prominens</i>	Gosford Wattle
	<i>Acacia schinoides</i>	-
Monimiaceae	<i>Doryphora sassafras</i>	Sassafras
Moraceae	<i>Ficus coronata</i>	Sandpaper Fig
Myrsinaceae	<i>Rapanea howittiana</i>	Brush Muttonwood
Myrtaceae	<i>Acmena smithii</i>	Lillypilly
	<i>Angophora floribunda</i>	Rough-barked Apple
	<i>Backhousia myrtifolia</i>	Grey Myrtle
	<i>Eucalyptus acmenoides</i>	White Mahogany
	<i>Eucalyptus pilularis</i>	Blackbutt
	<i>Eucalyptus punctata</i>	Grey Gum
	<i>Eucalyptus robusta</i>	Swamp Mahogany
	<i>Eucalyptus saligna</i>	Sydney Blue Gum
	<i>Eucalyptus siderophloia</i>	Northern Grey Ironbark
	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark
	<i>Neolitsea dealbata</i>	White Bolly Gum
	<i>Syncarpia glomulifera</i>	Turpentine
Oleaceae	<i>Notelaea longifolia</i>	Mock Olive
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum
Proteaceae	<i>Stenocarpus salignus</i>	Scrub Beefwood
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash
Rutaceae	<i>Melicope micrococca</i>	White Euodia

TABLE 2.3 FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
TREES		
Sapindaceae	<i>Diploglottis australis</i>	Native Tamarind
	<i>Guioa semiglauc</i>	Guioa
SHRUBS		
Araliaceae	<i>Astrotricha latifolia</i>	Broad-leaf Star-hair
	<i>Polyscias sambucifolia</i>	Elderberry Panax
Asclepidaceae	<i>Gomphocarpus fruticosus</i> *	Narrow Leaf Cotton Bush
Asteraceae	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> *	Boneseed
	<i>Ozothamnus diosmifolius</i>	Ball Everlasting
Celastraceae	<i>Maytenus silvestris</i>	-
Cesalpiniaceae	<i>Senna pendula</i> var. <i>glabrata</i> *	-
Epacridaceae	<i>Trochocarpa laurina</i>	Tree Heath
Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush
	<i>Omalanthus populifolius</i>	Bleeding Heart
Fabaceae	<i>Podolobium ilicifolium</i>	Prickly Shaggy Pea
Melastomataceae	<i>Tibouchina urvilleana</i> *	-
Mimosaceae	<i>Acacia binervia</i>	Coast Myall
	<i>Acacia floribunda</i>	Sally Wattle
	<i>Acacia longifolia</i> var. <i>longifolia</i>	Sydney Golden Wattle
	<i>Acacia suaveolens</i>	Sweet Scented Wattle
	<i>Acacia terminalis</i>	Sunshine Wattle
Monimiaceae	<i>Wilkiea heugeliana</i>	Wilkiea
Myrtaceae	<i>Baloghia inophylla</i>	Brush Bloodwood
	<i>Rhodamnia rubescens</i>	Brush Turpentine
Ochnaceae	<i>Ochna serrulata</i> *	Mickey Mouse Plant
Oleaceae	<i>Ligustrum sinense</i> *	Small-leaved Privet
Phytolaccaceae	<i>Phytolacca octandra</i> *	Inkweed
Pittosporaceae	<i>Citriobatus pauciflorus</i>	Orange Thorn
	<i>Pittosporum revolutum</i>	Yellow Pittosporum
Proteaceae	<i>Persoonia pinifolia</i>	Pine-leaved Geebung
Rosaceae	<i>Rubus anglocandicans</i> *	Blackberry
	<i>Rubus rosifolius</i>	Forest Bramble
Rutaceae	<i>Asterolasia correifolia</i>	-
Sapindaceae	<i>Dodonaea triquetra</i>	Hop Bush
Solanaceae	<i>Nicotiana glauca</i>	Tree Tobacco
	<i>Solanum mauritianum</i> *	Wild Tobacco
	<i>Solanum stelligerum</i>	Devil's Needles
Verbenaceae	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum
	<i>Lantana camara</i> *	Lantana
Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower
Adiantaceae	<i>Adiantum hispidulum</i>	Rough Maidenhair
	<i>Adiantum formosum</i>	Giant Maidenhair

TABLE 2.3 FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
SHRUBS		
Apiaceae	<i>Centella asiatica</i>	Swamp Pennywort
	<i>Hydrocotyle peduncularis</i>	Pennywort
	<i>Hydrocotyle tripartita</i>	Pennywort
Araceae	<i>Gymnostachys anceps</i>	Settlers Flax
Araeaceae	<i>Zantedeschia aethiopica</i> *	White Arum Lily
Asteraceae	<i>Ageratina adenophorum</i> *	Crofton Weed
	<i>Ageratina riparia</i> *	Mist Flower
	<i>Bidens pilosa</i> *	Cobbler's Pegs
	<i>Bidens subalternans</i> *	Graeter Beggar's Tick
	<i>Cirsium vulgare</i> *	Spear Thistle
	<i>Conyza albida</i> *	Fleabane
	<i>Conyza canadensis</i> *	Tall Fleabane
	<i>Euchiton involucrat</i>	Star Cudweed
	<i>Hypochaeris radicata</i> *	Flatweed
	<i>Senecio hispidulus</i> var. <i>dissectus</i>	Fireweed
	<i>Senecio linearifolius</i>	Fireweed
	<i>Senecio madagascariensis</i> *	Fireweed
	<i>Sigesbeckia orientalis</i>	Indian Weed
	<i>Sonchus oleraceus</i> *	Common Sow-thistle
	<i>Tagetes minuta</i> *	Stinking Roger
	<i>Taraxacum officinale</i> *	Dandelion
Blechnaceae	<i>Blechnum cartilagineum</i>	Gristle Fern
	<i>Blechnum nudum</i>	-
	<i>Doodia aspera</i>	Rasp Fern
Campanulaceae	<i>Wahlenbergia gracilis</i>	Australian Bluebell
Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed
	<i>Tradescantia fluminensis</i> *	Wandering Jew
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed
Cyperaceae	<i>Carex appressa</i>	Tall Sedge
	<i>Carex longibracteata</i>	-
	<i>Cyperus eragrostis</i> *	Umbrella Sedge
	<i>Cyperus gracilis</i>	-
	<i>Cyperus polystachyos</i>	-
	<i>Cyperus sesquiflorus</i> *	-
	<i>Gahnia aspera</i>	Saw Sedge
	<i>Gahnia clarkei</i>	Tall Saw-sedge
	<i>Lepidosperma laterale</i>	Variable Sword-sedge
Dennstaedtiaceae	<i>Histiopteris incisa</i>	Bat's Wing Fern
	<i>Hypolepis muelleri</i>	Harsh Ground Fern
	<i>Pteridium esculentum</i>	Bracken
Dicksoniaceae	<i>Calochlaena dubia</i>	False Bracken
Dryopteridaceae	<i>Lastreopsis decomposita</i>	Trim Shield Fern

TABLE 2.3 FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
SHURBS		
Fabaceae	<i>Trifolium repens</i> *	White Clover
Gentianaceae	<i>Centaurium erythraea</i> *	Pink Stars
Geraniaceae	<i>Geranium homeanum</i>	Northern Cranesbill
	<i>Geranium solanderi</i>	Cutleaf Cranesbill
Juncaceae	<i>Juncus continuus</i>	-
	<i>Juncus usitatus</i>	Common Rush
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne
Osmundaceae	<i>Todea barbara</i>	King Fern
Oxalidaceae	<i>Oxalis perrenans</i>	-
Phormiaceae	<i>Dianella caerulea</i> var. <i>producta</i>	Blue Flax Lily
Plantaginaceae	<i>Plantago lanceolata</i> *	Ribwort
Poaceae	<i>Andropogon virginicus</i> *	Whisky Grass
	<i>Aristida vagans</i>	Three-awn Speargrass
	<i>Axonopus affinis</i> *	Narrow-leaved Carpet Grass
	<i>Bothriochloa decipiens</i>	Redleg Grass
	<i>Briza maxima</i> *	Quaking Grass
	<i>Chloris gayana</i> *	Rhodes Grass
	<i>Chloris truncata</i>	Windmill Grass
	<i>Cymbopogon refractus</i>	Barbwire Grass
	<i>Cynodon dactylon</i>	Common Couch
	<i>Dichelachne micrantha</i>	Short-hair Plume Grass
	<i>Digitaria parviflora</i>	Small-flowered Finger Grass
	<i>Digitaria sanguinalis</i> *	Crab Grass
	<i>Echinochloa crus-galli</i> *	Barnyard Grass
	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Tufted Hedgehog Grass
	<i>Ehrharta erecta</i> *	Panic Veldtgrass
	<i>Entolasia marginata</i>	Bordered Panic
	<i>Entolasia stricta</i>	Wiry Panic
	<i>Eragrostis brownii</i>	Brown's Lovegrass
	<i>Eragrostis curvula</i> *	African Lovegrass
	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass
	<i>Lolium perenne</i> *	Perennial Ryegrass
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Rice Grass
	<i>Oplismenus aemulus</i>	Basket Grass
	<i>Oplismenus imbecillis</i>	-
	<i>Paspalidium distans</i>	-
	<i>Paspalum dilatatum</i> *	Paspalum
	<i>Paspalum urvillei</i> *	Vasey Grass
	<i>Pennisetum clandestinum</i> *	Kikuyu

TABLE 2.3 FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
SHRUBS		
	<i>Setaria gracilis</i> *	Slender Pigeon Grass
	<i>Setaria pumila</i> *	Pale Pigeon Grass
	<i>Sporobolus africanus</i> *	Parramatta Grass
	<i>Themeda australis</i>	Kangaroo Grass
Polygonaceae	<i>Acetosa saggitata</i> *	Turkey Rhubarb
	<i>Persicaria decipiens</i>	Slender Knotweed
	<i>Persicaria lapathifolia</i>	Pale Knotweed
	<i>Rumex crispus</i> *	Curled Dock
	<i>Microsorium scandens</i>	Fragrant Fern
Primulaceae	<i>Anagallis arvensis</i> *	Scarlet Pimpernel
Ranunculaceae	<i>Ranunculus lappaceus</i> var. <i>lappaceus</i>	Glossy Buttercup
Rubiaceae	<i>Pomax umbellata</i>	Pomax
Sinopteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Poison Rock Fern
	<i>Pellaea falcata</i>	Sickle Fern
Solanaceae	<i>Solanum nigrum</i> *	Black Nightshade
Thymelaeaceae	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	Slender Rice Flower
Verbenaceae	<i>Verbena bonariensis</i> *	Purpletop
	<i>Verbena rigida</i> *	Veined Verbena
Violaceae	<i>Viola hederacea</i>	Ivy-leaved Violet
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod
Asclepiadaceae	<i>Marsdenia rostrata</i>	Common Milk Vine
	<i>Tylophora barbata</i>	Bearded Tylophora
Basellaceae	<i>Anredera cordifolia</i> *	Madiera Vine
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Vine
Convolvulaceae	<i>Ipomoea indica</i> *	Coastal Morning Glory
Dilleniaceae	<i>Hibbertia dentata</i>	Twining Guinea Flower
	<i>Hibbertia scandens</i>	Climbing Guinea-flower
Dioscoreaceae	<i>Dioscorea transversa</i>	Native Yam
Fabaceae	<i>Desmodium rhytidophyllum</i>	-
	<i>Glycine clandestina</i>	Twining Glycine
	<i>Kennedia rubicunda</i>	Dusky Coral Pea
	<i>Vicia sativa</i> subsp. <i>sativa</i> *	Common Vetch
Flagellariaceae	<i>Flagellaria indica</i>	Whip Vine
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry
	<i>Geitonoplesium cymosum</i>	Scrambling Lily
Menispermaceae	<i>Sarcopetalum harveyanum</i>	Pearl Vine
	<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine
Monimiaceae	<i>Palmeria scandens</i>	Anchor Vine
	<i>Passiflora herbertiana</i>	Native Passionfruit
Moraceae	<i>Trophis scandens</i>	Burny Vine
Pittosporaceae	<i>Billardiera scandens</i> var. <i>scandens</i>	Apple Dumplings
Polygonaceae	<i>Muehlenbeckia gracillima</i>	Slender Lignum

TABLE 2.3 FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
SHRUBS		
Rubiaceae	<i>Morinda jasminoides</i>	-
Smilacaceae	<i>Ripogonum fawcettianum</i>	Small Supplejack
	<i>Smilax australis</i>	Lawyer Vine
	<i>Smilax glycyphylla</i>	Sarsaparilla
Vitaceae	<i>Cissus antarctica</i>	Native Grape
	<i>Cissus hypoglauca</i>	Water Vine
EPIPHYTES		
Aspleniaceae	<i>Asplenium australasicum</i>	Birds Nest Fern
Polypodiaceae	<i>Platynerium bifurcatum</i> subsp. <i>bifurcatum</i>	Elkhorn
WATERPLANTS		
Cyperaceae	<i>Cyperus difformis</i>	Variable Flat-sedge
	<i>Eleocharis sphacelata</i>	Tall Spike-rush
	<i>Isolepis prolifer</i> *	-
	<i>Schoenoplectus mucronatus</i>	River Clubrush
Juncaceae	<i>Juncus cognatus</i> *	-
	<i>Juncus planifolius</i>	Broad Rush
Typhaceae	<i>Typha australis</i>	Cumbungi
Species name ^{TS} = Threatened Species * = Introduced Species		

2.4 LOCAL DISTRIBUTION OF VEGETATION

Connectivity

The vegetation within the subject site is part of a fragmented and disturbed local landscape. Parts of the site form the northern extension of vegetation that extends to the south within Kincumba Mountain Reserve. The connectivity of the vegetation within the site is isolated to the west, north and north-east by residential land. The main area of connectivity exists in the southern part of the site where the vegetation provides a direct connection to Kincumba Mountain Reserve. A strip of open forest 80-100 metres wide in the south-east part of the site connects to other linear fragments of open forest to the east.

Local Area Vegetation Mapping

Lower Hunter Central Coast Regional Environmental Management (LHCCREMS) Vegetation mapping of the Lower Hunter and Central Coast (House 2003)

The vegetation within and in the vicinity of the subject site has been mapped by House (2003) as Map Units; 1 – Coastal Wet Gully Forest, 6 – Coastal Narrabeen Moist Forest and 22 – Coastal Narrabeen Shrub Forest.

Detailed ground truthing has identified that the Coastal Gully Closed Forest vegetation community is most similar to Map-unit 1 – Coastal Wet Gully Forest, the Tall Moist Open Forest is most similar to a Map-unit 6 – Coastal Narrabeen Moist Forest, the Disturbed Open Forest vegetation community is most similar to a mixture of Map-unit 6 – Coastal Narrabeen Moist Forest and Map-unit 22 – Coastal Narrabeen Shrub Forest and the Disturbed

Woodland vegetation community is most similar to a disturbed variant of Map-unit 6 – Coastal Narrabeen Moist Forest.

The three corresponding House (2003) communities are relatively common within the Central Coast Region with map-unit 1 – Vegetation Coastal Wet Gully Forest occupying 14600 ha, map-unit 6 – Coastal Narrabeen Moist Forest occupying 31167 ha and map-unit 22 – Coastal Narrabeen Shrub Forest occupying 6645 ha within the extant of the mapping project.

The Natural Vegetation of the Gosford Local Government Area, Central Coast NSW (Bell 2004)

The vegetation within and in the vicinity of the subject site has also been mapped by Bell (2004), as Map Units; E1a – Coastal Warm Temperate Rainforest, E6a – Coastal Narrabeen Moist Forest, E22a – Narrabeen Coastal Blackbutt Forest, Xr – Disturbed Canopy Only and Xs – Disturbed Regrowth.

Detailed ground truthing has identified that the Coastal Gully Closed Forest vegetation community is most similar to Map-unit E1ai – Coastal Wet Gully Forest, the Tall Moist Open Forest is most similar to a Map-unit 6ai and (6aiii) – Coastal Narrabeen Moist Forest (Disturbed Variant), the Disturbed Open Forest vegetation community as most similar to a mixture of Xr – Disturbed Canopy Only, Map-unit E6ai – Coastal Narrabeen Moist Forest and Map-unit E22 – Coastal Narrabeen Shrub Forest and the Disturbed Woodland vegetation community is most similar to a disturbed variant of Map-unit 6aiii – Coastal Narrabeen Moist Forest and Map Unit Xs – Disturbed Regrowth.

The extent of each of these communities within the Gosford LGA locality (Bell, 2004) are provided below.

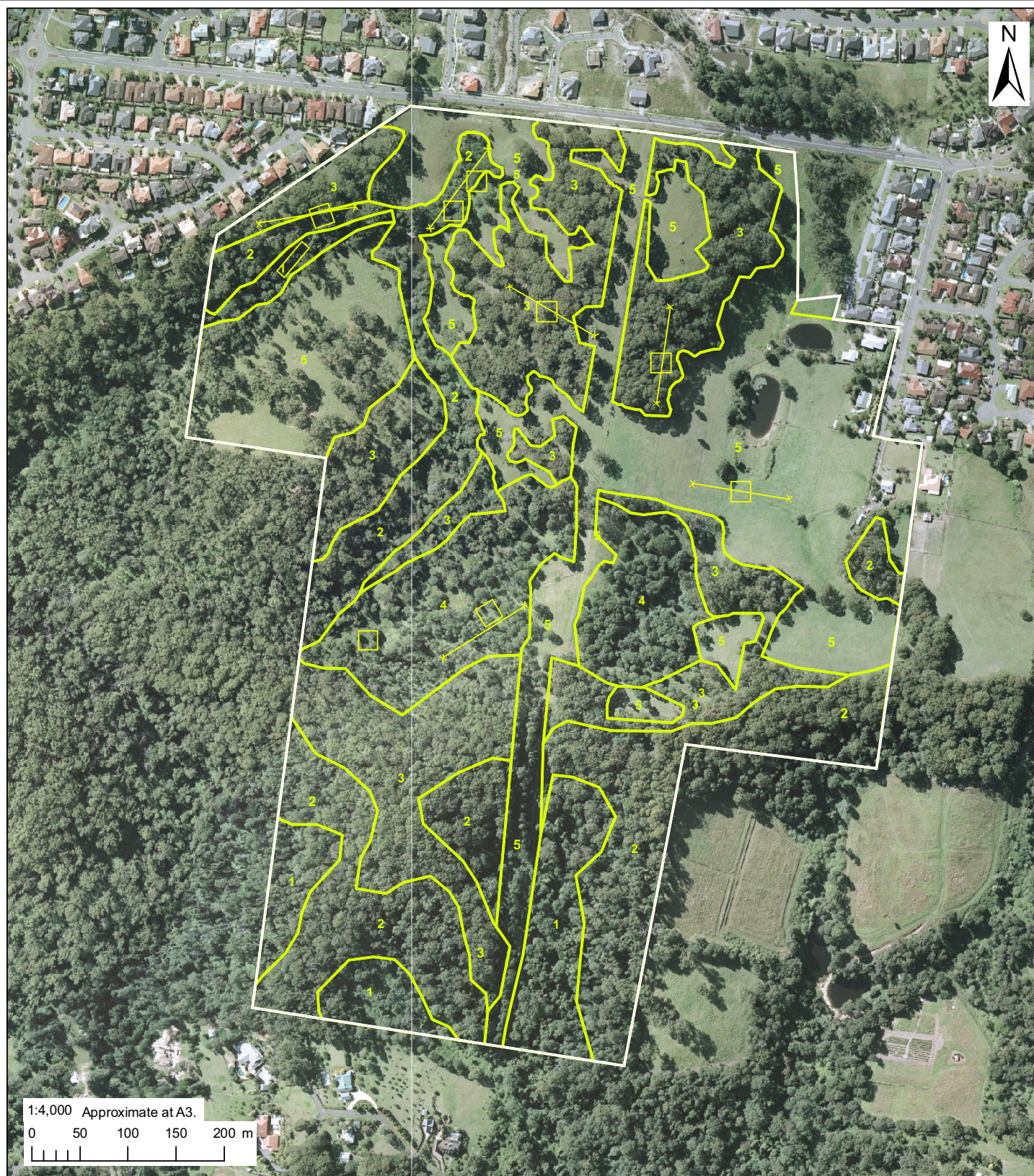
E1a – Coastal Warm Temperate Rainforest	= 738.17ha;
E6a – Coastal Narrabeen Moist Forest	= 4168.48ha;
E22a – Narrabeen Coastal Blackbutt Forest	= 1010.23ha;
Xr – Disturbed Canopy Only	= 3368.77ha;
Xs – Disturbed Regrowth	= 605.23ha.

2.5 CONSERVATION STATUS OF VEGETATION COMMUNITIES

The State, Regional and Local conservation status of the vegetation communities present were determined accordingly using TSC Act (1995), House (2003) and Bell (2004). A summary of the conservation status of the vegetation present is provided below in Table 2.4.

TABLE 2.4 LOCAL AND REGIONAL CONSERVATION STATUS OF VEGETATION COMMUNITIES			
Vegetation community	Conservation Status		
	State (TSC Act 1995)	Regional (House 2003)	Local (Bell 2004)
Coastal Warm Temperate Rainforest	Endangered Ecological Community, Lowland Rainforest	Regionally Significant – Specialised Communities	Of Local Significance – Under development pressure – Habitat for threatened species – Prone to fragmentation
Coastal Narrabeen Moist Forest	NA	NA	Of Local Significance – Under development pressure – Habitat for threatened species – Prone to fragmentation
Narrabeen Coastal Blackbutt Forest	NA	NA	In Part/ Local Significance – Under development pressure – Habitat for threatened species – Prone to fragmentation – Regionally naturally restricted – Prone to weed invasion
Disturbed Vegetation	NA	NA	NA
Grassland with Scattered Trees	NA	NA	NA

Within the subject site the Coastal Warm Temperature Rainforest community is identified as being of State, Regional and Local significance. This community will be retained within the subject site and subject to the recommendations of an Ecological Site Management Plan.



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

Vegetation communities according to Bell 2004



Original plan produced in A3 colour.

SECTION 3

FAUNA CHARACTERISTICS

3.1. BACKGROUND

Introduction

In order to detect the occurrence of threatened fauna species specific methods for targeting these species were employed in addition to the standard fauna survey methods of nocturnal spotlighting and habitat searches.

The methods used for the fauna survey are listed below.

- Small mammal trapping (terrestrial and arboreal);
- Nocturnal spotlighting and tree hollow stagwatching;
- Bat echolocation call detection;
- Nocturnal and diurnal reptile searches;
- Nocturnal and diurnal amphibian searches;
- Nocturnal and diurnal habitat searches;
- Playback of recorded owl calls;
- Diurnal and nocturnal bird surveys.

Details of the dates, times and weather conditions were recorded for each survey completed.

Literature Review

A review of local resource documents, previous reports and a search of the Atlas of NSW Wildlife (NPWS 2010) was undertaken to identify records of threatened fauna species located within 10km of the subject site. The results of the database search for threatened fauna species is provided in Table 1.3.

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) Aquatic areas including margins of creeklines and dams;
- B) Riparian vegetation along creeklines;

- C) Grassland with occasional trees;
- D) Disturbed Open Forest;
- E) Open Forest (southern area);

The biophysical characteristics of these fauna survey stratification units are outlined below.

A) Aquatic areas including margins of creeklines and dams

These areas contain permanent water or intermittent flows. They are generally located in the central and western parts of the site with a single dam located in the eastern part of the site.

B) Riparian vegetation along creeklines

These habitats are restricted to the central and eastern creeklines and include the terrestrial habitats and vegetation associated with the Tall Moist Open Forest.

C) Grassland with occasional trees

These areas include the improved pasture areas which contain occasional trees.

D) Disturbed Open Forest

These habitat areas are spread throughout the northern and central slopes and are characterised by an open canopy dominated by Eucalypts with a grassy understorey, grazed by cattle. Shrub species are generally absent or occur as occasional specimens with a distribution cover of less than 5%.

E) Open Forest (southern area)

This area of habitat occurs in the southern part of the site and includes the sheltered areas of open forest with a predominant south to south east aspect.

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 3.1 with survey locations shown in Figure 3.1.

TABLE 3.1 FAUNA SURVEY DATES AND WEATHER CONDITIONS					
Survey Weather Conditions Proforma					
Date	Temp (°C)	Wind (km/h)	Rain (nil/light/ heavy)	Relative Humidity (%)	Comments (eg. Heavy overnight rain, afternoon storm moon phase etc)
Time (hrs)					
DATE:14/8/07					
0900	17	E 8	NIL	50	
1500	20	SE 12	NIL	30	
1900					
DATE: 17/8/07					
0900	18	NE 5	NIL	50	
1500	16	NW 13	NIL	50	
1900					
DATE:27/8/07					
0900	17	SE 6	NIL	80	
1500	28	N 8	NIL	30	
1900					
DATE:10/9/07					
0900	15	E 5	LIGHT	90	
1500	21	E 12	NIL	70	
1900					
DATE:19/9/07					
0900	18	N 12	NIL	70	
1500	22	NE 15	NIL	60	
1900	14	NIL	NIL	65	2/4 moon
DATE:20/9/07					
0900	15	NIL	NIL	85	
1500	19	NE 10	NIL	60	
1900					
DATE:21/9/07					
0900	17	SE 10	NIL	75	
1500	19	E 12	NIL	65	
1900					
DATE:24/9/07					
0900	18	N 7	NIL	50	
1500	23	N 5	NIL	35	
1900					
DATE:25/9/07					
0900	17	E 8	NIL	80	
1500	20	E 11	NIL	70	
1900	15	NIL	NIL	75	Full moon

TABLE 3.1 (Cont.) FAUNA SURVEY DATES AND WEATHER CONDITIONS					
Survey Weather Conditions Proforma					
Date	Temp (°C)	Wind (km/h)	Rain (nil/light/ heavy)	Relative Humidity (%)	Comments (eg. Heavy overnight rain, afternoon storm moon phase etc)
Time (hrs)					
DATE:26/9/07					
0900	17	E 5	NIL	80	
1500	18	NE 15	NIL	75	
1900	14	NE 15	NIL	73	Full moon
DATE:27/9/07					
0900	19	NE 8	light rain	75	
1500	26	NW 6	NIL	30	
1900	16	NE 10	NIL	40	Full moon
DATE:3/10/07					
0900	24	N 12	NIL	32	
1500	32	E 15	NIL	51	
1900					
DATE:27/11/07					
0900	21	SE 12	NIL	95	
1500	22	SE 15	NIL	80	
1900					
DATE:28/11/07					
0900	23	SE 10	light rain	75	
1500	24	NE 5	NIL	70	
1900					
DATE:29/11/07					
0900	22	S 15	NIL	76	
1500	24	SE 20	NIL	75	Full moon
1900					
DATE:30/11/07					
0900	23	S 20	light rain	85	
1500	22	SE 12	NIL	80	
1900					
DATE:23/01/08					
0900	21	SE 15	NIL	54	
1500	24	SE 20	NIL	55	
1900					
DATE:19/02/08					
0900	22	N 25	NIL	80	Overnight shower
1500	25	SW 10	NIL	75	
1900	21	Calm	NIL	65	Full Moon

TABLE 3.1 (Cont.) FAUNA SURVEY DATES AND WEATHER CONDITIONS					
Survey Weather Conditions Proforma					
Date	Temp (°C)	Wind (km/h)	Rain (nil/light/ heavy)	Relative Humidity (%)	Comments (eg. Heavy overnight rain, afternoon storm moon phase etc)
Time (hrs)					
DATE:20/02/08					
0900	23	N 20	NIL	80	
1500	24	SW 10	NIL	72	
1900	20	Calm	NIL	70	Full Moon
DATE:21/2/08					
0900	21	SW 30	NIL	80	
1500	23	SW 10	Showers	85	
1900	20	Calm	Showers	85	Full Moon
DATE:19/3/08					
0900	21	S 8	NIL	85	
1500	26	S 9	NIL	70	
1900					
DATE:3/4/08					
0900	21	S 20	NIL	52	
1500	22	W 15	NIL	32	
1900					
DATE:5/5/08					
0900	14	W 3	NIL	70	
1500	20	SE 5	NIL	60	
1900					
DATE: 18/9/08					
0900	17	9W	NIL	64	
1500	22	10NE	NIL	54	
1900					
DATE 3/10/08					
0900	19	8NW	NIL	63	
1500	20	10NE	NIL	51	
1900					
DATE:29/5/09					
0900	13.5	NW7	NIL	76	
1500	16	SE9	NIL	69	
1900					
DATE 16/6/09					
0900	13	NW11	NIL	75	
1500	13.5	SE9	NIL	99	
1900					
DATE 23/6/09					
0900					
1500	19	NE2	NIL	69	
1900					