TERRESTRIAL FLORA & FAUNA ASSESSMENT

PROPOSED RESIDENTIAL & TOURIST DEVELOPMENT
CREEK STREET, HASTINGS POINT
LOT 156 ON DP628026

Prepared for WALTER ELLIOT HOLDINGS Pty Ltd

FEBRUARY 2010

By

Planit Consulting

1.0 INTRODUCTION

Planit Consulting has been commissioned by Walter Elliott Holdings to prepare Terrestrial Flora and Fauna Assessment documentation over land situated at Creek Street, Hastings Point (refer Attachment 1). This report outlines the results of detailed flora and fauna surveys and describes vegetation types, habitat associations and ecological values of the subject property.

This report was also prepared to supplement previous ecological studies undertaken on the site by James Warren & Associates in 2003 which resulted in the delineation of the zonings over the property.

Minor amendments regarding reductions in trees and vegetation communities to be removed have been added in February 2010 (to the November 2008 report) as a result of the minor modifications to the proposed Masterplan. These adjustments to the Masterplan were generated in response to the issues raised by the Department of Planning and Tweed Shire Council in relation to the draft Environmental Assessment (2009).

The amended Masterplan is contained within Attachment 1.

2.1 SITE DESCRIPTION

The subject property incorporates the following allotment which is accessed via Creek Street within Hastings Point:

- Lot 156 on DP628026

This allotment shall be hereafter referred to as '*the site*.' The property is irregular in shape and borders Christies and Cudgera Creeks to the south and southeast, Round Mountain/Cudgen Nature Reserve to the west and Creek Street road reserve and adjoining residential properties along the northern and north western boundaries.

The property is in part zoned 2(e) Residential Tourist and 7(a) Environmental Protection (Wetlands) Zone pursuant to Tweed Local Environmental Plan 2000. An extract from the LEP is attached below. The zoning boundaries generally define the cleared residential areas from the wetland/vegetated areas. The land is mostly level with a maximum height of 3.36 m AHD as surveyed.

Whilst the site is comparatively small in size, it does contain diversity in terms of vegetation communities, largely as a result of its ecotonal relationship between the saline environments of Cudgera/Christies Creek and freshwater wetlands and dry sclerophyll associated with the adjacent Cudgen Reserve. In this regard, nine vegetation communities have been mapped for the site which are described within the below sections of the report. Where possible identified communities have been compared to recognized documents such as Forest Types in NSW (1989), CRA Forest Ecosystems (1999) and the Tweed Vegetation Management Plan (2004).

The proposed development design and this associated report have been modified in response to draft Department of Planning comments dated 29 August 2008 and 2 April 2009 and Tweed Shire Council comments dated 16 April 2009.

FIGURE 1A: SUBJECT SITE
SOURCE: B&P SURVEYS, 2004

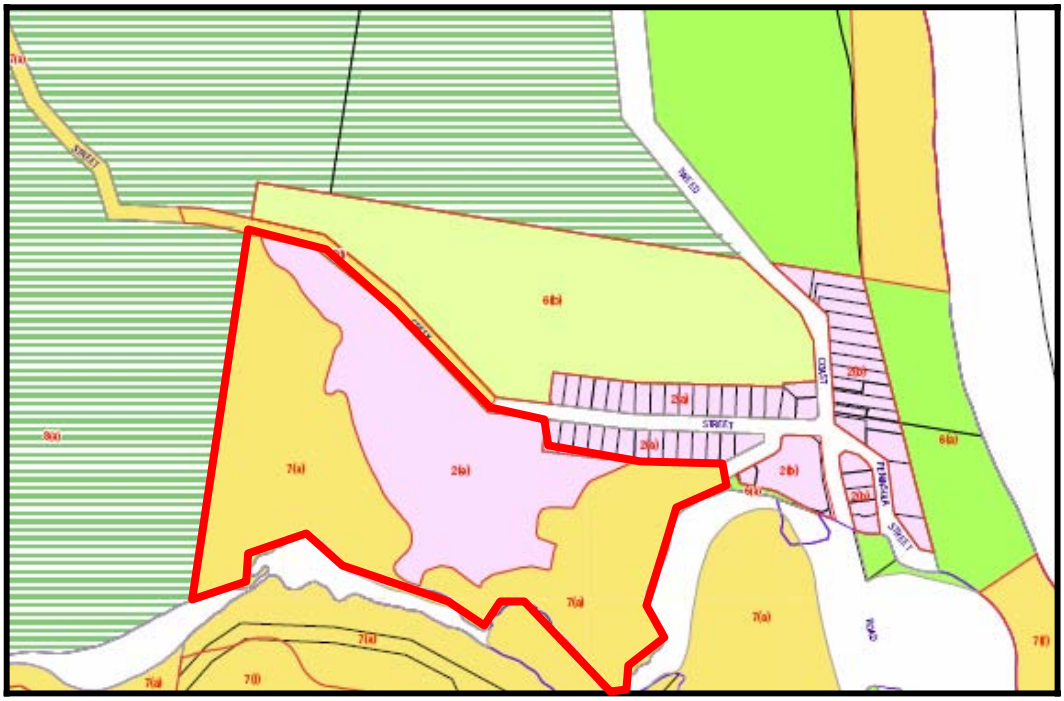


FIGURE 1B: ZONING PLAN
SOURCE:TWEED LEP 2000 SHEET 25

2.2 AIMS OF STUDY

The aim of this report is to describe the terrestrial flora and fauna habitat of the site and adjoining areas and to examine the potential for the occurrence of threatened species, populations, their habitats or endangered ecological communities. In order to provide this information the following specific objectives are to:

- Determine and describe the existing flora, vegetation communities, fauna assemblage and associated habitats of the site and adjoining areas,
- Determine the occurrence, or likely occurrence, threatened species, populations, their habitats or endangered ecological communities as a result of detailed survey and literature review,
- Undertake the 7-part test of significance pursuant to Section 5A of the Environmental Planning and Assessment Act 1979,
- Undertake SEPP 44 (Koala Habitat Protection), SEPP 14 (Coastal Wetland) and SEPP 26 (Littoral Rainforest) assessments,
- Describe the potential direct and indirect impacts of the proposal on existing terrestrial ecological values,
- Propose amelioration measures to mitigate potential impacts upon the ecological values of the study area.

2.3 ENVIRONMENTAL LEGISLATIVE FRAMEWORK

The proposed development will be requested to be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*. Part 3A consolidates the assessment and approval regime for major projects previously addressed under Part 4 or Part 5 (Environmental Assessment) of the *Environmental Planning and Assessment Act 1979*. In addition to the *Environmental Planning and Assessment Act 1979*, other NSW legislation and planning policies are relevant to the protection of biodiversity, as outlined below. Although licences and approvals under these state Acts and policies are not required in addition to approval under Part 3A of the *Environmental Planning and Assessment Act 1979*, consideration has been given to their intent. The state acts and policies include:

Threatened Species Conservation Act 1995 - The Threatened Species Conservation Act outlines the protection of threatened species, communities and critical habitat in New South Wales. An independent Scientific Committee has been set up under the Act to determine which species, populations and ecological communities should to be listed as endangered, vulnerable or extinct under the act, and also to determine key threatening processes. Threatened biodiversity listed pursuant to the act occurring within the study area are considered in Sections 3-6 of this report. The '7-part test of significance' pursuant to Section 5a of the *Environmental Planning and Assessment Act 1979* is also considered in Section 6 of this report.

National Parks and Wildlife Act 1974 - Under the National Parks and Wildlife Act, the Director-General of the NPWS is responsible for the care, control and management of all national parks, historic sites, nature reserves, reserves, Aboriginal areas and state game reserves. State conservation areas, karst conservation reserves and regional parks are also administered under the Act. The Director-General is also responsible under this legislation for the protection and care of native fauna and flora, and Aboriginal places and objects throughout NSW. Consideration of impacts to flora and fauna associated with this development are contained within Sections 7 and 8 of this report.

Native Vegetation Act 2003 & Native Vegetation Regulation (2005) - This provides the framework for the Government's commitment to end broad scale clearing, to protect the health of land, rivers and wildlife in NSW. It also provides a framework of investment security and increased flexibility for farmers, rehabilitation to repair damaged rivers and restore over cleared landscapes, and provides powers to local Catchment Management Authorities (CMAs) to make decisions in the best interests of the community. The native vegetation within the site is considered within Section 3 of this report.

State Environmental Planning Policy No. 44 (Koala Habitat Protection) - This Policy 'aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.' Koalas are considered in Section 6 of this report.

State Environmental Planning Policy No 71 (*Coastal Protection*) - This policy development in New South Wales coastal areas, with the exception of coastal land in the greater Sydney area to ensure that the coastal zone is protected in accordance with ecologically sustainable development principles. The proposal is located within the coastal zone to which the SEPP applies and these matters have been considered within the Town Planning report

State Environmental Planning Policy No. 26 (Littoral Rainforest) relates to development applications likely to damage or destroy littoral rainforest (rainforests in coastal areas) (EDO, 2007). Consideration of development related impacts to areas of Littoral Rainforest are contained within Section 6.

State Environmental Planning Policy No. 14 (Coastal Wetlands) aims to preserve and protect coastal wetlands in the environmental and economic interest of the State. It does this by defining any development that involves clearing, draining or filling wetlands, or constructing levees on wetlands to be designated development (EDO, 2007). There are SEPP14 wetlands in the eastern areas of the site in association with Cudgera Creek. However these wetlands are not expected to be significantly impacted by the proposal.

North Coast Regional Environment Plan — This plan provides local government with state and regional policy guidelines for the preparation of local environmental plans and for certain types of development. The plan sets the basis for new urban and rural development. The emphasis is on progress coupled with careful management. The NCRP and TSC LES prepared under its frameworks is considered in detail within the Town Planning Report.

The federal *Environment Protection and Biodiversity Conservation Act 1999* provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance. There are no matters of

environmental significance expected to be significantly affected by the proposal and, therefore, the provisions of this Act are not triggered.

2.4 DEFINITIONS, TERMINOLOGY AND NOMENCLATURE

For the purposes of this flora and fauna assessment the following definitions apply:

Site: refers to the extent of the lands forming the boundaries of this development application as described in Section 2.0

Development Envelope: refers to those areas of the site which will be occupied by the development footprint (i.e. roads, residential/tourist allotments and areas of vegetation modification, earthworks and service infrastructure installation).

Study Area: refers to the site and additional areas which could be potentially affected by the development directly or indirectly. In this case the study area is considered to be that area occupied by the site, connected surrounding properties/habitats and properties/habitats downstream to the east. The estuarine waters of Christies and Cudgera Creeks and the adjacent Cudgen Nature Reserve are included due to the potential for indirect downstream impacts (i.e. increase in water pollutants).

FIGURE 2: STUDY AREA SURROUNDING SITE
SOURCE: GOOGLE MAPS, 2008

Locality: the area within a 10km radius of the centre of the site.

Additional terminology regarding associated with significance assessments (i.e. threatened species, populations, communities, threatening process, direct impacts, indirect impacts etc) and the factors of such assessments (i.e. 7-part test) are taken to be those existing within the Threatened Species Conservation Act 1995, Environmental Planning and Assessment Act 1979, and the DEC (2008) document entitled 'Threatened Species Assessment Guidelines: The Assessment of Significance.' Additional terms within the report which warrant the source of the definition have been specifically referenced in the text.

Nomenclature for all plant species contained within this document follow Harden (1992, 1993, 2000 & 2003) The Flora of NSW Volumes 1-4. Scientific names for plants are used primarily in the document to avoid any confusion associated with use of common or descriptive plant names.

Nomenclature for all animal species contained within this document follows those utilised by the Department of the Environment and Climate Change/National Parks and Wildlife Service (2008) in association with the Atlas of NSW Wildlife. Scientific names for plants are used primarily in the document to avoid any confusion associated with use of common or descriptive animal names.

2.5 CONTRIBUTORS

Contributors to this report and their roles are tabulated below:

NAME	ORGANISATION	ROLE
Boyd Sargeant	Planit Consulting	Report preparation, flora/fauna survey and assessment, technical and quality assurance review
Graham Dart	Planit Consulting	Report preparation, flora/fauna survey and assessment.
Barbara Triggs	Dead Finish	Mammalian hair analysis, scat analysis

All work was performed under the appropriate licences which are summarized within Section 4.3.2.

2.6 REPORT STRUCTURE

The structure and content of this flora and fauna assessment is as follows:

- Section 1: introductory statement
- Section 2: details the site description, location and outlines general background information relating to the project and this report including the aims and objectives
- Section 3: details the methodology for flora survey and resultant species, community descriptions and mapping
- Section 4: details the methodology for fauna survey and resultant species records and descriptions of the recorded assemblage

- Section 5: describes and discusses the recorded and potentially occurring scheduled communities, populations and species of conservation significance
- Section 6: contains the statutory assessments of significance (7-part test) pursuant to the Environmental Planning and Assessment Act 1979 and the SEPP 14, 26 and 44 assessments
- Section 7: describes the potential impacts of the proposed development on the recorded flora and fauna values
- Section 8: describes the design, management and enhancement measures incorporated into the proposed development to avoid, mitigate and offset the impacts of the proposed development on flora and fauna habitat
- Section 9: provides a brief summary and conclusion of the report including the key findings and recommendations

3.0 VEGETATION ASSESSMENT

To identify and classify vegetation species and communities which occur on site, the following methodology was applied during the months of March-May 2006 with additional field work undertaken in October-November 2008 and January 2010 in response to the DoP/TSC comments on the draft Environmental Assessment:

- Desktop analysis including:

i. Review of Council's Planning Scheme Mapping & Associated Reporting (i.e. Tweed LEP 2000 Maps, Tweed VMP Maps 1-7)

ii. Review of existing vegetation community documentation to confirm dominant elements, forest descriptions and conservation status of mapped forested remnants/ecosystems including:

   - Forestry Commission NSW (1989) *Research Note 17: Forest Types in NSW*.
   - National Parks and Wildlife Service (1999) *Forest ecosystem classification and mapping for the upper and lower north east cra regions*. CRA Unit-Northern Zone.
   - DECC (2008) *BioMetric: Terrestrial Biodiversity Tool for the NSW Property Vegetation Planning System: Definitions of Vegetation Types for CMA Areas* (online @ http://www.environment.nsw.gov.au/projects/BiometricTool.htm)
   - Keith, D. (2004) *Ocean Shores to Desert Dunes*. The native vegetation of NSW. DECC, Hurstville.
   - Ecograph (2004) *Tweed Vegetation Management Strategy*. Ecograph, Limpinwood.

iii. Review of threatened flora species and endangered ecological communities listed as occurring within the Murwillumbah (Qld - Southeast Hills and Ranges) CMA sub-region of the Northern Rivers CMA (http://threatenedspecies.environment.nsw.gov.au/tsprofile/cma_subregion_list.aspx?id=15

iv. Review of search of the Atlas of NSW Wildlife database within a search area 10km surrounding the site to review threatened plant records

v. Review of Environment Australia Protected Matters data within a search area 10km surrounding the site to review threatened plant records

vi. Review of SEPP Mapping (Coastal Wetlands, Littoral Rainforest) mapping to determine the indicative presence/absence of regional forest ecosystems reflective of wetland (marine, estuarine, riverine, lacustrine and/or palustrine) communities and/or Littoral Rainforests.

vii. Review of selected ecological surveys previously undertaken in the locality including:

- James Warren & Associates (2003) Analysis of Environmental Constraints Lot 156 Creek Street Hastings Point.
- SKM (2003) Cudgera Creek Road Ecological Assessment.

viii. Review of the following legislation to ensure the latest lists of threatened species and communities were noted as well as investigating the existence of any relevant recovery plans, threat abatement plans, key threatening processes or any preliminary determinations which may be applicable to the site and/or the proposed use/action:

- *Threatened Species Conservation Act (1995)*
- *Environment Protection and Biodiversity Conservation Act (1999)*

- Site survey including:

i. Transects

100m transects were walked by two observers within each community type recording all species observed, crown cover, tree heights and DBH estimation, dominant species present and identification of ecologically dominant layer.

ii. Random Meander:

Random searches within each vegetation community identified recording all species observed were undertaken in accordance with Cropper (1993). Knowledge of known habitats for rare and threatened floral species was utilised to target any specific areas with this technique where relevant.

The above survey techniques were applied to determine the following:

- Validate or modify existing vegetation mapping;
- Meet minimum Council and State Government vegetation/survey requirements;
- Identify floral species existing within the site;
- Measure and/or estimate Crown Cover (Walker and Hopkins, 1998, Nelder, 2004. EPA, 2005) to determine vegetation structure designations;
- Identify average height of canopy trees;
- Identify the incidence of senescent trees;
- Determine species dominance within ecologically dominant layer;
- Determine incidence of weed invasion and disturbance over the site and within vegetation strata;
- Determine incidence of species listed as endangered, vulnerable or rare under the *Threatened Species Conservation Act;*
- Determine incidence of species listed as endangered or vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*

Structural Analysis

Tree height (T1 layer) was determined via use of clinometer (Suunto PM-5/360) and tape measure to determine canopy tree heights. Heights were also estimated occularly from the mean of two experienced observers. Height classes were then selected from classifications provided in Walker & Hopkins (in McDonald et al, 1998).

Crown cover % for the T1 layer was estimated using the mean of two experienced observers or measured via crown intercept method (Nelder et al, 2004, EPA, 2005). *Structural formation classes* were determined via an assessment of growth form and crown cover % information as per Walker & Hopkins (1998).

Table 1: Height Classes & Names for Various Growth Forms (sensu Walker & Hopkins, 1998: Table 15)

Height		Growth Form			
Height Class	**Height Range (m)**	**Trees, vines, palms**	**shrub, heath shrub, chenopod shrub, mallee (tree or shrub form), cycads**	**tussock grass, hummock grass, forbs, rushes, sedges, ferns, Xanthorrhoea**	**Sod grasses, mosses, lichens, liverworts**
9	>35.01	Extremely tall	N/A	N/A	N/A
8	20.01-35	Very Tall	N/A	N/A	N/A
7	12.01-20	Tall	N/A	N/A	N/A
6	6.01-12	Mid-high	Extremely tall	N/A	N/A
5	3.01-6	Low	Very tall	Extremely tall	N/A
4	1.01-3	Dwarf	Tall	Very tall	N/A
3	0.51-1	N/A	Mid-high	Tall	Extremely tall
2	0.26-0.5	N/A	Low	Mid-high	Tall
1	<0.25	N/A	Dwarf	Low	Low

Table 2: Structural formation classes defined by growth form and crown separation (Walker & Hopkins, 1998: Tables 14a & 17)

Crown Separation	*D Closed or dense*	*M Mid-dense*	*S Sparse*	*B Very sparse*	*I Isolated plants*	*L Isolated clumps*
Field criteria	*Touching - overlap*	*Touching - slight separation*	*Clearly separated*	*Well separated*	*Isolated*	*Isolated*
Crown separation ratio	<0	0-0.25	0.25-1	1-20	>20	>20
Crown Cover %	81-100%	52-81%	20-52%	0.2-20%	<0.2%	<0.2%
Growth Form	Structural Formation Classes					
T Tree	Closed forest	Open forest	Woodland	Open woodland	Isolated trees	Isolated clump of trees
M Tree mallee	Closed mallee forest	Open mallee forest	Mallee woodland	Open mallee woodland	Isolated mallee trees	Isolated clump of mallee trees
S Shrub	Closed shrubland	Shrubland	Open shrubland	Sparse shrubland	Isolated shrubs	Isolated clump of mallee shrubs
Y Mallee shrub	Closed mallee shrubland	Mallee shrubland	Open mallee shrubland	Sparse mallee shrubland	Isolated mallee shrubs	Isolated clump of mallee shrubs
Z Heath shrub	Closed heathland	Heathland	Open heath	Sparse heath	Isolated heath shrubs	Isolated clump of heath shrubs
C Chenopod shrub	Closed chenopod shrubland	Chenopod shrubland	Open chenopod shrubland	Sparse chenopod shrubland	Isolated chenopod shrubs	Isolated clump of chenopod shrubs

Table 3: Structural formation classes for ground covers (Walker & Hopkins, 1998: Table 14b))						
Crown class	*D Closed or dense*	*M Mid-dense*	*S Sparse*	*B Very sparse*	*I Isolated plants*	*L Isolated clumps*
Foliage cover	>70	30-70	10-30	<10	<1	<1
Growth Form	Structural Formation Classes					
G Tussock grass	Closed grassland	Grassland	Open grassland	Sparse grassland	Isolated grasses	Isolated clump of tussock grasses
H Hummock grass	Closed hummock grassland	Hummock grassland	Open hummock grassland	Sparse hummock grassland	Isolated hummock grasses	Isolated clump of hummock grasses
D Sod grass	Closed sod grassland	Sod grassland	Open sod grassland	Sparse sod grassland	Isolated sod grasses	Isolated clump of sod grasses
V Sedge	Closed sedgeland	Sedgeland	Open sedgeland	Sparse sedgeland	Isolated sedges	Isolated clump of sedges
R Rush	Closed rushland	Rushland	Open rushland	Sparse rushland	Isolated rushes	Isolated clump of rushes
F Forb	Closed forbland	Forbland	Open forbland	Sparse forbland	Isolated forbs	Isolated clump of forbs
E Fern	Closed fernland	Fernland	Open fernland	Sparse fernland	Isolated ferns	Isolated clump of ferns
O Moss	Closed mossland	Mossland	Open mossland	Sparse mossland	Isolated mosses	Isolated clump of mosses
L Vine	Closed vineland	Vineland	Open vineland	Sparse vineland	Isolated vines	Isolated clump of vines

It is noted that Qld EPA (2005) and Nelder et al (2004) have recently provided Structural formation Class Tables which vary slightly from Tables 1 and 2 above. This table is displayed below:

Table 4: Structural formation classes for woody plant communities qualified by height: (classes defined by growth form, height and cover) [sensu EPA, 2005]				
Foliage projective cover	70-100%	30-70%	10-30%	<10%
Crown separation	closed or dense	mid-dense	sparse	very sparse
Field criteria	touching-overlap	touching - slight separation	clearly separated	well separated
Crown separation ratio	<0	0-0.25	0.25-1	1-20
Crown cover %	81-100%	52-81%	20-52%	0.2-20%
Growth form	*Structural Formation Classes (qualified by height)*			
trees > 30m	tall closed-forest	tall open-forest	tall woodland	tall open-woodland
trees 10 – 30m	closed-forest	open-forest	woodland	open-woodland
trees < 10m	low closed-forest	low open-forest	low woodland	low open-woodland
shrubs 2 – 8m	closed-scrub	open-scrub	tall shrubland	tall open-shrubland
shrubs 1 – 2m	closed-heath	open-heath	shrubland	open-shrubland
shrubs <1m	-	-	dwarf shrubland	dwarf open-shrubland

Displayed vegetation maps (refer Section 3.1) have been compiled using Mapinfo geographic information system (GIS) software (Ver. 8.5). Information utilized has included:

- Registered digital data provided by the consulting surveyor (B&P Surveys) including contours, site boundaries and aerial photographs.
- Tweed VMP (2004) vegetation community mapping (VMP MAP 2) boundaries rasterised and registered to property boundaries and aerial photographs
- Upper North East CRA Forest Ecosystem Layer metadata (online @ http://maps.environment.nsw.gov.au/terms.aspx?file=forest_ecosystems_upper_north_east.zip)
- Wetlands of New South Wales metadata (online @ http://maps.environment.nsw.gov.au/terms.aspx?file=nsw_wetlands.zip)

Vegetation survey was performed as outlined with geo-referenced colour aerial photographs overlaid with contour plans, existing mapped vegetation boundaries and cadastre boundaries utilized for the initial recognition of community boundaries in the field and adjustments noted as necessary. Communities (refer below) were then transcribed directly into the GIS program utilizing the aerials, contours, geological information and vegetation boundaries as a reference background. Where necessary vegetation boundaries were traversed with a hand held GPS (Garmin s72) and loaded into Mapinfo with existing boundaries rectified where necessary.

The above methodology is considered to be reasonably consistent with the intent of the following documents:

- DEC (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* DEC, NSW.
- NSW Department of Infrastructure, Planning and Natural Resources (1997) *Interim Guidelines for Targeted and General Flora and Fauna Surveys under the Native Vegetation Conservation Act 1997*.
- NSWNPWS (2001) *The Community Biodiversity Survey Manual*. New South Wales National Parks & Wildlife Service.
- QLD Department of Environment and Heritage (1999) *Suggested Conservation Criteria for Development Assessment*.
- Gold Coast City Council (2004) *Guidelines for preparing Ecological Site Assessments during the Development Process (v1.1)*. G.C.C.C., Nerang.
- Shire of Maroochy (1997) *Flora and Fauna Assessment Requirements for Developments in Maroochy Shire*. M.S.C
- Brisbane City Council (1999) *Ecological Assessment Guidelines*. B.C.C.
- Walker, J. & Hopkins, M.S. (1998) Chapter 5: Vegetation in McDonald, R. C., Isbell, R.F., Speight, J.G., Walker, J. & Hopkins, M.S. *Australian Soil and Land Survey: Field Handbook Second Edition*. CSIRO Australia, Canberra.
- Nelder, V. J., Wilson, B.A., Thompson, E. J. & Dillewaard, H.A. (2004) *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland*. EPA, Brisbane.

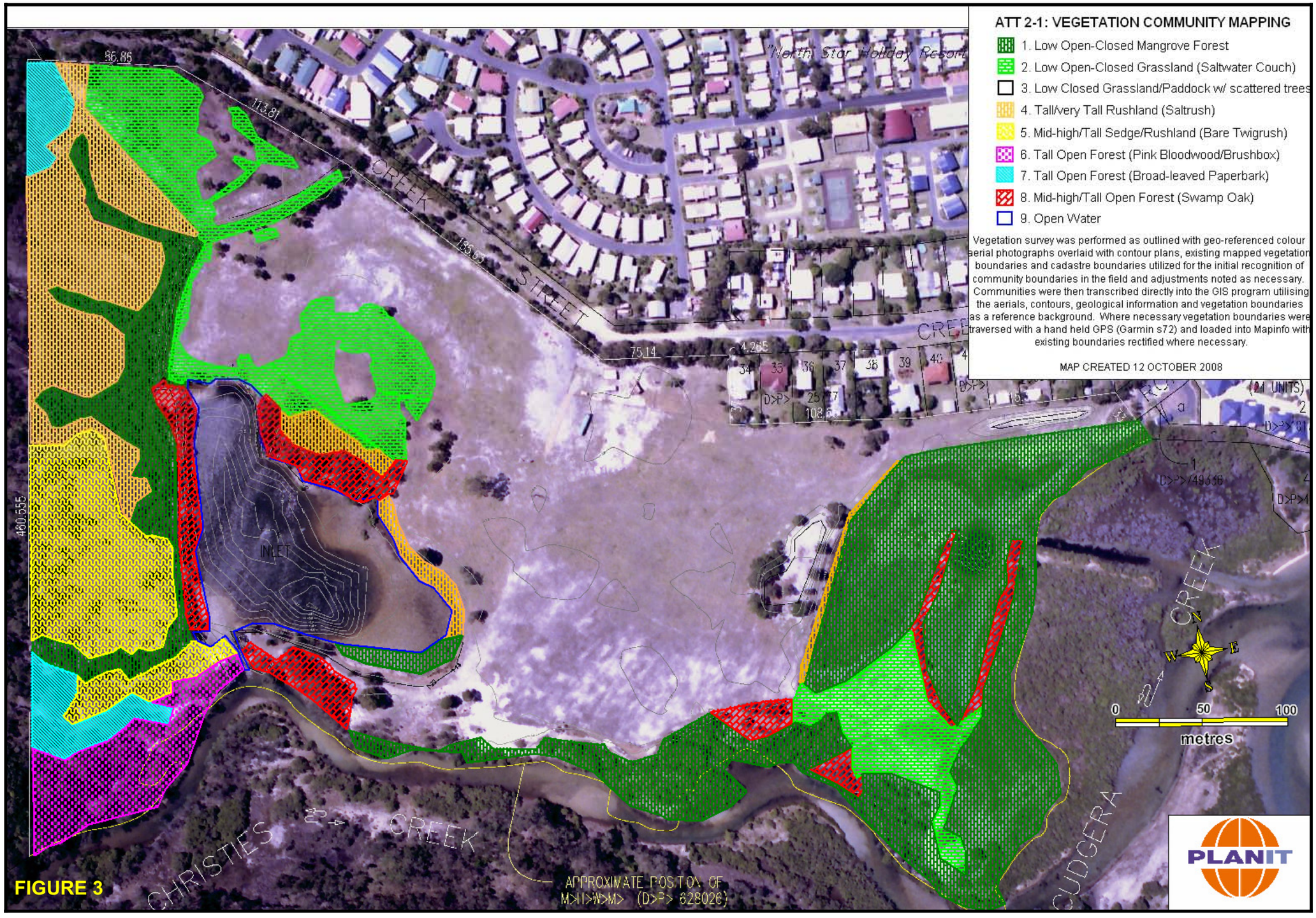

ATT 2-1: VEGETATION COMMUNITY MAPPING
1. Low Open-Closed Mangrove Forest
2. Low Open-Closed Grassland (Saltwater Couch)
3. Low Closed Grassland/Paddock w/ scattered trees
4. Tall/very Tall Rushland (Saltrush)
5. Mid-high/Tall Sedge/Rushland (Bare Twigrush)
6. Tall Open Forest (Pink Bloodwood/Brushbox)
7. Tall Open Forest (Broad-leaved Paperbark)
8. Mid-high/Tall Open Forest (Swamp Oak)
9. Open Water
Vegetation survey was performed as outlined with geo-referenced colour aerial photographs overlaid with contour plans, existing mapped vegetation boundaries and cadastre boundaries utilized for the initial recognition of community boundaries in the field and adjustments noted as necessary. Communities were then transcribed directly into the GIS program utilising the aerials, contours, geological information and vegetation boundaries as a reference background. Where necessary vegetation boundaries were traversed with a hand held GPS (Garmin s72) and loaded into Mapinfo with existing boundaries rectified where necessary.
MAP CREATED 12 OCTOBER 2008
"North Star Holiday Resort"
CREEK STREET
86.86
113.81
135.63
75.14
4.265
460.555
INLET
CHRISTIES CREEK
CUDGERA CREEK
APPROXIMATE POSITION OF MOUTH (D>P> 828026)
0
50
100
metres
PLANIT

FIGURE 3

3.1 VEGETATION SURVEY RESULTS

As a result of flora surveying nine (9) vegetation associations/assemblages were identified on site and are described separately below. Vegetation community maps and flora species lists are contained within Attachments 2 and 3 respectively to supplement the following descriptions.

COMMUNITY 1: LOW OPEN-CLOSED FOREST (MANGROVE) [T5D]

This community is widespread on the site and incorporates the eastern areas within the low-lying inter-tidal zone, fringes the southern boundary in association with Christies Creek and also occurs in tidal areas in the west of the site proximate to the dredge pond. The average canopy height of the mangrove community is reasonably low (2-4m) presumably as a result of most areas having been cleared in the past. TSC (2002) note that significant areas now colinised by mangroves largely cleared on 1984 aerial photographs. Larger specimens were however common on both banks of Christies Creek along the site's southern boundary.

The mangrove community is typically dominated by Grey Mangrove (*Avicennia marina*) with River Mangrove sub-dominant (*Aegiceras corniculatum*) and Spotted Mangrove (*Rhizophora stylosa*) occurring sporadically. Additional species noted within or directly adjacent this community include Salt Rush (*Juncus kraussii*), Saltwater Couch (*Sporobolus virginicus*), Salt Couch (*Paspalum virginatum*), Swamp Oak (*Casuarina glauca*), Bitou Bush, Samphire (*Sarcocornia quinqueflora*), Mangrove Fern (*Acrostichum speciosum*), Common Reed (*Phragmites australis*), Swamp Grass (*Ischaemum australe*), Knobbly Club-rush (*Isolepis nodosa*), Fringe Rush (*Fimbristylis dichotoma*), Easter Cassia (*Senna pendula*) and Sea Blite (*Suaeda australis*).

A small variety of vines and parasitic species were also noted including Mangrove Wax-Flower Vine (*Cynanchum carnosum*), Swamp-oak Mistletoe (*Amyema cambagei*) and Mangrove Mistletoe (*Amyema mackayense*).

Proximate to the mangrove forest in numerous inter-tidal areas are distinct patches of Salt Rush, Saltwater Couch, Swamp Oak and/or Bare Twigrush. As part of additional 2008 vegetation mapping works requested by DoP these patches have been separately mapped.

Equivalent vegetation communities

Forest Types in NSW 1989:	Code 33_Mangrove
CRA Forest Ecosystems 1999:	Code 77_Mangrove
Tweed VMP 2004:	Code 602_Low Closed Mangrove Forest to Woodland
Biometric Vegetation Database NRCMA:	Mangrove-Grey Mangrove low closed forest of the NSW Coastal Bioregions/Mangrove - River Mangrove low closed forest of the NSW Coastal Bioregions
Keith (2004) Ocean Shores-Desert Dunes:	Mangrove Swamps

COMMUNITY 2: LOW/MID-HIGH OPEN-CLOSED GRASSLAND (SALTWATER COUCH) [G1D]

This community incorporates two areas within the western portions of the site which are predominately comprised of Saltwater Couch which are grazed/slashed to 20-50mm in height over most of its extent. Another large patch occurs in the eastern portions of the site amongst Mangrove Forests.

The first patch is irregular in shape and covers an occasionally tidally inundated area extending north from the dredge pond lagoon. Most areas are slashed and surrounded by other grasses associated with the paddock. The southern portions of this patch are unslashed and form a narrow fringe to the tidal lagoon where Salt Rush, Bare Twigrush and Mangroves become common due to more regular tidal inundation.

The western most patch of this community falls within 7a and 2e zoned areas and is more variable in composition. Saltcouch dominates with additional wetland groundcovers also present in lower abundance (Saltrush, Bacopa, Fringe Rush, Streaked Arrowgrass, Swamp Foxtails, Villarsia, Phragmites, Bare Twigrush) with a semi-mature Swamp Mahogany over storey noted in the northern portions. Areas of exposed sand and mud containing Sundews are also present.

Adjacent the constructed channel draining the offsite holiday park is a uniform row of Saltrush and Saltcouch to 2-3m in width. The trees also fringing the drain are described in Community 3 below. Pasture grasses are a common occurrence within this community as a result of spread from the adjacent paddock (Community 3).

Significant areas of Saltwater Couch also occur in the eastern portions of the site in association with the mangrove forests of Christies Creek. Such areas exhibit a more open grassland structure with exposed sands and muds and occasional clumps of Saltrush.

Equivalent vegetation communities

Forest Types in NSW 1989: N/A

CRA Forest Ecosystems 1999: Code 77_Mangrove, Code 125_Saltbush

Tweed VMP 2004: Code 603_Saltmarsh Communities (S1)

Biometric Vegetation Database NRCMA: Saltmarsh complex of the North Coast

Keith (2004) Ocean Shores-Desert Dunes: Saltmarshes

COMMUNITY 3: LOW/MID-HIGH CLOSED GRASSLAND/PADDOCK (PASTURE GRASSLAND W/ SCATTERED TREES) [G1D]

This association occupies the zones above HAT in the central and northern areas of the site and have been historically utilized for grazing and rural pursuits. Infrastructure improvements are present in the northern areas and include paddock fencing. A dwelling has also been constructed in the southeastern corner of the community. The community is dominated by common residential and pasture grasses which are slashed uniformly to 30-50mm in height. Additional introduced species (i.e. siratro, flatweed, fireweed, cobbler's pegs, billygoat weed etc) are present in the ground layer. Native regeneration from the sandy substrate is also common with species such as Kangaroo Grass, Rice Flower, Flax Lily, Bluebell, Pomax, Sundew and Goodenia noted.

Although predominately cleared scattered trees and tree groupings do remain within the paddock area including:

GROUP 1:

This grouping west of the drain through the paddock includes 12 x Paperbark (*Melaleuca quinquenervia*) and 43 x Swamp Mahogany (*Eucalyptus robusta*). The lower strata consists of a matrix of the described pasture species with regeneration of some native species (including Pomax, Goodenia, Bluebell, Broad-leaved Banksia, Tall Swordgrass) from the adjacent road reserve.

Areas of tidal intrusion are also present which contain typical salt tolerant species. These areas have been mapped separately and are reflective of Community 2 (Saltwater Couch) above.

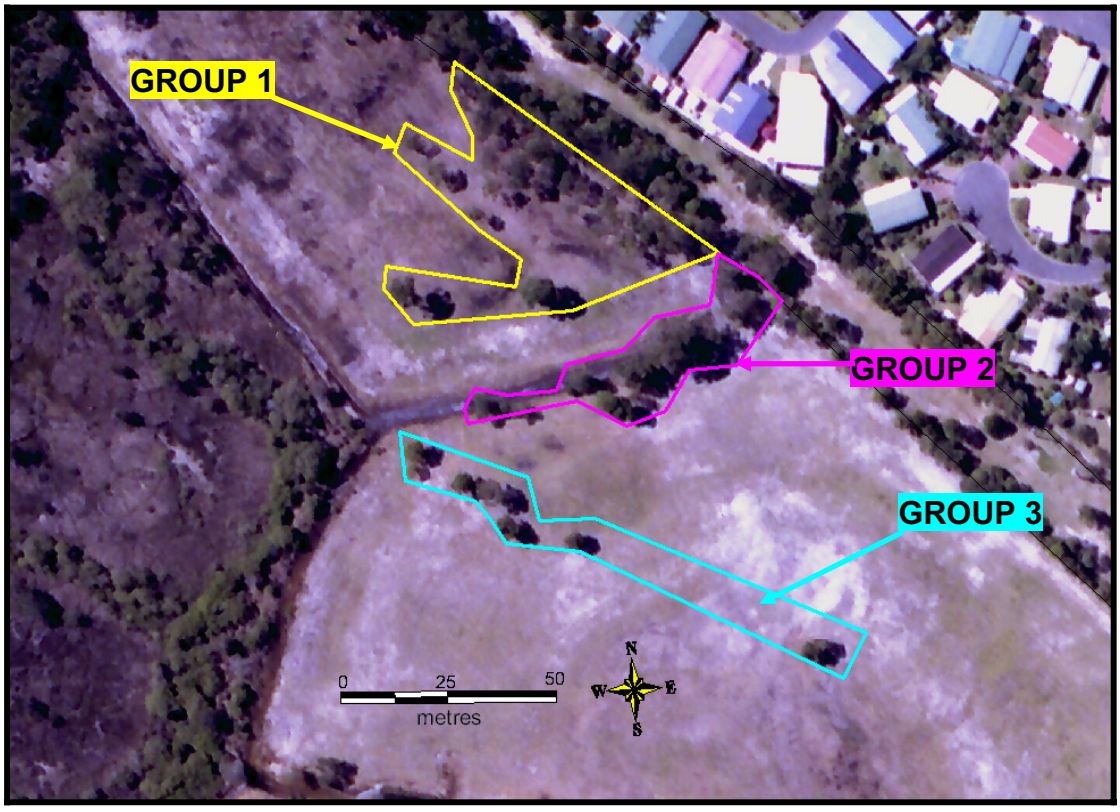
GROUP 2:

Within the western portions of the paddock exists a drainage line previously constructed to convey runoff from developments to the north (Northstar Holiday Resort). This area as a result is subject to tidal inundation with exposed sands and muds present and Saltrush and Saltcouch to 2-3m in width adjacent. The trees fringing the drain include:

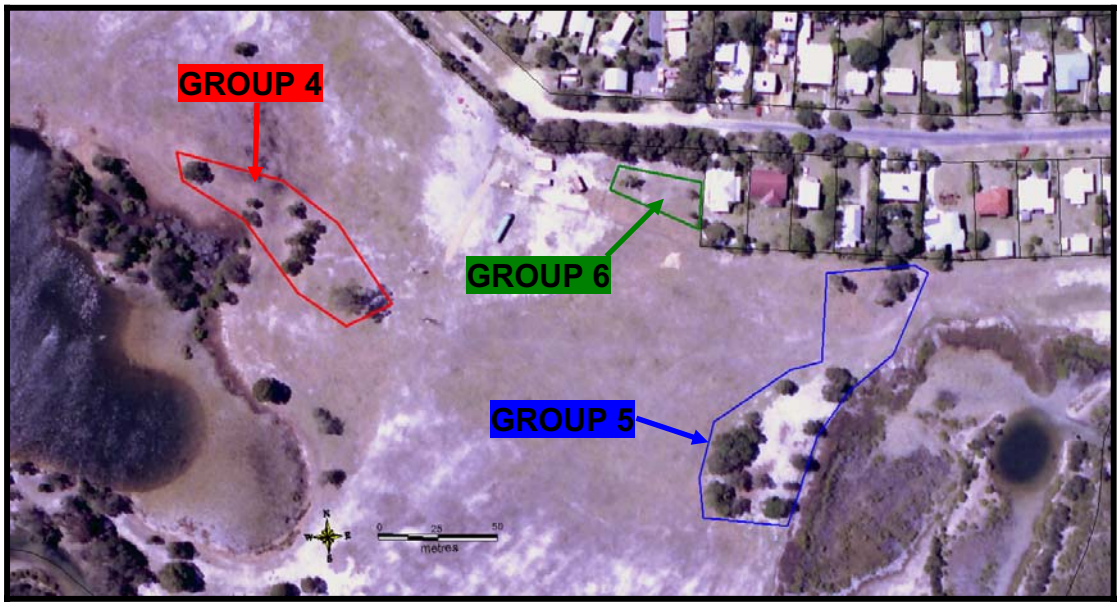
- Paperbarks (*Melealeuca quinquenervia*) x 37
- Swamp box (*Lophostemon suaveolens*) x 7
- Geebung (*Persoonia cornifolia*) x 1
- Pink Bloodwood (*Corymbia intermedia*) x 3
- Tuckeroo (*Cupaniopsis anacardioides*) x 1
- *Eucalyptus* x *kirtoniana* x 1
- Swamp oak (*Casuarina glauca*) x 2

GROUP 3

This group includes a small scattering of native trees within the western portions of the paddock including Paperbark x 7, Brushbox (*Lophostemon confertus*) x 2 and Pink Bloodwood x 1. Group 3 trees are also located individually on the survey plan contained within Attachment 3.



GROUP 4



This group includes native trees north of the dredge-pond and its associated fringing vegetation communities of Swamp Oak, Saltrush and Saltcouch. Trees include:

- Paperbarks (*Melealeuca quinquenervia*) x 13
- Swamp box (*Lophostemon suaveolens*) x 4
- Blue Gum (*Eucalyptus tereticornis*) x 8
- Swamp Oak (*Casuarina glauca*) x 1

Group 4 trees are also located individually on the survey plan contained within Attachment 3.

GROUP 5

This group includes a patch of vegetation has also been retained in the very east of the paddock which is not subjected to the slashing regime. It consists of trees averaging 10-15m in height including Swamp Oak, Pink Bloodwood, Swamp Box and Paperbark with smaller trees such as Macaranga and Blackwood [35-40 stems]. The lower layer is dominated by pasture and other grasses (Pigeon Grass, Couch, Paspalum, Swamp Grass etc) and weed growth (Easter Cassia, Bitou Bush, Lantana, Morning Glory, Corky Passionflower). It is noted that this patch of vegetation was incorporated within the 7(a) zone in association with 2003 LEP amendments.

North of this grouping and adjacent to existing residences of Creek Street are an additional 6 x Paperbark, 3 x Swamp Oak and 1 x Mango.

GROUP 6

Two blue gums and one dead standing tree with a small strangling fig are present near the site entrance.

Figure 2 - Amended Draft Tweed Local Environmental Plan 2000 (Amendment No 44) over Air Photo showing patch of native trees and wetlands

FIGURE 4: DRAFT LEP AMENDMENT NO 44
SOURCE: TSC MINUTES 3 SEPTEMBER 2003

GROUP 7

This group includes a patch of vegetation straddling the northern fence line of the property proximate to the site entrance. Trees are generally in the 5-12m height range with several larger stems of Blue Gum and Paperbark present at the eastern end of the patch. Species encountered include:

- Paperbarks (*Melealeuca quinquenervia*) x49
- Swampbox (*Lophostemon suaveolens*) x 12
- Blue Gum (*Eucalyptus tereticornis*) x 6
- Black She-oak (*Allocasuarina littoralis*) x 7
- Coast Wattle (*Acacia sophorae*) x 2
- Swamp Mahogany (*Eucalyptus robusta*) x 3
- Pink Bloodwood (*Corymbia intermedia*) x 3

Group 7 trees are also located individually on the survey plan contained within Attachment 3.

Equivalent vegetation communities

Forest Types in NSW 1989:	Code 216_Improved Pasture and Cropland Code 220_Cleared/Partially Cleared
CRA Forest Ecosystems 1999:	Code 173_Cleared/Partially Cleared
Tweed VMP 2004:	Code 1099_Substantially Cleared of Native Vegetation
Biometric Vegetation Database NRCMA:	N/A
Keith (2004) Ocean Shores-Desert Dunes:	N/A

COMMUNITY 4:TALL-VERY TALL RUSHLAND (SALT RUSH) [R4D]

This community occurs predominately in the western portions of the site within the intertidal zone and is dominated by Salt Rush (*Juncus kraussii*). Additional patches of Salt Rush were also recorded in the northern and eastern tidal ranges of the dredge pond and proximate the Mangrove Forest which dominates the eastern extent of the site.

The vegetation community recorded consists almost entirely of clumping Saltrush to 1-1.5m in height. Additional species included Bare Twigrush (*Baumea juncea*) and Saltwater Couch which are commonly associated with scattered occurrences of regenerating Swamp Oak, Paperbark, Mangrove and Groundsel Bush (*Baccharis halimifolia*) noted.

The community intergrades with Mangrove Forest, Melaleuca Forest (offsite to the west in Cudgen Reserve), Saltcouch and Bare Twigrush communities.

Equivalent vegetation communities

Forest Types in NSW 1989: N/A

CRA Forest Ecosystems 1999: Code 77_Mangrove, Code 125_Saltbush

Tweed VMP 2004: Code 603_Saltmarsh Communities (S2)

Biometric Vegetation Database NRCMA: Saltmarsh complex of the North Coast

Keith (2004) Ocean Shores-Desert Dunes: Saltmarshes

COMMUNITY 5: MID-HIGH/TALL SEDGELAND/RUSHLAND (BARE TWIGRUSH) [R3D]

This community occurs within the southwestern corner of the site within the intertidal zone where it intergrades with Mangrove Forest, Tall Saltrush and Pink Bloodwood/Brushbox Open Forest. Melaleuca Forest/Woodland occurs directly adjacent within the Cudgen Reserve to the west.

The Rushland is dominated by Bare Twigrush to a height of 0.5-1m with Saltwater Couch and Saltrush also common. Additional species noted include Paperbark, Swamp Oak, Groundsel Bush, Mangroves, Fringe Rush, Kangaroo Grass (*Themeda australis*) and Rhodes Grass (*Chloris gayana*).

Equivalent vegetation communities

Forest Types in NSW 1989:	N/A
CRA Forest Ecosystems 1999:	Code 77_Mangrove, Code 125_Saltbush
Tweed VMP 2004:	Code 603_Saltmarsh Communities (S3)
Biometric Vegetation Database NRCMA:	Saltmarsh complex of the North Coast/ Wallum sedgeland and rushland of near coastal lowlands of the North Coast
Keith (2004) Ocean Shores-Desert Dunes:	Saltmarshes

COMMUNITY 6: VERY TALL OPEN FOREST (PINK BLOODWOOD/BRUSHBOX) [T8M]

This community is restricted to the southwestern corner of the site and extends into the adjacent Cudgen Reserve. It is bound to the south and east by marine environments associated with Christies Creek and the dredge pond and intergrades to the north into Melaleuca Woodland, Sedgeland and Mangrove Forests which share the econtonal areas between marine and palustrine wetlands.

Canopy species within this community are dominated by Pink Bloodwood (*Corymbia intermedia*) and Brushbox (*Lophostemon confertus*) to an average height range of 20-25m. Additional species within the T1 layer include Swamp Box (*Lophostemon suaveolens*), Blue Gum (*Eucalyptus tereticornis*) and Paperbark (*Melaleuca quinquenervia*).

A dense small tree and shrub layer also occurs which includes species such as Forest Oak (*Allocasuarina torulosa*), Wattles (*A. disparrima, A. melanoxylon, A. sophorae*), Coastal Banksia (*Banksia integrifolia*), Beach Acronychia (*Acronychia imperforata*), Tuckeroo (*Cupaniopsis anacardioides)*, Blueberry Ash (*Elaeocarpus reticulatu*s), Soap Tree (*Alphitonia excelsa*), Corkwood (*Endiandra sieberi*), Bitou Bush (*Chrysanthemoides monilifera*), Lantana (*Lantana camara*) and Macaranga (*Macaranga tanarius*).

Lower strata and vine/scrambling species noted to be present include Matrush (*Lomandra longifolia*), Flax Lily (*Dianella caerulea*), Midyim (*Austromyrtus dulcis*), Common Bracken (*Pteridium esculentum*), Blady Grass (I*mperata cylindrica*), Kangaroo Grass (*Themeda australis*), Sword Sedge (*Lepidosperma longitudinale*), Dodder Laurel (*Cassytha glabella*) and Barbed Wire Vine (*Smilax australis*).

Equivalent vegetation communities

Forest Types in NSW 1989:	Code 53_ Brushbox/ Code 119_Scribbly Gum Bloodwood
CRA Forest Ecosystems 1999:	Code 106_Open Coastal Brushbox/ Code 23_Coast Range Bloodwood Mahogany
Tweed VMP 2004:	Code 302_Coastal Pink Bloodwood/Brushbox Open Forest Code 301_Coastal Pink Bloodwood
Biometric Vegetation Database NRCMA:	Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast [in part] Pink Bloodwood open forest of the coastal lowlands of the North Coast Forests [in part]
Keith (2004) Ocean Shores-Desert Dunes:	North Coast Wet Sclerophyll Forests [in part] Coastal Dune Dry Sclerophyll Forests [in part}

COMMUNITY 7: VERY TALL OPEN FOREST (BROAD-LEAVED PAPERBARK) [T8M]

This community occurs within two locations in the western portions of the site which are directly connected to more extensive Melaleuca Forests within the Cudgen Reserve. In the SW corner of the site the community occurs as a narrow band between the Bare Twigrush Sedge/Rushland and the Sclerophyll Forest (Pink Bloodwood/Brushbox) adjacent Christies Creek. In the NW corner the community extends offsite and intergrades with Mangrove/Saltrush associations.

The canopy layer of the community is comprised principally of Broad-leaved Paperbark (*Melaleuca quinquenervia*) although additional species such as Swamp Box, Blueberry Ash, Swamp Oak, Coastal Banksia and Blue Gum do occur. Species noted in the lower layers include Bare Twigrush, Groundsel Bush, Bracken, Easter Cassia, Bitou Bush and Bungwall Fern (*Blechnum indicum*).

Equivalent vegetation communities

Forest Types in NSW 1989:	Code 31_ Paperbark
CRA Forest Ecosystems 1999:	Code112_Paperbark
Tweed VMP 2004:	Code 401_Broadleaved Paperbark Closed Forest to Woodland
Biometric Vegetation Database NRCMA:	Paperbark swamp forest of the coastal lowlands of the North Coast
Keith (2004) Ocean Shores-Desert Dunes:	Coastal Swamp Forests

COMMUNITY 8: MID-HIGH/TALL OPEN FOREST (SWAMP OAK) [T6M]

Swamp Oak forms small copses within the inter-tidal areas of the site, mostly in association with Christies Creek and the onsite dredge pond. Narrow remnants are also present within the eastern Mangrove Forests of Cudgera Creek on slightly elevated banks.

The canopy of these areas is exclusively comprised of Swamp Oak with predominately tidal wetland species in the lower strata including Saltrush, Saltcouch, Bare Twigrush and mangroves. In the slightly more elevated copses in the southern riparian zones additional pasture species from the adjacent paddocks are also present.

Equivalent vegetation communities

Forest Types in NSW 1989:	Code 32_Swamp Oak
CRA Forest Ecosystems 1999:	Code143_Swamp Oak
Tweed VMP 2004:	Code 601_Swamp She-oak Closed Forest to Woodland.
Biometric Vegetation Database NRCMA:	Swamp Oak swamp forest of the coastal lowlands of the North Coast
Keith (2004) Ocean Shores-Desert Dunes:	Coastal Floodplain Wetlands

COMMUNITY 9: OPEN WATER

This community consists of the open water area which was created as a dredge pond in association with previous mining activities. The dredge pond is fringed with Mangroves, Saltrush, Swamp Oak, Saltcouch and Grassland (pasture grass) as described in the above sections.

Equivalent vegetation communities

Forest Types in NSW 1989:	Code 235_Water Surfaces
CRA Forest Ecosystems 1999:	Code 171_Water Surfaces
Tweed VMP 2004:	Code 903_Open Water
Biometric Vegetation Database NRCMA:	N/A. Associated with Saltmarshes, Mangrove Forest and Swamp Oak (forest)
Keith (2004) Ocean Shores-Desert Dunes:	N/A. Associated with Saltmarshes, Mangrove Forest and Swamp Oak (coastal floodplain wetlands)

Weeds

Throughout the site there is evidence of varying degrees of ongoing weed invasion resulting from edge effects and disturbance particularly where proximate to existing open and exposed areas of the site. Of the weed species noted within Attachment 3, the following are subject to the '*Noxious Weed Declaration – Far North County Council Control Area (2005)*' as follows:

a. Bitou Bush (*Chrysanthemoides monilifera*) – W3^
b. Castor Oil Bush (*Ricinus communis*) – W2*
c. Groundsel Bush (*Baccharis halimifolia*) – W2*
d. Lantana (*Lantana camara*) – W3^

*W2 – the weed must be fully and continuously suppressed and destroyed
^W3 – the weed must be prevented from spreading and it numbers and distribution reduced

3.2 REGIONAL SIGNIFICANCE & CONSERVATION STATUS

3.2.1 ENDANGERED ECOLOGICAL COMMUNITES

A discussion of potentially applicable endangered ecological communities (EECs) is provided below in the context of vegetation surveys undertaken of the site and the relevant scientific determinations for EECs.

SWAMP SCLEROPHYLL FOREST ON COASTAL FLOODPLAINS OF THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS

This EEC is described by the scientific committee (online @ http://www.environment.nsw.gov.au/determinations/SwampSchlerophyllEndSpListing.htm) as follows:

> Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. In some areas the tree stratum is low and dense, so that the community takes on the structure of scrub. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. Typically these forests, scrubs, fernlands, reedlands and sedgelands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

It is considered that Community 7 [Very Tall Open Forest (Broad-leaved Paperbark)] located within the SW and NW portions of the site are partially reflective of the above listed EEC as described by the Scientific Committee. The community has dominance of Paperbark within the canopy, is situated in a low lying areas (<5mAHD) but according to geological mapping (Morland, 1996) is located on the aeolian kingscliff sand sheets.

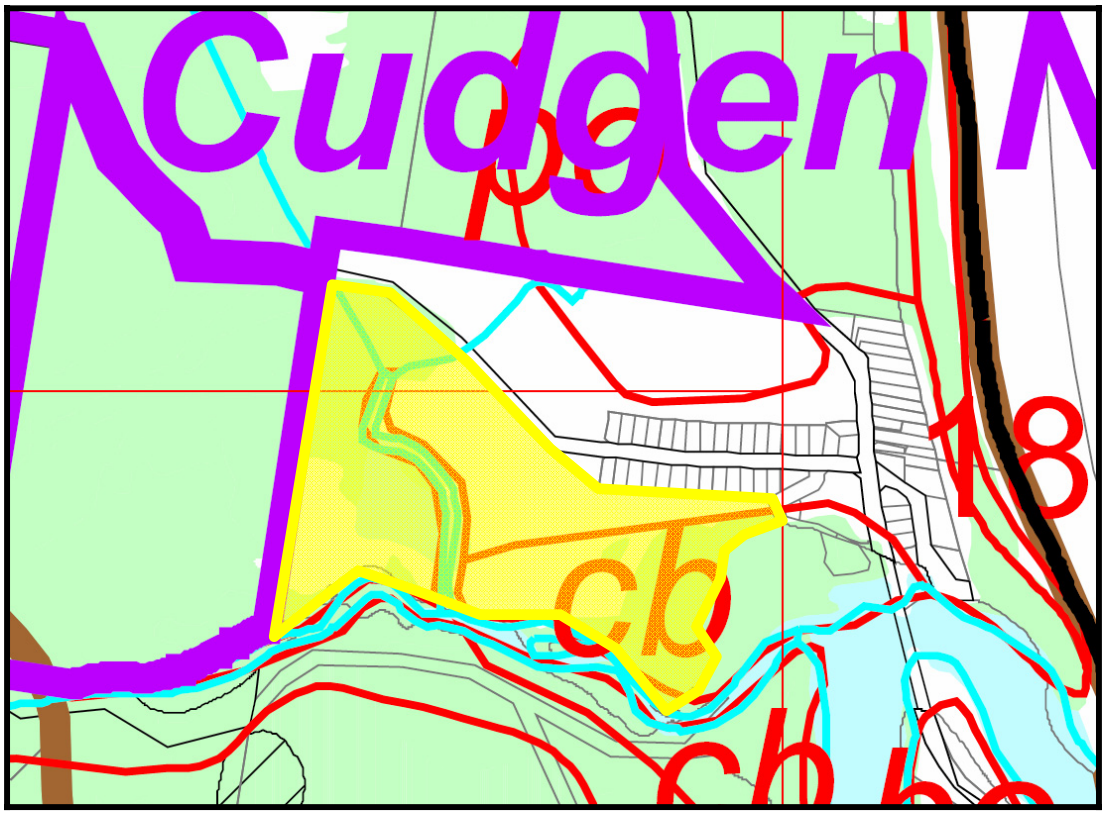


FIGURE 5: EXISTING GEOLOGY MAPPING
SOURCE TWEED VMP, 2004; MORLAD, 1996

Review of Gales Holdings Pty Ltd VS Tweed Shire Council (NSWLEC 209, 2008) notes that:

> *As with the Scientific Committee's description of Freshwater Wetlands, the description of Swamp Sclerophyll Forest has three components: an edaphic component ("humic clay loams and sandy loams"), a topographical component ("waterlogged or periodically inundated alluvial flats and drainage lines") and a locational component ("associated with coastal floodplains"). [106]*

The court in this instance held that the soils described in the applicable soil landscapes of Kingscliff Aeolian sand sheets establish that the soils are not humic clay loams or sandy loams, nor are they associated with such soils. For this reason the court held that the edaphic component of the EEC determination was not met and thus not an EEC.

However, detailed soil analysis has been previously undertaken by Soil Survey Engineers (2004) which notes the following:

5.2 Regional Geology
The coastal landforms, of which this site forms part, are essentially dependent on the basement geology and the river erosion and deposition processes. Low rises in the flood plain in this area are commonly residual soils and shallow rock (mainly phyllite and metasandstone), while the relatively flat flood plains consist of alluvial soils.

The reason for two systems side by side is explained in terms of Pleistocene ice ages when, at times, the level of the sea was some 100 metres lower than the present level. Major rivers then entered the sea somewhere on the continental shelf. Progressive rising and falling sea levels resulted in depositional and erosional processes.

Prominent along the low lying areas of the eastern, northern and north-western coasts of Australia, particularly below RL 5.0 AHO, iron sulfide layers are found. These sulphide layers formed when the sea level rose and inundated the land. Seawater containing sulfate mixed with land sediments. These sulfide sediments, when exposed to air oxidise to produce sulfuric acid, thus the term Acid Sulfate Soils.

5.3 Subsurface Conditions
The natural subsurface conditions encountered in the boreholes were relatively consistent between bore locations and were dominated by an alluvial sequence comprising upper level interbedded silty sands and sands with occasional clayey sand and very occasional silty clay lenses encountered to the depths investigated (SSE, 2004:4-5)

As such, it may be possible that lower lying area adjacent Christies Creek, despite the mapping of Aeolian dominated deposits (Pleistocene sand sheets, dunes) have been re-worked over time with recent processes being alluvial in nature (i.e. deposition of sediments during overbank or flood flow associated with the creek system). In this regard a precautionary approach is adopted and it is considered that Community 7 would be reflective of the nominated EEC.

Notwithstanding, the development proposes the retention of this Community.

SUBTROPICAL COASTAL FLOODPLAIN FOREST OF THE NSW NORTH COAST BIOREGION

This EEC is described by the scientific committee (online @ www.environment.nsw.gov.au/determinations/SubtropicalCoastalFloodplainEndSpListing.htm) as follows:

Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion is the name given to the ecological community associated with clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Subtropical Coastal Floodplain Forest generally occurs below 50 m, but may occur on localised

river flats up to 250 m elevation in the NSW North Coast bioregion. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. Typically these forests and woodlands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

A recent analysis of available quadrat data from these [EEC] habitats identified a distinct grouping of vegetation samples attributable to this community (Keith and Scott 2005). The combination of features that distinguish Subtropical Coastal Floodplain Forest from other endangered ecological communities on the coastal floodplains include: its dominance by a mixed eucalypt canopy, often with Lophostemon suaveolens; the presence of rainforest elements as scattered trees or understorey plants; the relatively low abundance or sub-dominance of Casuarina and Melaleuca species; the relatively low abundance of Eucalyptus robusta; and the prominent groundcover of soft-leaved forbs and grasses. It may occupy central or marginal parts of floodplains and sandy flats, including Pleistocene back-barrier flats (Pressey and Griffith 1992); habitats where flooding is periodic and soils are rich in silt and sand, sometimes humic, and show little influence of saline ground water.

It is considered that Community 6 [Very Tall Open Forest (Pink Bloodwood/Brushbox)] located within the SW portions of the site is partially reflective of the above listed EEC as described by the Scientific Committee.

The community has contains several of this EEC characteristic species (DECC 2007 Identification Guidelines for Endangered Ecological Communities) within the canopy and lower strata, is situated in a low lying area (<5mAHD) but according to geological mapping (Morland, 1996) is located on the aeolian kingscliff sand sheets. Please refer to the Swamp Sclerophyll EEC above for discussion regarding edaphic features of floodplain forests.

Per Community 7 (above) a precautionary approach is adopted and it is considered that Community 6 would be reflective of the nominated EEC.

Notwithstanding, the development proposes the retention of this Community.

NOTE:

The above comments with regard to geological profiling are made in 'lay' terms and have not been examined by an expert in the relevant field of geology and soil processes. This is explained from the viewpoint that in certain circumstances the location of an EEC within a landscape and the geology/soils upon (i.e. edaphic, topographic and locational factors) which it is located can be a significant determining factor in defining the EEC regardless of floristic or habitat value. Readers are directed to Gales Holdings Pty Ltd VS Tweed Shire Council (NSWLEC 209, 2008) in this regard.

However, for the purposes of this report Communities 7 & 6 are considered as EECs and analyzed according.

SWAMP OAK FLOODPLAIN FOREST OF THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS

This EEC is described by the scientific committee (online @ http://www.environment.nsw.gov.au/determinations/SwampOakFloodplainEndSpListing.htm) as follows:

> Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Swamp Oak Floodplain Forest generally occurs below 20 m (rarely above 10 m) elevation in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. Typically these forests, woodlands, scrubs and reedlands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

It is considered that Community 8 [Mid-high/Tall Open Forest (Swamp Oak)] located as seven small copses within the southern and eastern portions of the site is partially reflective of the above listed EEC as described by the Scientific Committee. The community has dominance of Swamp Oak within the canopy, is situated in a low lying areas (<5mAHD) and according to geology mapping and descriptions (Morland, 1996) is located on estuarine landscapes (cobaki quaternary estuarine alluvium).

The development proposes the retention of this Community.

COASTAL SALTMARSH IN THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS

This EEC is described by the scientific committee (online @ http://www.environment.nsw.gov.au/determinations/CoastalSaltmarshEndSpListing.htm) as follows:

> Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is the name given to the ecological community occurring in the intertidal zone on the shores of estuaries and lagoons including when they are intermittently closed along the NSW coast. Coastal saltmarsh has been recorded from sites along the NSW coast (NSW North Coast, Sydney Basin and South East Corner Bioregions).

Community 2: [Low/Mid-High Closed Grassland (Saltwater Couch)], Community 4 [Tall-Very Tall Rushland (Salt Rush)] and Community 5 [Mid-high/Tall Sedgeland/Rushland (Bare Twigrush)] are considered to be reflective of this EEC as described by the Scientific Committee.

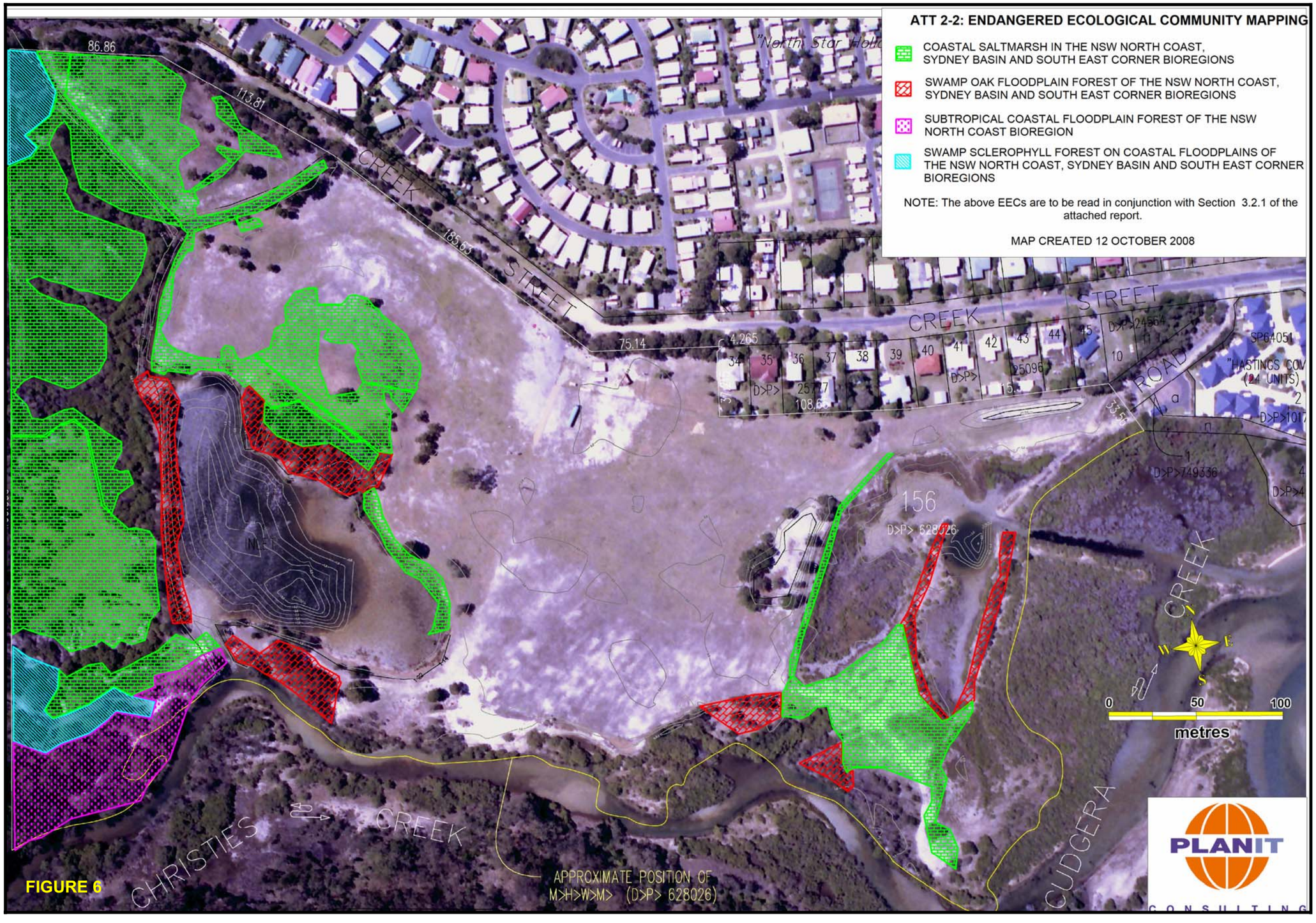

ATT 2-2: ENDANGERED ECOLOGICAL COMMUNITY MAPPING
COASTAL SALTMARSH IN THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS
SWAMP OAK FLOODPLAIN FOREST OF THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS
SUBTROPICAL COASTAL FLOODPLAIN FOREST OF THE NSW NORTH COAST BIOREGION
SWAMP SCLEROPHYLL FOREST ON COASTAL FLOODPLAINS OF THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS
NOTE: The above EECs are to be read in conjunction with Section 3.2.1 of the attached report.
MAP CREATED 12 OCTOBER 2008
86.86
113.81
CREEK
STREET
185.63
75.14
4.265
CREEK
STREET
ROAD
SP64051
"HASTINGS COV
(24 UNITS)
D>P>24564
D>P>25096
D>P>749336
D>P>101
D>P>4
156
D>P> 628026
INLET
CREEK
0
50
100
metres
CHRISTIES
CREEK
APPROXIMATE POSITION OF
M>H>W>M> (D>P> 628026)
CUDGERA
PLANIT
CONSULTING

FIGURE 6

3.2.2 CRA FOREST TYPE & TWEED VMP DESIGNATIONS

As discussed in Section 3.1 above, the mapped vegetation communities over the site can be partially or fully compared to the regional forest ecosystems defined within the 1999 CRA document. With regard to these forest types the Tweed VMP (2004) document provides the following information:

Vegetation Codes & Classification			Regional Conservation Status (based on CRA targets current to Feb 2002 sourced from Tweed VMP 2004)												
Site Vegetation Community Descriptions	**Tweed Vegetation Code**	**Tweed Vegetation Type**	**CRA Forest Ecosystem Code**	**CRA Forest Ecosystem**	**R & E Status**	**Pre 1750 UNE area (ha)**	**Current UNE area (ha)**	**Current Tweed area (ha; based on CRA Forest Ecosystem modelling)**	**Depletion Status (% remaining)**	**Percent Locally Endemic (Tweed area/UNE area)**	**target %**	**Percent Target Met (Feb 2002)**	**NPWS Private Lands Priority**	**Derived Regional Vegetation Status Code (based on CRA % Target Met and other info)**	**Additional Notes**
	Vegcode	**Vegtype**	**CRA_code**	**CRA_FE**	**RE_ status**	**1750 UNEha**	**UNE_ha**	**TWD_CRA_HA**	**Z_ remain**	**Z_Endem**	**Target_ Z**	**Z_Target_ Met**	**NPWS Priv**	**RegVegStat**	
Tall Open Forest (Pink Bloodwood/Brushbox)	302	Coastal Pink Bloodwood / Brush Box Open Forest to Woodland	106	Open Coastal Brushbox	-	9549.0	6533.0	489.0	68.4	7.5	15.0	88.6		3	Contained within 7a zone. Reflective or partially reflective of EEC (refer Section 3.2.1)
Tall Open Forest (Broad-leaved Paperbark)	401	Broad-leaved Paperbark Closed Forest to Woodland	112	Paperbark	V	-9999.0	28577.0	1154.0	-9999.0	4.0	60.0	52.1	Y	1	Reflective or partially reflective of EEC (refer Section 3.2.1).Contained within 7a zone
Mid-high/Tall Open Forest (Swamp Oak)	601	Swamp She-oak Closed Forest to Woodland	143	Swamp Oak	R	11165.0	2883.0	666.0	25.8	23.1	100.0	30.2	Y	1	Reflective or partially reflective of EEC (refer Section 3.2.1). Contained within 7a zone
Low Closed Forest (Mangrove)	602	Mangrove Low Closed Forest to Woodland	77	Mangrove	R	-9999.0	734.0	337.0	-9999.0	45.9	100.0	51.8	Y	1	Contained within 7a zone
Open Water	903	Open Water	171	Water Surfaces	#N/A	-9999.0	-9999.0	2247	-9999.0	-9999.0	-9999.0	-99990		7	Artificial lagoon/ dredge pond. Contained within 7a zone.
Low Closed Grassland (Pasture Grassland w/ scattered trees)	1099	Substantially Cleared of Native Vegetation	173	Cleared-Partially Cleared	#N/A	-9999.0	-9999.0	2247	-9999.0	-9999.0	-9999.0	-99990		7	Highly disturbed/ modified

Vegetation Codes & Classification			Table 5: Regional Conservation Status (based on CRA targets current to Feb 2002 sourced from Tweed VMP 2004)												
Site Vegetation Community Descriptions	**Tweed Vegetation Code**	**Tweed Vegetation Type**	**CRA Forest Ecosystem Code**	**CRA Forest Ecosystem**	**R & E Status**	**Pre 1750 UNE area (ha)**	**Current UNE area (ha)**	**Current Tweed area (ha; based on CRA Forest Ecosystem modelling)**	**Depletion Status (% remaining)**	**Percent Locally Endemic (Tweed area/UNE area)**	**target %**	**Percent Target Met (Feb 2002)**	**NPWS Private Lands Priority**	**Derived Regional Vegetation Status Code (based on CRA % Target Met and other info)**	**Additional Notes**
	Vegcode	**Vegtype**	**CRA_code**	**CRA_FE**	**RE_ status**	**1750 UNEha**	**UNE_ha**	**TWD_CRA_HA**	**Z_ remain**	**Z_Endem**	**Target_ Z**	**Z_Target_ Met**	**NPWS Priv**	**RegVegStat**	
Low Closed Grassland (Saltwater Couch)/ Tall-Very Tall Rushland (Salt Rush)/ Mid-high/Tall Sedgeland/Rushland (Bare Twigrush)	603	Saltmarsh Communities (S1, S3 & S3)	77	Mangrove	R	-9999.0	734.0	337.0	-9999.0	45.9	100.0	51.8	Y	1	Reflective or partially reflective of EEC (refer Section 3.2.1). Salt Rush Communities retained in 7a zone. Bare Twigrush Communities retained in 7a zone. Saltcouch mostly retained in 7a zone. ~1341sqm to be removed adjacent paddock in 2e zone. Western portions of the EEC in the 2e zone shall be retained.

Definitions:

Tweed Vegetation Code/Type: Provides a forest type and code as per Tweed VMP 2004

CRA Forest Ecosystem Code: Provides a forest type ecosystem number as per *Forest Ecosystem Classification and Mapping for Upper and Lower Northeast CRA Regions 1999*

CRA Forest Type: Most analogous forest type compared to those listed within *Forest Ecosystem Classification and Mapping for Upper and Lower Northeast CRA Regions 1999*

Pre 1750 UNE Area: Extent of forest type present pre 1750 as listed within *Forest Ecosystem Classification and Mapping for Upper and Lower Northeast CRA Regions 1999*

Current UNE Area: Amount of forest type remaining as listed within *Forest Ecosystem Classification and Mapping for Upper and Lower Northeast CRA Regions 1999*

R & E Conservation Status: Application of JANIS (1997) criteria for the recognition of rare, endangered and vulnerable ecosystems as below:

Status	Description
Endangered	Where less than 10% of its former range or the total area has contracted to less than 10% of its former area, or where 90% of its area is in small patches which are subject to threatening processes and unlikely to persist.
Vulnerable	Where a reduction of 70% within a bioregional context and which remains subject to threatening processes or [which is] not depleted but subject to continuing and significant threatening processes which may reduce its extent.
Rare	Where its geographic distribution involves a total range of generally less than 10,000ha, a total area of generally less than 1000ha or patch sizes of generally less than 100ha, where such patches do not aggregate to significant areas.

Current Tweed Area: Extent area of forest type remaining within Tweed Shire

Depletion Status: % of current UNE forest area remaining from Pre 1750 area.

Percent Locally Endemic: % of current UNE forest area remaining within Tweed Shire

Target %: JANIS (1997) specified minimum benchmarks for the proportion of each forest ecosystem which should be protected within the CAR reserve system as follows:

- As a general criterion, 15% of the pre-1750 distribution of each forest ecosystem should be protected in the CAR reserve system;
- Where forest ecosystems are recognized as vulnerable, then at least 60% of their remaining extent should be reserved
- All remaining occurrences of rare and endangered forest ecosystems should be reserved or protected by other means as far as is practicable; and
- To ensure representativeness, the reserve system should, as far as possible, sample the full range of biological variation within each forest ecosystem, by sampling the range of environmental variation typical of its geographic range.

Target Met?: Describes whether the JANIS targets have been met by the National Parks Estate as at February 2002.
Derived Vegetation Status: Status of forest ecosystem within Tweed Shire per Table 3.4 TVMP 2004.

Figures and data sourced from TVMP 2004

4.0 FAUNA ASSESSMENT

This section describes the site's fauna and associated habitat as identified through surveying. The methodology applied to arrive at the comprehensive species list is outlined and significant species have been identified where relevant.

4.1 METHODOLOGY

- Desktop analysis including:

i. Review of Council's Planning Scheme Mapping & Associated Reporting (i.e. Tweed LEP 2000 Maps, Draft LEP Amendment No 21 Mapping, Tweed VMP Maps 1-7)

ii. Review of threatened fauna species and endangered populations listed as occurring within the Murwillumbah (Qld - Southeast Hills and Ranges) CMA sub-region of the Northern Rivers CMA (http://threatenedspecies.environment.nsw.gov.au/tsprofile/cma_subregion_list.aspx?id=15

iii. Review of search of the Atlas of NSW Wildlife database within a search area 10km surrounding the site to review threatened plant records

iv. Review of Environment Australia Protected Matters data within a search area 10km surrounding the site to review threatened plant records

v. Review of selected ecological surveys previously undertaken in the locality including:

  - James Warren & Associates (2003) Analysis of Environmental Constraints Lot 156 Creek Street Hastings Point.

  - SKM (2003) Cudgera Creek Road Ecological Assessment.

vi. Review of the following legislation to ensure the latest lists of threatened species were noted as well as investigating the existence of any relevant recovery plans, threat abatement plans, key threatening processes or any preliminary determinations which may be applicable to the site and/or the proposed use/action:

  - *Threatened Species Conservation Act (1995)*
  - *Environment Protection and Biodiversity Conservation Act (1999)*

- Field survey of the flora communities located within and immediately adjacent to the site (in accordance with Section 3 above) to review habitat values;
- The following fauna field survey methods were implemented during April-June 2006 in general accordance with the following:

  - DEC (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft*. DEC, NSW.

- NSWNPWS (2001) *The Community Biodiversity Survey Manual*. New South Wales National Parks & Wildlife Service.
- Gold Coast City Council (2006) Planning Scheme Policy 8: *Guidelines for Ecological Assessments*. G.C.C.C., Nerang.
- Shire of Maroochy (1997) *Flora and Fauna Assessment Requirements for Developments in Maroochy Shire*. M.S.C
- Department of Land and Water Conservation (1997) *Interim Guidelines for Targeted and General Flora and Fauna Surveys under the Native Vegetation Conservation Act 1997*. NSWDLWC, Parramatta.
- Brisbane City Council (1999) *Ecological Assessment Guidelines*. B.C.C.
- Redland Shire's *Planning Scheme Policy 4-Ecological Impacts*

Diurnal Survey

- Active searches were conducted for key habitat components and potential macro- and micro- habitat components for rare and threatened species;
- Binocular search and identification of all fauna heard or sighted;
- Opportunistic sightings/audible identifications were conducted and recorded whilst all survey works were being undertaken;
- Bird identification surveys were conducted in association with dawn and dusk activity and comprised a combination of walked transects through each vegetation community and stationary observations within selected locations. Audible bird call identification was conducted as were wader bird surveys within inter-tidal zones.

  Water based transects were also conducted via kayak to target estuarine and secretive waterfowl (i.e. bitterns, hens, mangrove honeyeater etc)
- Detailed ground track/trace survey was performed including:
  - Scat/pellet examination
  - Scratch/trace examination of trees
  - Diggings, burrow, trace and track examination
  - Humus/crevice examination
  - Examination and assessment of tree hollows, hanging bark, termite mounds, flowering and nesting trees
- Diurnal frog-call recognition and identification during rainfall events and opportunistically performed during other survey works,
- Hair funnels (Faunatech) were installed within the ground and low canopy strata of the site. Funnels were baited with rolled oats, golden syrup, peanut butter and laced with vanilla essence. All hair samples received were sent to Barbara Triggs for analysis.

- Trapping for fauna was performed in accordance with NSW DPI permits issued to Planit Consulting. Type 'A' & 'B' Elliot traps and open wire traps (hook baited and foot paddle spring-loaded) of various sizes were utilised. Traps were set at intervals of approximately 10 – 20 metres depending on habitat complexity within the surveyed vegetation remnants.
- Dry pitfall traps targeting small mammals, reptiles and frogs were installed in accordance with NSW Agriculture Animal Welfare Unit and DEC requirements (http://www.agric.nsw.gov.au/reader/wildlife-research/arrp-pitfall-traps.htm). Each pitfall trapping line consisted of 5 x 20L buckets with 5m of drift fence (0.5m high) either side.

  Trapping was undertaken over a 192 hour period separated by a closed/no trapping period of 3 days after 96 hours. Traps were checked and emptied (where necessary) every morning. Baits utilized within the traps included rolled oats & golden syrup, rolled oats & peanut butter, dog biscuits, tuna, banana, apple, sunflower seed mix, wombaroo insectivore mix, liver and chicken. In addition selected baits were laced with aniseed or vanilla essence. Traps placed within the inter-tidal zone targeting *Xeromys myoides* were baited with west Australian pilchards per Ball (2004).

  Leaf litter and/or grass was placed within all traps to protect captured fauna from potential hypothermia and to provide nesting refuge during the period between trapping and release. All animals were released at the point of capture following positive species identification. In association with this survey no animals were needed to be taken as voucher specimens.

TABLE 6A: REVIEW OF TRAPPING PROGRAM
(James Warren & Associates, 2003)

	Elliot Traps	Cage Traps	Pitfall Traps	Hair Tubes
No. of days	4	4	3	10
No. of traps	75	4	15	25
Total no. of trap nights	300	16	45	250

TABLE 6B: REVIEW OF TRAPPING PROGRAM
(Planit Consulting, 2006 & 2008 in response to DoP raised issues)

	Elliot Traps	Cage Traps	Pitfall Traps	Hair Funnels
No. of trap lines	8	8	4	5
No. of nights per line	4	4	4	10
No. of traps per line	13	4	5	5
Total no. of trap nights	416	96	80	250

Nocturnal Survey

Nocturnal survey included the following survey techniques:

- Audible survey for calls, scratching and landings;
- Trapping for fauna as described above;

- Spotlighting focusing on flowering and senescent trees, vegetated corridors, drainage lines, open grassland and canopy breaks utilising:
    - Short duration-long distance white light, and
    - Long duration-short distance red light

  Duration: Two researchers on four nights for 90 minutes each night (12 person hours)
- Naked eye observation utilising dawn/dusk/moon light for bats and fauna returning to potential nest/shelter areas.
- Anabat detection system was utilized to record echolocation of microchirpteran bats at fixed points and along spotlighting transects. Recordings were undertaken in areas most likely to attract bat species including standing water, drainage lines, remnant edges, areas of flowering vegetation and sites of high insect activity. Calls were analyzed utilizing Analook 49j and accepted reference keys.
- Amplified call recording/playback for avifauna, mammals and amphibians. Playback of pre-recorded calls included the following threatened species:

    - Wallum Froglet (*Crinia tinnula*)
    - Wallum Sedgefrog (*Litoria olongburensis*)
    - Red Goshawk (*Erythrotriorchis radiatus*)
    - Barred Cuckoo-shrike (*Coracina lineata*)
    - Beach-stone Curlew (*Esacus neglectus*)
    - Bush-stone Curlew (*Burhinus grallarius*)
    - Regent Honeyeater (*Xanthomysa phrygia*)
    - Bush Hen (*Amaurornis olivaceus*)
    - Glossy Black Cockatoo (*Calyptorhynchus lathami*)
    - Red-tailed Black Cockatoo (*Calyptorhynchus banksii*)
    - Powerful Owl (*Ninox strenua*)
    - Masked Owl (*Tyto novaehollandiae*)
    - Grass Owl (*Tyto capensis*)
    - Koala (*Phascolarctos cinereus adustus*)
    - Squirrel Glider (*Petaurus norfolcensis*)
    - Woompoo Fruit-dove (*Ptilinopus magnificus*)
    - Rose-crowned Fruit-dove (*Ptilinopus regina*)
    - White-eared Monarch (*Monarcha leucotis*)
    - Black Bittern (*Ixobrychus flavicollis*)

Each call playback session comprised of the following:

- A 15min listening period for unelicited fauna calls
- 5min call playback for relevant species on a 25W Toa Megaphone
- 10min search/spotlight for fauna at the playback site

Depending on the targeted species playback was undertaken at dawn, dusk and/or after dark. All call files were obtained from BOCA or NATURESOUND.

The approximate locations of fauna survey plots (for defined methods such as trapping, call playback, spotlighting etc) across the site are depicted in Attachment 4.

Table 7: Summary of Fauna Survey Effort			
Fauna Group	**Survey Technique**	**Period**	
		Planit 2006 & 2008	Warren 2003
Mammals			
Small terrestrial	Type A Elliot traps	As per above table	
	Hair tubes/funnels	As per above table	
	Pitfall traps	As per above table	
Medium-large terrestrial	Type B Elliott traps/open wire traps	As per above table	
	Hair tubes/funnels	As per above table	
Arboreal mammals	Type B Elliott traps	As per above table	
	Hair tubes/funnels	As per above table	
	Faecal pellet searches	Two person hours beneath favoured koala feed trees & opportunistic survey	Two minutes per koala food tree & opportunistic survey
	Scratch/trace trunk examination	Opportunistic survey	
	Spotlighting	12 hours	3 hours
	Call playback	2 evenings	1 evening
Microchiropteran bats	Harp netting	-	4 nights
	Anabat detection	3 hours at 3 sites	1.5 hours
Megachirpteran bats	Spotlighting	12 hours	3 hours
	Diurnal camp/roost search	Opportunistic survey	-
Birds			
Diurnal	Dusk/dawn observations/audible detection	Opportunistic survey during trap release, vegetation survey and other survey works	Opportunistic survey
	Call playback	Two mornings	-
	Transects & stationary observation points	Avifauna transects: 40 min x 5 lines [replicated twice] Observation points: 30min x 5 points [replicated twice] 1.5 hours waterbased survey on two separate days: 3 hours	Two hours
	Wader bird survey in intertidal zone	60 min dawn survey on four separate days	4 hours
Nocturnal	Call playback/audible detection	2 evenings	1 evening
	Spotlighting	12 hours	3 hours
Reptiles			
	Opportunistic recording	Opportunistic survey	Opportunistic survey
	Active searches, rock/timber roll	30 minute x 0.5ha habitat search on two separate days at three selected sites 3 hours	-
	Spotlighting	12 hours	3 hours
	Pitfall trapping	As per above table	
Amphibians			
	Audible detection	Two hours (during rain 30 April, 1 May) plus opportunistic survey during other works	2.5 hours during rainfall events
	Call playback	2 evenings	1 evening
	Spotlighting	12 hours	3 hours
	Pitfall trapping	As per above table	

4.2 HABITAT ASSESSMENT

Prior to the commencement of the abovementioned survey works on site a broad habitat assessment was conducted. The purpose of this overview was to determine which species were likely to be present based on available habitat components and to target areas for detailed surveying of protected fauna species. The site incorporated the following habitat components as a result of previous landuse, vegetation types (refer Section 3), geomorphic variability, surrounding uses and hydraulic regime:

- Suitable habitat is available within the western forested areas for ground-dwelling fauna as a result of structural and floristic diversity within most areas of the understorey and groundlayer. Suitable refuge for smaller species includes areas of grasses/ferns, fallen logs and debris. Sandy substrate is also available for burrowing animals. The balance of the site (open areas, mangroves forests, casuarinas forest) provides limited structural variation in the lower layers and thus provide less habitat potential for ground-dwelling fauna.

- A high edge: area ratio has been created for all areas adjacent the central paddocks as a result of previous clearing activities. The opportunities for transient, aggressive species to invade forest remnants from surrounding areas and reducing habitat value for more secretive and sensitive species is increased as a result;

- Permanent water-availability providing potentially suitable habitat for a variety of frogs, reptiles and avifauna is present in the form of tidal and freshwater wetlands within the east, south and western areas of the site below HAT. Wetlands and riparian zones containing various vegetation communities increase the potential for coastal and estuarine avifauna (waterfowl, kingfishers etc) to occur. The proximity of creeks and rivers also increases the potential occurrence of coastal raptors. The western wetland areas (Saltrush and Twigrush) are likely to provide amphibian habitat during times of high rainfall. At other times this habitat may become unsuitable as a result of salinity levels associated with the tidal extent;

- Moderate sequential seasonal nectar sources including Eucalypts, Acacias, Corymbian etc. are available for the nectivorous avifauna guild, flying foxes/bats and certain arboreal mammals. Limited numbers of fruiting species suitable for the frugivorous avifauna guild and some flying mammals are available, mostly within the southwestern Eucalypt Forest remnant;

- Moderate levels connectivity across the site (along Christies Creek in the south) between estuarine areas and regional bushland remnants (Cudgen Reserve) is present. The central and northern areas of the site occupied by grassed paddocks are unlikely to represent significance fauna movement corridors;
- A paucity of suitable mature/post mature Eucalypt species incorporating hollows is present. Connectivity to larger remnants capable of supporting significant and viable populations of arboreal mammals may occur to the west in association with the habitats Cudgen Nature Reserve;

- Surveying located any one large stick associated with birds of prey (Brahminy Kite) on the site. Potential occurs for mature trees overhanging waterways or intertidal zones in the south and the western areas to be utilized as nest trees for other raptors or migratory species;
- The proximity of large expanses of estuarine areas and intertidal habitats increases the potential occurrence of wading birds and migratory waterfowl;
- Natural geomorphic variation (sandy substrate, marine clays) and wetland types (marine, brackish, grading to freshwater west of the site in Cudgen Nature Reserve) occurs increasing the habitat types available for flora and fauna.
- Previous sand mining activities have increased the area of marine/tidal habitat through the creation of a large dredge pond and associated tidal channels. This has subsequently increased the areas available for colinisation by marine plants and habitats for estuarine fauna.

4.2.1 BROAD HABITAT STRATIFICATION MAPPING

In association with fauna survey the site was stratified into three broad habitat types as described below

ESTUARINE ENVIRONS

These areas incorporate the tidal and intertidal estuarine wetlands associated with the Mangrove Forest/Woodlands, Saltmarsh (saltcouch, saltrush and bare twigrush) areas, fringing swamp oak copses and the open estuarine water bodies of the dredge pond and adjacent Christies Creek.

FORESTED AREAS

These habitats include the combined remnant of Paperbark Open Forest and Brushbox/Pink Bloodwood Open Forest contained in the southwestern and northwestern corners of the site which are contiguous with offsite remnants of the Cudgen Nature Reserve and the riparian/estuarine zone of Christies Creek.

MODIFIED ENVIRONMENTS

These areas dominate the central portions of the site in association with the pasture grassland and general open areas of the site. Despite dominance of pasture, copses of native vegetation and scattered native trees remain present.

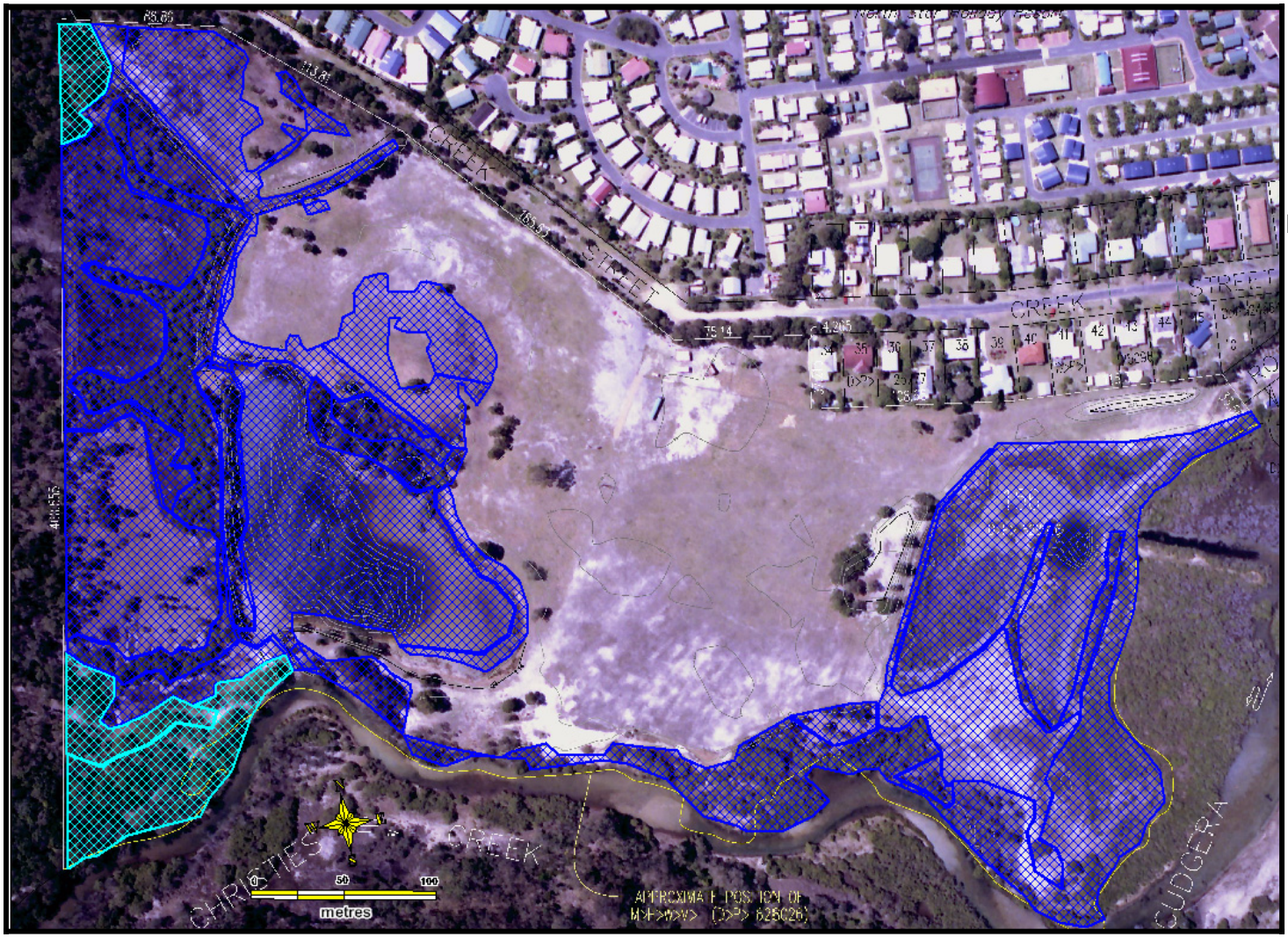


FIGURE 7: BROAD HABITAT STRATIFICATION

ESTUARINE/TIDAL ENVIRONS

MELALEUCA AND PINK BLOODWOOD/BRUSHBOX OPEN FOREST AREAS ADJACENT ESTUARINE ENVIRONMENTS & FRINGING CHRISTIES CREEK

MODIFIED ENVIRONMENTS

MAP CREATED NOVEMBER 2008

4.3 SITE SURVEY RESULTS

The following section(s) list the fauna species recorded on the subject site during detailed surveying and lists the methods by which each species was identified. Results are grouped by the Class of species recorded. Those techniques utilised to record fauna are listed below and correlate with the acronyms included within the Survey Methods column of the grouped Survey Results tables. An element has also been incorporated into the table which quantifies the abundance of each species recorded on site.

Survey Method Codes:

O	Direct Observation
SL	Direct Observation with Spotlight
Sc	Scat
C	Call (Audible) Detection and/or response to playback
HT	Hair tube/funnel
Scr	Scrape
Scrt	Scratch
Sh	Shell/Shell Fragment/Skeleton
Trk	Track/Trace
T	Trapped/hand captured
Ana	ANABAT Detection
*	All birds were either directly observed through diurnal survey, spotlighting or call identification.
**	Introduced/feral species
***	Recorded in adjacent areas or circling overhead

4.3.1 SURVEY LIMITATIONS

Whilst the duration of flora surveys and inspections of the property are considered appropriate, it was not practical to intensively search all areas of vegetation present (~17.9ha). Additional undetected threatened or other native flora species may be present on the property (particularly weed species within the pasture). Seasonal surveys would also be necessary to detect flora species that are dormant or inconspicuous for part of the year (i.e. from the Asteraceae, Orchidaceae, Cyperaceae, Poaceae etc). Some of these species (dormant or non flowering) may have been undetected or under-represented within the survey period. Further ungerminated seed of various species may have been present within the soil seed bank.

Whilst the duration and sampling methodology of the fauna survey is considered appropriate, it is acknowledged that the entire seasonal fauna assemblage is unlikely to be recorded. It is also accepted that although assessments of habitat and species ecology does provide an additional measure to anticipate the presence of species (as a surrogate for its actual observation), there is no absolute certainty to the absence of a species from marginal or potential habitat.

Additionally, there may be some species that may utilise the habitats within the site but have remained undetected due to their rarity, elusive nature or the sporadic utilisation of the habitats (i.e. the Long-nosed Potoroo, Common Planigale and Dunnart are elusive species that are difficult to trap or observe directly; the Black-

necked Stork, Powerful Owl and Red Goshawk may only visit an area occasionally within a much larger home-range; the Swift Parrot and Regent Honeyeater may only visit an area during peak flowering periods etc).

The conclusions of this report are therefore based upon data available at the time and the results of field works undertaken and are therefore indicative of the environmental condition of the site at the time of sampling, including the presence or otherwise of species. At should be acknowledged that site conditions, including the presence of threatened species, can change over time.

The above limitations have been taken into account and the likelihood of threatened such species occurring within the site assessed through habitat assessment, records of the species within the locality and aspects of species ecology (refer Section 6).

4.3.2 LICENCING

The following issued licences are relevant to the survey undertaken:

TABLE 8: RELEVANT LICENCES

Authority	Licence/Permit	Title	Expiration	Permit No.
NSW DPI	Animal Research Authority	Fauna Surveying, Trapping & Release	30 July 2009	01/1537
NSW DPI	Animal Care & Ethics Committee	Fauna Surveying, Trapping & Release	30 July 2009	01/1537
NSW National Parks & Wildlife Service	Scientific Licence	Flora & Fauna	28 February 2009	S11892

BIRDS*

Class	FAMILY	SPECIES NAME	Common Name
Birds	Accipitridae	*Pandion haliaetus*	Osprey***
Birds	Accipitridae	*Haliaeetus leucogaster*	White-Bellied Sea-Eagle***
Birds	Accipitridae	*Haliastur indus*	Brahminy Kite***
Birds	Accipitridae	*Haliastur sphenurus*	Whistling Kite***
Birds	Alcedinidae	*Alcedo azurea*	Azure Kingfisher
Birds	Anatidae	*Anas superciliosa*	Pacific Black Duck
Birds	Anhingidae	*Anhinga melanogaster*	Darter
Birds	Ardeidae	*Ardea alba*	Great Egret
Birds	Ardeidae	*Ardea ibis*	Cattle Egret
Birds	Ardeidae	*Ardea intermedia*	Intermediate Egret
Birds	Ardeidae	*Ardea novaehollandiae*	White-Faced Heron
Birds	Ardeidae	*Butorides striatus*	Striated Heron
Birds	Artamidae	*Cracticus nigrogularis*	Pied Butcherbird
Birds	Artamidae	*Gymnorhina tibicen*	Australian Magpie
Birds	Artamidae	*Strepera graculina*	Pied Currawong
Birds	Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo
Birds	Cacatuidae	*Cacatua galerita*	Sulphur-Crested Cockatoo
Birds	Cacatuidae	*Cacatua roseicapilla*	Galah
Birds	Campephagidae	*Coracina novaehollandiae*	Black-Faced Cuckoo-Shrike
Birds	Charadriidae	*Vanellus miles*	Masked Lapwing
Birds	Centropodidae	*Centropus phasianinus*	Pheasant Coucal
Birds	Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked Stork
Birds	Columbidae	*Geopelia humeralis*	Bar-Shouldered Dove
Birds	Columbidae	*Geopelia striata*	Peaceful Dove
Birds	Columbidae	*Ocyphaps lophotes*	Crested Pigeon
Birds	Columbidae	*Streptopelia chinensis*	Spotted Turtle-Dove
Birds	Coraciidae	*Eurystomus orientalis*	Dollarbird
Birds	Corvidae	*Corvus orru*	Torresian Crow
Birds	Cuculidae	*Scythrops novaehollandiae*	Channel-Billed Cuckoo
Birds	Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird
Birds	Dicruridae	*Dicrurus bracteatus*	Spangled Drongo
Birds	Dicruridae	*Grallina cyanoleuca*	Magpie-Lark
Birds	Dicruridae	*Rhipidura fuliginosa*	Grey Fantail
Birds	Dicruridae	*Rhipidura leucophrys*	Willie Wagtail
Birds	Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra
Birds	Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher
Birds	Hirundinidae	*Hirundo neoxena*	Welcome Swallow
Birds	Laridae	*Larus novaehollandiae*	Seagull***
Birds	Maluridae	*Malurus cyaneus*	Superb Fairy-Wren
Birds	Meliphagidae	*Entomyzon cyanotis*	Blue-Faced Honeyeater
Birds	Meliphagidae	*Lichenostomus chrysops*	Yellow-Faced Honeyeater
Birds	Meliphagidae	*Lichmera indistincta*	Brown Honeyeater
Birds	Meliphagidae	*Manorina melanocephala*	Noisy Miner
Birds	Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater
Birds	Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater
Birds	Meliphagidae	*Philemon corniculatus*	Noisy Friarbird

Class	FAMILY	SPECIES NAME	Common Name
Birds	Meliphagidae	*Phylidonyris nigra*	White-Cheeked Honeyeater
Birds	Meropidae	*Merops ornatus*	Rainbow Bee-Eater***
Birds	Motacillidae	*Anthus novaeseelandiae*	Richard's Pipit***
Birds	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-Thrush
Birds	Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler
Birds	Pardalotidae	*Pardalotus striatus*	Striated Pardalote
Birds	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican***
Birds	Passeridae	*Neochmia temporalis*	Red-Browed Finch
Birds	Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant
Birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant***
Birds	Psittacidae	*Platycercus adscitus*	Pale-Headed Rosella
Birds	Psittacidae	*Trichoglossus chlorolepidotus*	Scaly-Breasted Lorikeet
Birds	Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet
Birds	Sturnidae	*Acridotheres tristis*	Common Myna
Birds	Sylviidae	*Megalurus timoriensis*	Tawny Grassbird
Birds	Threskiornithidae	*Platalea regia*	Royal Spoonbill
Birds	Threskiornithidae	*Threskiornis molucca*	Australian White Ibis
Birds	Threskiornithidae	*Threskiornis spinicollis*	Straw-Necked Ibis
Birds	Zosteropidae	*Zosterops lateralis*	Silvereye

MAMMALS

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	METHOD
Mammals	Canidae	***Canis familiaris*	Dog	O
Mammals	Equidae	***Equus spp.*	Horse	Trk, Sc
Mammals	Macropodidae	*Wallabia bicolor*	Swamp Wallaby	O
Mammals	Leporidae	***Lepus capensis*	Brown Hare	SL
Mammals	Molossidae	*Tadarida australis*	White-striped Freetail-bat	Ana
Mammals	Muridae	***Mus musculus*	House Mouse	T
Mammals	Muridae	*Rattus lutreolus*	Swamp Rat	T
Mammals	Muridae	***Rattus rattus*	Black Rat	T
Mammals	Peramelidae	*Isoodon macrourus*	Northern Brown Bandicoot	Trk, T, HT
Mammals	Phascolarctidae	*Phascolarctos cinereus*	Koala	Sc
Mammals	Pteripodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	SL
Mammals	Vesptertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	Ana

REPTILES

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	METHOD
Reptiles	Agamidae	*Pogona barbata*	Bearded Dragon	O
Reptiles	Scincidae	*Cryptoblepharus virgatus*	Wall Skink	O,T
Reptiles	Scinidae	*Ctenotus robustus*	Eastern Striped Skink	T
Reptiles	Scincidae	*Lampropholis delicata*	Grass Skink	O,T
Reptiles	Varanidae	*Varanus varius*	Lace Monitor	O

AMPHIBIANS

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	METHOD
Amphibians	Bufonidae	***Bufo marinus*	Cane toad	SL, T
Amphibians	Hylidae	*Litoria fallax*	Eastern Sedgefrog	C
Amphibians	Hylidae	*Litoria carulea*	Green Treefrog	O
Amphibians	Myobatrachidae	*Crinia signifera*	Clicking Froglet	C
Amphibians	Myobatrachidae	*Limnodynastes peronii*	Striped Marshfrog	C
Amphibians	Myobatrachidae	*Limnodynastes terraereginae*	Northern Pobblebonk	T
Amphibians	Myobatrachidae	*Pseudophryne bibroni*	Brown Toadlet	C

4.4 DISCUSSION OF SURVEY RESULTS

4.4.1 BIRDS

Sixty-five (65) species of bird were recorded during surveys of the subject site. Three species scheduled as endangered or vulnerable under the *Threatened Species Conservation Act 1995* or *Environment Protection and Biodiversity Conservation Act 1999* were recorded on the site during fauna survey works. This species are separately discussed within following sections of this report.

Subsequent to the fauna survey it is considered that the site exhibits habitat generally suitable for coastal species common to a mixture of terrestrial and aquatic (freshwater and estuarine) environments. The high levels of fragmentation and presence of open grassland areas proximate to residential developments also provides suitable environments for common territorial species (Crow, Magpie, Minor) and edge-specialist species (Kookaburra, Currawong, Butcherbird) which dominated such areas of the site.

The proximity of extensive coastal wetlands (estuarine and freshwater) has resulted in the recording of numerous waterfowl such as Egrets, Herons, Ducks and Ibis. The majority of these species were recorded from Communities 1, 4, 5, 8 and 9 which are those tidally influenced areas of the site. Some species (White-faced Heron, Cattle Egret, Straw-necked Ibis, White Ibis) were also typically recorded foraging within the open grassland/paddock areas of the site.

Diurnal coastal raptors were also noted to be common in the locality and were either recorded circling over the site and surrounds or perching within trees overhanging Christies Creek or other wetland areas. One Brahminy Kite nest was noted within the upper branches of a mature *E. tereticornis* central to the paddock area.

The limited abundance of fruiting rainforest/riparian species (i.e. Tuckeroo, Kurrajong, Figs, Lilly Pilly, Laurels etc) during the survey of the site is the likely cause for a low recording of frugivores. Doves and Pigeons were, however, commonly recorded during survey works mostly associated with the ornamental plantings of surrounding residential areas. A higher diversity of such species is likely to be recorded (principally within the southwestern areas of the site-Community 6 fringing Christies Creek) during peak fruiting periods.

The nectarivorous guild was well represented as a result of habitat diversity (e.g. vegetation associations and disturbance variability) and suitable forage bases mostly associated with the western forest remnants (although individual flowering trees within other areas were also utilized for foraging). Of these species the majority were associated with the remnant Eucalypt Forest/Woodland areas in the west of the site which provide greater a structural diversity and nectar variety than the balance of the site. Throughout the year a progression of potential food resources from the Eucalypt, Lophostemon, Melaleuca and Acacia generas represent a relatively constant supply of food for nectarivores. Flowering periods of common species on site are tabulated below:

TABLE 9 FLOWERING PERIODS OF COMMON TREE SPECIES (Source: Qld Museum, 2003; Brooker & Kleinig, 1999; SCAP, 2002/2005)

	SPRING			SUMMER			AUTUMN			WINTER		
	S	O	N	D	J	F	M	A	M	J	J	A
A. sophorae	■	■	■							■	■	■
A. melanoxylon			■	■	■							
C. intermedia			■	■	■							
E. robusta									■	■	■	
E. tereticornis	■	■						■	■	■	■	■
L. suaveolens		■	■	■	■	■	■	■				
M. quinquenervia							■	■	■	■	■	■
B. integrifolia				■	■	■				■	■	■
A. excelsa							■	■	■			

Suitable habitat for more secretive/rare species is mostly absent due to the disturbed edges of the existing vegetation communities and additional occupation of the majority of these fringes by aggressive edge-specialist populations. Transient use of the site by such species however, cannot be discounted given the proximity of the Round Mountain/Cudgen Nature reserve and the extensive home ranges occupied by some species (particularly coastal and nocturnal raptors).

The nocturnal raptor guild was not represented although the Tawny Frogmouth and White-throated Nightjar are considered likely to occur.

4.4.2 MAMMALS

A total of twelve (12) mammal species were recorded on the subject site. No species scheduled as endangered or vulnerable under the *Threatened Species Conservation Act 1995* or *Environment Protection and Biodiversity Conservation Act 1999* was directly recorded on the site during fauna survey works.

Ground-dwelling Mammals

All terrestrial mammals require vegetated cover for shelter and to facilitate movement. Small terrestrial mammals prefer areas within a complex vegetation structure which is dense within the lower strata and subsequently provides shelter/nesting sites and refuge from predators. Larger terrestrial mammals (larger wallabies, kangaroos) also generally require dense cover for refuge but tend to favour more open areas for grazing/feeding.

Suitable structural forest variation and dense understorey components were generally absent over the majority of the site but were present in areas to the west of the dredge pond (particularly the southwestern Pink Bloodwood/Brushbox Forest). Bandicoots, Black Rat and Hares were commonly recorded from this location with the Swamp Wallaby occasionally noted. Adjacent sedgeland/rushland areas were also noted to provide suitable habitat for the Swamp Rat which was repeatedly trapped by placing Elliot traps in anticipated runway areas and adjacent logs (following Norton, 1987).

The balance of the site yielded low terrestrial mammal counts which were restricted to the Black Rat and House Mouse that were trapped at on the southern riparian fringes where grass and weed growth occurred between the Mangrove Forest and slashed paddocks. Horse tracks were also recorded with several dogs noted crossing the paddocked areas at night.

All of the above terrestrial mammal species are considered to be regular occurrences within the sub-region. The proximity of the large Cudgen Nature/Round Mountain Reserve immediately to the west of the site would indicate that additional terrestrial mammals (i.e. Long-nosed Bandicoot, Grassland Melomys) may utilise the western communities which border the reserve.

Arboreal Mammals

Arboreal mammals previously noted to occur within the vicinity of the site are all noted to be hollow dependent with the exception of the Koala and the Ringtail Possum (which does utilize hollows but will also construct leaf dreys) (Strahan eds, 2002; Gibbons and Lindenmayer, 2002). It is widely accepted that a reduction in senescent trees is a limiting factor in hollow dependent arboreal mammal populations (Smith and Lindenmayer, 1998; Gibbons and Lindenmayer, 2002; Lindenmayer, 2002; Lunney, 1987).

Within the site there exists a general lack of hollow bearing trees which are mostly restricted to the southwestern corner of the site. Inspection within the adjacent reserve does note the presence of several nearby hollow bearing trees and it is considered likely that, although hollow dependent arboreal mammals are unlikely to rely on the site as an important breeding area, they may forage in the southwestern areas during suitable fruiting/flowering periods. Whilst no such species were recorded during survey, the occurrence of the Sugar Glider and Brushtail Possum within the southwestern and adjacent forested areas is considered reasonably likely.

A limited abundance of potential Koala foraging trees (principally *E. robusta, E. tereticornis, E. x kirtoniana*) were recorded on site, the majority of which were scattered throughout the open paddock/grassland areas. These areas are currently separated from the larger forested remnants of the Cudgen/Round Mountain Nature Reserve by tidal channels and wetland areas limiting to a degree the potential usage

of the open areas by the Koala. The open nature of these areas, broad scattering of trees and ongoing rural use and domestic animal presence is also likely to be a factor precluding Koala use of the paddock area.

Within the southwestern corner of the site, however, exists an intact Eucalypt Forest remnant (Community 6) that connects to the large remnants of Cudgen Reserve which is noted to contain a significant Koala population (NPWS, 1998). As such Koalas are anticipated to utilize the southwestern corner of the site as part of territorial movements associated with the larger adjacent reserve. Koala scat searches within this southwestern forest yielded results as did the 2003 ecological survey (James Warren & Associates).

Flying Mammals

Megachiropteran bats (Grey-headed Flying Fox) were recorded foraging on flowering melaleucas on site or flying overhead across the subject site to additional areas of Melaleuca Wetland (Cudgen Reserve) to the west. The mega-bats require a continual source of blossom nectar and/or fruits for foraging throughout the year, and despite the moderate presence of such resources on the site no evidence of roosting or breeding areas were recorded or observations made during the survey. The presence of additional mega-bats (Black Flying Fox, Blossom Bat) may occur during peak flowering periods. Deposits of guano/excrement below mature trees were also absent further supporting the hypothesis that bat species do not roost on site. The development of the site will not result in a significant reduction of the existing local foraging base for the mega-bats given that construction is largely restricted to cleared areas.

The presence of riparian areas, melaleuca wetlands and nearby eucalypt forest indicates that microchiropteran bats are likely to forage on site and in the surrounding areas. Species such as Sheathtails, Freetails, Wattled and Bentwing Bats are commonly recorded within the Cudgen/Round Mountain area and have potential to forage on site. During survey Gould's Wattled Bat and the White-striped Freetail were recorded via echolocation with additional species (Southern Forest Bat, Little Bentwing Bat, Yellow-bellied Sheathtail) having been recorded in nearby locations (Planit, 2006; Parker, 2002; SKM, 2003).

The low number of hollow bearing trees limits the roosting potential of threatened bat species such as the Eastern Freetail, Hoary Wattled and Greater Broadnosed Bats. In addition no suitable caves or tunnels were present to support nesting colonies of Little Bentwing and Eastern Bentwing Bats. Stag watching of hollow bearing trees and inspection of nearby building roofs failed to locate any nesting/roosting presence of bat species.

4.4.3 REPTILES

A total of five (5) reptile species were recorded on the subject site. No species listed as endangered or vulnerable under the *Threatened Species Conservation Act 1995* or *Environment Protection and Biodiversity Conservation Act 1999* were recorded on the site during fauna survey works.

Typically reptile species require a large diversity of microhabitats (including vegetation structure, ground substrates, basking sites etc) and suitable shelter sites to regulate body heat. Such components are crucial as reptiles require differing

levels of microhabitat to regulate body heat which controls essential functions such as movement, digestion, respiration and breeding activity (Kaplan, 1996). In this regard, it is considered that the grassed and paddocked areas proposed for development provide lower quality habitat for reptile species.

The southwestern forested areas (Community 6) are considered to provide the better quality reptile habitat on the site due to the presence of suitable reptile habitat components such as logs, decorticating bark, debris, sandy substrate for burrowing, thick ground cover vegetation and leaf litter layers.

Reptiles recorded on site are noted to be common occurrences within the locality and are also generally found within areas impacted to some degree by disturbance and/or human activity. Overall reptile recording was lower than anticipated prior to surveying with the presence of a higher diversity of lizards and snakes expected. The time of survey is likely to have resulted in reduced species count as a result of cooler temperatures limiting reptile activity.

4.4.4 AMPHIBIANS

Five (5) species of native frog and one (1) introduced toad were recorded on the subject site. No species listed as endangered or vulnerable under the *Threatened Species Conservation Act 1995* or *Environment Protection and Biodiversity Conservation Act 1999* were recorded on the site during fauna survey works.

Amphibians typically require a series of permanently wet or damp habitats (streams, moist understorey, dams, depressions etc) to disperse (it is noted however that they will disperse across additional areas during prolonged wet weather) and require access to various breeding sites on a seasonal basis. Negative impacts to continued amphibian survival within local and regional areas can occur when appropriate breeding sites and habitats are isolated, thus separating breeding individuals and access to alternate food resources. This is particularly relevant for rare and threatened species, which are usually already geographically isolated from similar populations.

The majority of the site (open grassed and intertidal areas) provide poor quality habitat for amphibian species with the southwestern and northwestern forest immediately adjacent Melaleuca wetland areas providing better quality habitat. The more extensive freshwater melaleuca wetlands within Cudgen Reserve to the west may provide habitat for threatened acid frogs (i.e. *Crinia tinnula, Litoria olongburensis*). The sedge/rushlands in the west of the site may also represent favoured habitat in times of high rainfall leading to ponding of freshwater. At other times the salinity of the tidal waters within this zone is likely to limit use by amphibians.

During site works the Striped Marshfrog, Northern Pobblebonk and Cane Toad were trapped in pits in the southwestern forest (Community 6) proximate to adjacent Melaleuca wetland and sedge/rushlands. The Eastern Sedgefrog, Clicking Froglet and Brown Toadlet were also recorded calling from adjacent this area within Cudgen Nature Reserve.

5.0 SCHEDULED COMMUNITIES, POPULATIONS AND SPECIES OF CONSERVATION SIGNIFICANCE

A review of the flora and fauna assessments undertaken for the site (2003 and 2006) identifies a number of environmental constraints to any proposed development or activity. Identified constraints include:

- Significant vegetation communities (poorly reserved, rare or vulnerable within UNE region, regionally significant within Tweed Shire etc)
- Endangered ecological communities
- Recorded or potential occurrence of threatened fauna (and associated habitat) species
- Intertidal communities (below HAT) and riparian associations of Cudgera/Christies Creeks
- Presence of significant environmental reserves (Cudgen Nature Reserve) to the west of the site
- Fauna corridors/linkages

The potential presence of scheduled endangered populations, threatened fauna and declared critical habitats are also discussed below:

5.1 ENDANGERED/THREATENED ECOLOGICAL COMMUNITIES

Endangered ecological communities are listed under Schedule 1, Part 3 of the *Threatened Species Conservation Act 1995*, while threatened ecological communities are listed under the *Environment Protection and Biodiversity Conservation Act 1999* as critically endangered, endangered and vulnerable.

Four endangered ecological communities have been recorded on the subject site:

TABLE 10: RECORDED ENDANGERED ECOLOGICAL COMMUNITIES

EEC	SITE VEGETATION COMMUNITY
COASTAL SALTMARSH IN THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS	Community 2 [Low/Mid-High Closed Grassland (Saltwater Couch)], Community 4 [Tall-Very Tall Rushland (Salt Rush)] Community 5 [Mid-High/Tall Sedgeland/Rushland (Bare Twigrush)]
SWAMP OAK FLOODPLAIN FOREST OF THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS	Community 8 [Mid-High/Tall Open Forest (Swamp Oak)]
SUBTROPICAL COASTAL FLOODPLAIN FOREST OF THE NSW NORTH COAST BIOREGION	Community 6 [Very Tall Open Forest (Pink Bloodwood/Brushbox)]
SWAMP SCLEROPHYLL FOREST ON COASTAL FLOODPLAINS OF THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS	Community 7 [Very Tall Open Forest (Broad-Leaved Paperbark)]

The above EEC's will be retained with the exception of the removal of ~1341sqm of Community 2.

5.2 ENDANGERED POPULATIONS

Endangered populations are listed under Schedule 1, Part 2 of the *Threatened Species Conservation Act 1995*. No endangered populations are considered to occur on or proximate to the study area with the closest being the 'Cobaki Lakes and Tweed Heads West population of the Long-nosed Potoroo *Potorous tridactylus* (Kerr 1792) in the Tweed local government area.' The development proposal will not impact upon this population.

5.3 THREATENED FLORA SPECIES

No flora species listed as endangered or vulnerable under Schedules 1 and 2 of the *Threatened Species Conservation Act 1995* or listed as critically endangered, endangered, vulnerable or conservation dependant under the *Environment protection and Biodiversity Conservation Act 1999* were observed on the site.

A search of the *NPWS 'Atlas of NSW Wildlife' [2006]* has determined that twenty-three species of threatened flora occur within the region (search area 153.51, -28.415, 153.61, 28.315).

Based on habitat assessment and the known distribution of these species within the NENSW bioregion, 18 of these species are considered unlikely to be present within the site. It is considered that suitable or potential habitat occurs for 10 species, however they were not detected during field survey (2003 or 2006). None of the listed species are likely to occur in areas proposed to be developed.

TABLE 11: POTENTIALLY OCCURING THREATENED FLORA

Species Name	Preferred Habitat	TSCA Status
Amorphospermum whitei	Warm-temperate rainforest/sub-tropical rainforest (Hauser & Blok, 2002; Williams, Harden & McDonald, 1984).	V
Acacia bakeri	In or near lowland subtropical rainforest, in adjacent eucalypt forest and in regrowth. (NSW Dept. Env. & Cons., 2005)	V
Acronychia littoralis	Littoral rainforest on sand (Hauser & Blok, 2002; Williams, Harden & McDonald, 1984; Floyd, 1989).	E1
Archidendron hendersonii	Riverine and lowland subtropical rainforest, and littoral rainforest. (NSW Dept. Env. & Cons., 2005)	V
Cassia brewsteri var.marksiana	Littoral and riverine rainforest, and in regrowth vegetation on farmland and along roadsides. (NSW Dept. Env. & Cons., 2005)	E1
Chamaesyce psammogeton	Sand dunes adjacent the sea (Harden in Heyligers, 1998; NSW Flora online, 2006)	E
Cryptocarya foetida	Littoral rainforest, usually on sandy soils, but mature trees are also known on basalt soils. (NSW Dept. Env. & Cons., 2005)	V
Cryptostylis hunteriana	Swamp heath on sandy soils (NSW Flora online, 2006)	V
Cynanchum elegans	Ecotones of dry subtropical rainforest and sclerophyll forest/woodlands (NPWS, 2002)	E1

Species Name	Preferred Habitat	TSCA Status
Davidsonia jerseyana	Lowland subtropical rainforest and wet eucalypt forest at low altitude (below 300m). Many trees are isolated in paddocks and on roads in former rainforest habitats.(NSW Dept. Env.&Con., 2005)	E1
Davidsonia johnsonii	Disturbed sub-tropical rainforest or in the margin with wet sclerophyll forest. (Plant Net 2006)	E1
Dendrocnide moroides	Occurs in lowland rainforest, especially in gaps or other disturbed sites. (NSW Dept. Env. & Cons., 2005)	E1
Drynaria rigidula	Usually found in rainforest, but also in moist eucalypt and Swamp Oak forest. (NSW Dept. Env. & Cons., 2005)	E1
Elyonurus citreus	Sandy soils near rivers or along the coast in wallum areas or sand dunes. NSW locations of this species found on infertile white sands. (NSW Dept. Env. & Cons., 2005).	E1
Endiandra floydii	Warm temperate or subtropical rainforest with Brushbox overstorey, and in regrowth rainforest and Camphor Laurel forest. (NSW Dept. Env. & Cons., 2005)	E1
Endiandra hayesii	Sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils.	V
Endiandra muelleri subsp. bracteata	Rainforest or wet eucalypt forest, chiefly at lower altitudes. (NSW Dept. Env. & Con., 2005)	E1
Fontainea australis	Lowland subtropical rainforest, usually on basaltic alluvial flats, and also in cooler subtropical rainforest (NSW Dept. Env.& Con., 2005)	V
Geodorum densiflorum	Dry eucalypt forest and coastal swamp forest at lower altitude, often on sand. (NSW Dept. of Env. & Cons., 2005)	E1
Hedyotis galioides	Margins of seasonally inundated wetlands in paperbark swamps and Forest Red Gum (*E.tereticornis)* Woodlands. (NSW Dept. Env. & Cons., 2005)	E1
Macadamia tetraphylla	Subtropical rainforest, particularly on basaltic soils. (Williams, Harden and McDonald, UNE, 1984).	V
Marsdenia longiloba	Rainforest and adjacent wet sclerophyll forest (NPWS, 2002)	E2
Ochrosia moorei	Riverine and lowland subtropical rainforest (NSW Dept. Env.&Con.2005)	E2
Peristeranthus hillii	Restricted to coastal and near-coastal environments, particularly littoral rainforest and the threatened ecological community lowland rainforest on floodplain. (NSW Dept. Env. & Cons., 2005)	V
Randia moorei	Subtropical, riverine, littoral and dry rainforest. In NSW, Hoop Pine and Brush Box are common canopy species.	E1
Syzygium hodgkinsoniae	Usually found in riverine and subtropical rainforest on rich alluvial or basaltic soil. (NSW Dept. Env. & Cons., 2005)	V

Species Name	Preferred Habitat	TSCA Status
Syzygium moorei	Subtropical and riverine rainforest at low altitude. Often occurs as isolated remnat paddock trees.	V
Thesium australe	Grassland or grassy eucalypt woodland where Themeda australis is a predominant groundcover (NPWS, 2002).	V

Potential Occurrence Sources:

NPWS: NPWS database search 5km radius surrounding site [accessed online @ http://wildlifeatlas.nationalparks.nsw .gov.au/wildlifeatlas/watlasSpecies.jsp 22 August 2006]

It is considered that potential habitat for the majority of the nominated species is absent from the area to be developed. Notwithstanding, active searches throughout all observed macro- and micro-habitats occurring throughout the site were undertaken to locate the presence or absence of the tabled species. As the species were not recorded, further assessment is considered unnecessary.

5.4 THREATENED FAUNA SPECIES

Several species listed as endangered or vulnerable under Schedules 1 and 2 of the *Threatened Species Conservation Act 1995* or listed as critically endangered, endangered, vulnerable or conservation dependant under the *Environment protection and Biodiversity Conservation Act 1999* were recorded on or adjacent the site during survey works:

TABLE 12: RECORDED THREATENED/MIGRATORY FAUNA

Species	Location Recorded	Recorded 2006?	Recorded 2003?	TSCA 1995	EPBC 1999
Osprey	Cudgen Reserve adjacent western boundary and commonly within Hastings Point estuarine areas.	√	√	Vulnerable	-
Glossy Black Cockatoo	SW Corner of site and within Cudgen Reserve	√	√	Vulnerable	-
Black-necked Stork	Dredge Pond	√	-	Vulnerable	-
Koala	SW Corner of site & within Cudgen Reserve. Scats only.	√	√	Vulnerable	-
Grey-headed Flying Fox	All areas where melaleuca trees flowering	√	√	Vulnerable	Vulnerable
White-bellied Sea-Eagle	Circling over Christies Creek SW of site	√	-	-	Migratory Terrestrial

Species	Location Recorded	Recorded 2006?	Recorded 2003?	TSCA 1995	EPBC 1999
Lantham's Snipe	Intertidal mangrove forest in eastern areas of site	-	√	-	Migratory Wetland
Great Egret	Commonly recorded foraging in inter-tidal communities including dredge pond	√	√	-	Migratory Marine
Little Bentwing Bat	Mangroves and swamp sclerophyll communities	-	√	Vulnerable	-

A search of the *NPWS 'Atlas of NSW Wildlife' [2006]* has determined that an additional twenty-nine species of threatened fauna occur within the region (search area 153.51, -28.415, 153.61, 28.315).

TABLE 13: POTENTIALLY OCCURRING THREATENED FAUNA (SOURCE: NPWS WILDLIFE DATABASE, 2006) SELECTED AREA 153.51, -28.415, 153.61, -28.315

Species Name	Common Name	Status
Amaurornis olivaceus	Bush-hen	V
Anseranas semipalmata	Magpie Goose	V
Burhinus grallarius	Bush-stone Curlew	E1
Calidris alba	Sanderling	V
Calidris tenuirostris	Great Knot	V
Calyptorhynchus banksii	Red-tailed Black Cockatoo	V
Calyptorhynchus lathami	Glossy Black-Cockatoo	V
Caretta caretta	Loggerhead Turtle	E1
Chelonia mydas	Green Turtle	V
Crinia tinnula	Wallum Froglet	V
Ephippiorhynhcus asiaticus	Black-necked Stork	E1
Esacus neglectus	Beach Stone-curlew	E1
Gygis alba	White Tern	V
Haemotopus fuliginosus	Sooty Oystercatcher	V
Haemotopus longirostris	Pied Oystercatcher	V
Ixobrychus flavicollis	Black Bittern	V
Litoria olongburensis	Wallum Sedgefrog	V
Miniopterus australis	Little Bentwing Bat	V
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat	V
Megaptera novaeangliae	Humpback Whale	V
Monarcha leucotis	White-eared Monarch	V
Myotis adversus	Large-footed Myotis	V
Nyctophilus bifax	Eastern Long-eared Bat	V
Pandion haliaetus	Osprey	V
Phascolarctos cinereus	Koala	V
Phaethon rubricauda	Red-tailed Tropicbird	V
Petaurus norfolcensis	Squirrel Glider	V
Planigale maculata	Common Planigale	V
Pteropus aclecto	Black Flying-fox	V

Species Name	Common Name	Status
Pteropus poliocephalus	Grey-headed Flying Fox	V
Ptilinopus magnificus	Wompoo Fruit Dove	V
Ptilinopus regina	Rose-crowned Fruit Dove	V
Sterna albifrons	Little Tern	E1
Syconycteris australis	Common Blossom Bat	V
Todiramphus chloris	Collared Kingfisher	V
Tyto capensis	Grass Owl	V
Tyto novaehollandiae	Masked Owl	V

E1 – Endangered (Threatened Species Conservation Act 1995)
E2 – Endangered (Threatened Species Conservation Act 1995)
V – Vulnerable (Threatened Species Conservation Act 1995)

A review of available habitats and the ecology of the database listed species (i.e. range, preferred habitat, home range etc) indicate that it is unlikely that all of these previously recorded species in the region would rely on the habitats of the subject site or be significantly affected by the development proposal.

Subsequently several such threatened species are considered unlikely to be significantly affected by the proposal for one or more of the following reasons:

- core habitats were not recorded in the study area
- resources used by the species are unlikely to be adversely affected or only likely to be minimally affected by the proposal.

Details of such species requirements and reasons for not considering impacts to these species further are contained within the below Table. A number of threatened species have been excluded from discussion in the below table where they are considered reasonably unlikely occurrences due to the following:

- Being a marine reptile or mammal (i.e. whale, turtle, seal)
- Being a pelagic seabird, wader bird or intertidal zone coastal bird (i.e. tern, godwit, oystercatcher)

For species considered a potential occurrence (based upon distribution, database recording, suitable habitat present etc) or which were recorded within or directly adjacent the site during either survey period and for which it is considered that the species would be affected by the proposal (i.e. impact on feeding, roosting, nesting, behaviour and associated habitat), the seven-part test of significance has been performed in Section 6 of this report.

Notwithstanding, all the species tabled below were actively targeted during the fauna survey.

Species	Potential occurrence based upon known habitat and range	Notes	Potential for the species or associated habitat to be impacted upon by proposal
Osprey (*Pandion haliaetus*)	Recorded	This species is associated with waterbased habitats including estuaries, coastal wetlands, rivers and streams. The Osprey is predominately a coastal raptor frequenting estuaries, bays, inlets, islands and rocky cliffs within all Australian states except for Tasmania and sporadically within Victoria (DEC, 2005; NPWS, 2002). It is noted however, that the species sometimes inhabits inland islands (Pizzey and Knight, 1997; Readers Digest, 2002). Within suitable environment it usually constructs a nest in an overhanging large tree or upon elevated man made structures such as platforms or telegraph poles. The species preys almost exclusively on fish by usually hunting alone and traversing the water's surface for prey which it secures by swooping over the waters surface or plunging below (Readers Digest, 2002; Clancy, 2005). Studies of prey middens on Lizard Island within the Great Barrier Reef also noted that occasional Terns and crustaceans are sourced for food (Smith, 1985). The species is noted to occur and nest within the Hasting's Point area and was observed during 2003 and 2006 fauna surveys.	**Recorded. 7-part test performed**
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)	Recorded	Potential occurs for the Glossy Black Cockatoo to frequent the site due to the presence of foraging materials (*Allocasuarina* spp.) although suitable nesting trees (large hollow within a live or dead Eucalypt: 10-20m, Depth: 40-120cm, Entry: ~21cm: Inside Dia: ~23cm (Forshaw, 1981; Gibbons & Lindenmayer, 2002)) are considered to be absent. Favoured habitat, however, is considered to be limited to the SW corner of the site in association with Community 6 Pink Bloodwood/Brushbox forest. It is noted that extensive areas of eucalypt forest habitat occur within the adjacent Cudgen Reserve and that the species has been recorded there (NPWS, 1998). During the 2003 survey chewings typical of the species previous presence (per Triggs, 2001) were recorded within the SW corner of the site. Additional chewings were also recorded in this location during the 2006 survey. Three individuals were observed on two occasions within the SW corner of the site during April 2006 with a very large group of individuals (nine) also recorded proximate to the site within the Cudgen Reserve in March 2006.	**Recorded. 7-part test performed**

Barred Cuckoo-shrike (*Coracina lineata*)	Unlikely	This species has been recorded from a variety of habitats including rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses within Coastal NSW (NPWS, 2002). Foraging requirements include fruiting tree species within in rainforest, wet sclerophyll forest, vegetation remnants or isolated trees (DEC, 2005) and insects captured among foliage (NPWS, 2002). Preferred habitat is considered to be mostly absent from the site although some fruiting trees were recorded within the SW Forest (i.e. Eleocarpus, Glochidion, Austromyrtus, Acronychia). This area will be retained in association with the proposal.	**Unlikely to be significantly affected by proposal.** **All areas of preferred habitat will be retained in association with the proposal.**
Black-necked Stork (*Ephippiorhynchus asiaticus*)	Recorded	The species is generally associated with wetlands, mudflats, mangroves, swamps and floodplains while it may also sometimes be found in open woodland environs where a grassy understorey is present (NPWS, 2002, Readers Digest, 2002; DEC, 2005). Irrigated lands are also occasionally a foraging resource and it has also been recorded foraging in artificial wetlands of sewerage treatment plants (ERM, 2001). An individual of this species was observed foraging within the eastern end of the onsite dredge pond (Community 4: Saltrush/ Community 9: Open Water) during May 2006.	**Recorded. 7-part test performed**
Powerful Owl (*Ninox strenua*)	Unlikely	This species of Owl occupies a very large (800-1000ha) permanent range within mostly wet sclerophyll forests and woodlands in southeastern Australia (NPWS, 2002; NPWS, 2005). Within this range its favoured prey include large arboreal mammals (greater glider, brushtail possum) although additional smaller prey (flying fox, sugar glider, ringtail possum, rabbit, birds) are also taken (NPWS, 1997; 2005). Kavanagh & Stanton (2002) note that small (<200 ha) fragments do not provide a significant reservoir for populations of large forest owl (Sooty, Powerful, Masked) species. Roosting occurs within 'groves of dense mid-canopy trees or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines, but also adjacent to cliff faces and below dry waterfalls. Roosting sites are commonly among small groves of up to 2 ha of similar-sized trees with dense foliage in the height range 3-15 m. (Data from Kavanagh 1997, Kavanagh 2002b in DEC, 2005; 8). Nesting has been recorded in over-mature eucalypts within 100m of streams/drainage lines	**Unlikely to be significantly affected by proposal.**

		in large hollows (>45cm dia; 100cm deep) surrounded by canopy trees and subcanopy or understorey trees or tall shrubs The owl is faithful to traditional nesting hollows, but also sometimes uses alternative hollows in the nesting gully (Data from Schodde and Mason 1980, McNabb 1996, Kavanagh 1997, Kavanagh 2002b, Higgins 1999 in DEC, 2005: 8). Given its previous recording in the region its transitional movement through or over the site cannot be precluded. However, the absence of large tracts of intact tall forest associations and suitable populations of favoured prey indicate that the site may not represent an important foraging area. Stag watching, spotlighting and call playback proximate to the taller trees of the site did not result in any recording of the species.	
Squirrel Glider (*Petaurus norfolcensis*)	Possible	This species of Glider is associated with dry sclerophyll forest and woodlands although in northern NSW and Qld it has been recorded from wet sclerophyll environments (Suckling in Strahan eds, 2002; Lindenmayer 2002). It is considered to be most abundant in associations containing winter flowering Eucalypts and/or environments with a high abundance of Acacia, Banksia species in the lower layers (Smith & Murray, 2003; Menkhorst et al, 1998; Quinn, 1995). Within the canopy of the preferred habitat numerous trees bearing hollows are critical habitat values required to support populations of the species (Quinn, 1995; Smith & Murray, 2003; Lindenmayer, 2002). Gliders are known to regularly swap den trees and utilise a number of such dens (between 6 and 19 den trees per Glider) within their home range (van der Ree, 2000). These results are supported by survey work undertaken by Southern Cross University (June/July 2002) which indicated that 12 radio tracked gliders utilised 37 den trees incorporating live hollow bearing trees and stags (Cited in Warren, 2004). Within the site, favoured habitats are considered to be restricted to the SW Forest (Community 6) although the low abundance of suitable hollow bearing trees may limit the potential of this area to be of significance for the species. This community will be retained in association with the proposal and therefore the species is considered unlikely to be impacted.	**Unlikely to be significantly affected by proposal.** **All areas of preferred habitat will be retained in association with the proposal.**

Koala (*Phascolarctos cinereus*)	Possible	This species is considered a potential occurrence on site due to its recording of scats (2003 and 2006) and its presence within the adjacent Cudgen Reserve which contains extensive areas of suitable habitat. Within the site suitable foraging habitat is considered to be restricted to the SW corner of the site (Community 6) which incorporates potential foraging resources such as *E. tereticornis* and *E. robusta.* Several Scats were retrieved from this location. However, diurnal canopy search, spotlighting and call playback failed to yield any direct observation of the species.	**Trace recorded. 7-part test performed**
Grey-headed Flying-fox (*Pteropus poliocephalus*)	Recorded	This species forages on a variety of fruits, flowers and pollen. It occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps (Eby 1995). It additionally utilises cultivated fruit crops and urban gardens. This species was recorded in large numbers in the western portions of the site (and adjacent reserve) foraging on Melaleucas which were flowering heavily during the 2006 survey period. Individuals were also noted to be feeding on Melaleucas fringing the dredge pond. The species was also recorded in this location during the 2 003 survey (Warren & Associates).	**Recorded. 7-part test performed**
Black Flying-fox (*Pteropus alecto*)	Possible	The Flying-fox forages on the nectar and pollen of native trees and fruits of native rainforest trees and vines as well as ornamental and orchard trees/crops. The preferred food includes the blossoms of Eucalypts, paperbarks and turpentines. Other native and introduced blossoms and fruits are also eaten (Strahan eds, 2002; Nicola and Hall, 2004). A number of flowering trees will be removed in association with the proposed development, however, this is not considered to reflect a significant reduction in the potential regional forage base for the flying fox. Notwithstanding, the 7-part tests have been performed for the species.	**Yes.** **7-part test performed as part of 2006 submission. It is noted that this species was de-registered as a threatened species in NSW by the Scientific Committee on 8 August 2008.**

Wallum Froglet (*Crinia tinnula*)	Possible	This species of wallum frog is found along drainage lines in sub-coastal wet heath, in acid paperbark (*Melaleuca*) swamps, and sedge swamps associated with sandy coastal plains (but rarely from around coastal lakes) and low slopes below 40m altitude and above areas of tidal influence (Ehmann, 1997; Meyer et al, 2006). "The swamps in which wallum frog species breed are typically oligotrophic (i.e. nutrient poor), tannin-stained and acidic (pH < 6.0). These attributes may render wallum frog breeding habitat unsuitable for related species (i.e. the common sedgefrog *Litoria fallax*, striped rocketfrog *L. nasuta*, clicking froglet *C. signifera* and beeping froglet *C. parinsignifera*). This could explain why wallum frog species and related species seldom occur together" (Ingram and Corben, 1975; Straughan, 1966 in Myer et al, 2006: 16). Suitable habitat is considered to occur in the western portions of the site in association with Melaleuca Forest (Community 7) and sedge/rushlands (Communities 4 and 5) although its occurrence may be limited as a result of tidal waters inundating most of these areas. Such saline influence to habitat areas is likely to limit amphibian movement (i.e. the amphibian permeable skin provides no protection against water loss via osmosis to a surrounding medium of saline water [Barker, Grigg & Tyles, 1995]). Significant areas of Melaleuca Forest are present within the adjacent Cudgen Reserve with the species known to occur there (NPWS, 1998) Diurnal and nocturnal wet weather survey and call detection did not record the species onsite although it is considered a potential occurrence given the location of extensive palustrine wetland habitat in the adjacent reserve. These areas are significantly buffered from the proposed development envelope and unlikely to be significantly affected as a result of site development.	**Unlikely to be significantly affected by proposal.** **All areas of preferred habitat will be retained in association with the proposal.**
Magpie Goose (*Anseranas semipalmata*)	Possible	This species favours coastal wetlands and swamps with prolific reed/sedge growth mostly within northern Australia (NPWS, 2002; Tulloch et al, 1981). Breeding is confined to the northern areas in association with large floodplains of creeks/rivers generally within 80km of the coast (Frith and Davies, 1961). Dense sedge/rush growth within shallow waters in these locations is favoured for nest formation (Tulloch et al, 1981; Bayliss and Yeoman, 1990). Foraging within grazed paddocks and breeding within constructed stormwater wetlands has also been observed at Carrara on the Gold Coast (pers. obs.). It is considered that the site represents marginal habitat for the species (given the limited size of the onsite dredge pond and rush/sedge areas) which is unlikely to breed in the area although the habitats of the site, including the paddock areas, could be utilised for foraging.	**Not recorded. Reduction in insignificant areas of marginal foraging habitat (grasslands, paddock).** **Unlikely to be significantly affected by proposal.**

Black Bittern (*Ixobrychus flavicollis*)	Possible	The species is widely distributed throughout the coastal regions of Australia but is more common in the northern extent of the country. Within its distribution, the species shows a preference for densely vegetated areas within terrestrial and aquatic wetlands. It has been recorded from a variety of vegetation types (including grassland, mangroves, wet sclerophyll forest, rainforest) where permanent water is present (Marchant & Higgins, 1990; Simpson & Day, 1996; NPWS, 2001). In northern NSW black bitterns are most often recorded in riparian habitats along fresh or brackish streams, although the species is also known to utilise drains, permanently inundated swamp forest, and freshwater wetlands (Sandpiper Ecological Surveys, 2003). Suitable habitat is considered to occur in proximity to the site in association with Christies Creek and the estuarine and freshwater wetland habitats of Cudgen Reserve from which the species has been recorded (NPWS, 1998). Although the species was not recorded during avifauna searches (including water based transects) and did not respond to call playback it is considered a possible occurrence given the presence of suitable habitat in the area and the extension of such habitat external to the western and eastern portions of the site.	**Unlikely to be significantly affected by proposal.** **All areas of preferred habitat will be retained in association with the proposal.**
Wompoo Fruit Dove (*Ptilinopus magnificus*)	Unlikely	This species is confined to mature rainforest and adjacent wet sclerophyll environments in eastern Australia from Cape York to around Coffs Harbour. As an obligate fruigivore it requires a high availability of fruiting materials which it generally feeds on in the high canopy (Recher et al, 1995). Suitable habitat for this species is considered to be largely absent from the site although it has been previously recorded within the Cudgen Reserve (NPWS, 1998)	**Unlikely to be significantly affected by proposal.** **Preferred habitat largely absent.**
Common Planigale (*Planigale maculata*)	Possible	This species is known to inhabit a broad range of habitats incorporating a dense ground cover layer including rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas (Redhead in Strahan, 2002; Lewis, 2005). In northern NSW, it has been suggested that their distribution often corresponds with the low lying flat and undulating areas of the coastal plains often near intensively settled areas (Gilmore and Parnaby 1994 in Lewis, 2005). A small population of the species has been recently recorded on the northern banks of the Cobaki Broadwater in association with Swamp Mahogany/Brushbox Forest (Ecopro, 2004; Lewis Ecological Surveys, 2004). Potential habitat is considered to occur within the western portions of the site adjacent the Cudgen Nature Reserve from where it has been recorded (NPWS, 1998). Pitfall trapping within these areas failed to record the species.	**Unlikely to be significantly affected by proposal. All areas of preferred habitat will be retained in association with the proposal.**

Rose-crowned Fruit Dove (*Ptilinopus regina*)	Unlikely	This species generally occurs within sub-tropical rainforest, camphor laurel and occasionally wet sclerophyll and swamp forests which contain suitable fruiting species for foraging (DEC, 2005; Recher et al, 1995). As an obligate frugivore a high proportion of fruiting species (figs, lillipillis, laurels etc) is necessary and as such rainforest habitats are favoured. The species is considered a partial migrant and moves north in autumn/winter and returning in spring/summer to breed (Recher et al, 1995). Preferred habitat is considered to be mostly absent from the site although some fruiting trees were recorded within the SW Forest (i.e. Eleocarpus, Glochidion, Austromyrtus, Acronychia). This area will be retained in association with the proposal.	**Unlikely to be significantly affected by proposal.** **All areas of preferred habitat will be retained in association with the proposal.**
Common Blossom Bat (*Syconycteris australis*)	Possible	This species is one of the smallest members of the flying fox family (Pteropodidae) and is considered to be a specialist pollen feeder favouring Banksia, Melaleuca, Callistemon and certain species of Eucalypt (Strahan eds, 2002). Required habitats include Coastal rainforest, heathlands and Melaleuca swamps. Roosting is noted to occur in Littoral Rainforest with foraging occurring in proximate heathland and melaleuca forest (Law, 1993). The presence of Melaleuca Forest (Community 7) on site and extensive areas of Melaleuca Forest and Eucalypt Forest within the adjacent reserve indicates the species may be a potential occurrence. A number of flowering trees will be removed in association with the proposed development, however, this is not considered to reflect a significant reduction in the potential regional forage base for the Bat. Notwithstanding, the 7-part tests have been performed for the species.	**Yes. Minor reduction in potential foraging resources proposed.** **7-part test performed**
Little Bentwing Bat (*Miniopterus australis*)	Recorded	This species utilises well-timbered habitats including rainforest, *Melaleuca* swamps and dry sclerophyll forests where it It feeds on insects within the canopy and requires caves, mines, stormwater drains and/or tree hollows to roost (Strahan eds, 2002). Potential habitat for the species occurs in association with the western portions of the site incorporating Community 6 (Pink Bloodwood/Brushbox Forest) and Community 7 (Melaleuca Forest). Additional extensive areas also occur within the nearby Cudgen Reserve where the species has been previously recorded (NPWS, 1998). The species was also detected via Anabat within the 2003 survey.	**Recorded** **7-part test performed**

Eastern Bentwing (*Miniopterus schreibersii oceanensis*)	Possible	This species usually forages on insects within intact, well timbered forest complexes and have been found to roost within caves, tunnels, stormwater culverts or disused mining areas (Strahan eds, 2002; DEH, 2005). They utilise a broad range of habits including wet and dry sclerophyll forest, open woodland, paperbark forests, rainforests and open grasslands (North & Pasic, 2006). Potential foraging habitat occurs in association with the forested communities (6 and 7) although it has been noted to forage within more open grassland areas. As such its foraging within the development envelope (open paddock/scattered trees) is considered possible. However, roosting and/or breeding requirements are considered to be absent. Survey capable of detecting the species was performed with no recordings made within 2003 or 2006.	**Yes. Minor reduction in potential foraging resources proposed.** **7-part test performed**
White-eared Monarch (*Monarcha leucotis*)	Possible	This species generally occurs within Coastal/Subtropical/Littoral Rainforests and occasionally Eucalypt/Riparian Forest, Mangroves and Swamp Sclerophyll with mesomorphic understorey along the eastern coast of Australia from Cape York to the Tweed River (Readers Digest, 2002; DEC, 2005). Potential exists for the species to occur given the presence of suitable habitats onsite (Mangrove Forest, Pink Bloodwood/Brushbox Open Forest and Paperbark Open Forest). As the above communities will be retained in association with the proposal no significant impact to the monarch is anticipated. The species has been previously recorded from the adjacent Cudgen Reserve (NPWS, 1998)	**Unlikely to be significantly affected by proposal. All areas of preferred habitat will be retained in association with the proposal.**
Bush-hen (*Amaurornis olivaceus*)	Possible	This species favors coastal rivers and inlets from the Clarence River, north. It prefers densely overgrown margins of permanent terrestrial freshwater wetlands such as creeks and rivers, billabongs, ponds, swamps, waterholes, dams, lakes and roadside ditches (Muranyi and Baverstock, 1996). Suitable habitat for the bush-hen is considered to be present in association with the estuarine and paperbark, pink bloodwood/brushbox habitats within and adjacent the Christies Creek riparian zone. However, avifauna survey including dusk/dawn searches and call playback failed to record the species presence. The species has been previously recorded from the adjacent Cudgen Reserve (NPWS, 1998)	**Unlikely to be significantly affected by proposal. All areas of preferred habitat will be retained in association with the proposal.**

Wallum Sedge-frog (*Litoria olongburensis*)	Possible	This species is known from ephemeral wetlands and acid swamps containing sedgeland, banksias (wallum) and melaleuca forest/woodland within the coastal sandy zones of NE NSW and SE QLD (DEH, 2005; NPWS, 2002). During wet periods the frog can be found on emergent vegetation (rushes, sedges, ferns) whilst during drier periods it may be found at the base of such vegetation (DEH, 2005) Potential habitat is considered to occur in the western portions of the site in association with Melaleuca Forest (Community 7) and sedge/rushlands (Communities 4 and 5) although its occurrence may be limited as a result of tidal waters inundating most of these areas. Significant areas of Melaleuca Forest are present within the adjacent Cudgen Reserve with the species known to occur there (NPWS, 1998) Diurnal and nocturnal wet weather survey and call detection did not record the species onsite although it is considered a potential occurrence given the location of extensive palustrine wetland habitat in the adjacent reserve.	**Unlikely to be significantly affected by proposal. All areas of preferred habitat will be retained in association with the proposal.**
Bush Stone-curlew (*Burhinus grallarius*)	Possible	This species is widespread throughout predominately coastal Australia where its preferred habitat consists of open forest-woodlands containing a grassy understorey with fallen timber and leaf litter (Readers Digest, 2002; NPWS, 2006). Foraging however, has been noted to occur over a broader spectrum of habitats including paddocks, grasslands, domestic areas (gardens, sports fields, [golf courses, residential areas pers. obs] etc), estuarine areas (mudflats, saltmarsh, mangrove forest, swamp oak, melaleuca forest) (NPWS, 1999; 2006). Potential habitat is present on the site in association with estuarine areas (Communities 1, 2 and 8) and the forested areas in the western portions (Communities 6 and 7). It is also considered that the open paddock areas (Community 3) provide potential foraging habitat as the species is known to utilize domestic areas and be tolerant of human presence/disturbance. Avifauna survey and call playback failed to record the species on site although it is not considered to be uncommon in the local area (pers obs). As the proposal will be largely restricted to the open grassland/paddock (with estuarine and forested areas retained) this curlew is unlikely to be significantly impacted.	**Unlikely to be significantly affected by proposal. Insignificant area of potential foraging habitat (open grassland/paddock) to be impacted upon by the proposal.**

Beach Stone-curlew (*Esacus neglectus*)	Possible	This species is distributed throughout coastal western, northern and eastern Australia from Norwest Cape to the Manning River (Readers Digest, 2002). Within this area it utilised open beaches, islands, reefs and sand/mudflats (NPWS, 2005; 1999; 2002) where it forages on crabs and other hard shelled marine invertebrates (Readers Digest, 2002). Mudflat areas are present in the eastern tidal areas of the site with additional mudflats and sandflats present in the locality associated with Cudgera Creek. As such it is considered that potential habitat is available within the vicinity of the site. As the development proposes the retention of the eastern areas (which are currently within the 7a zone), the species is unlikely to be affected by the proposal should it occur. It is noted that the species was not recorded during wader bird surveys.	**Unlikely to be significantly affected by proposal. All areas of preferred habitat will be retained in association with the proposal.**
Red-tailed Black-Cockatoo (*Calyptorhynchus banksii*)	Possible	This species has been recorded from a variety of habitats including dry open forest and areas of mixed rainforest-eucalypt forest within Coastal NSW (NPWS, 2002). Within such forest it requires large hollow bearing trees in which to nest and a suitable availability of seeds and nectar upon which to forage. Suitable habitat is considered to occur on site in association with Communities 6 and 7 (Paperbark and Bloodwood/Brushbox Forest) although potential foraging resources (flowering/seed producing species) are also broadly scattered within the open paddock (Community 3). Fauna survey works capable of detecting the species were undertaken with no recordings of the Cockatoo made. As preferred habitat areas will be retained the species is unlikely to be significantly impacted. The removal of scattered flowering trees (Melaleuca, Eucalypt, Acacia etc) within the development envelope does not represent a significant reduction in the regional forage base for the species.	**Unlikely to be significantly affected by proposal. Insignificant area of potential foraging habitat (scattered trees in open grassland/paddock) to be impacted upon by the proposal.**
Collared Kingfisher (*Todiramphus chloris*)	Likely	This species is recorded in coastal Australia from Shark Bay to the Clarance River where it is almost exclusively associated with mangrove and estuarine areas (NPWS, 2005; Readers Digest, 2002). The species is considered likely to occur within Christies and Cudgera Creeks given the presence of mangrove forest and estuarine communities both on and adjacent the site. As such areas are to be retained in association with the proposal, kingfisher populations are unlikely to be significantly impacted upon.	**Unlikely to be significantly affected by proposal. All areas of preferred habitat will be retained in association with the proposal.**

Grass Owl (*Tyto capensis*)	Unlikely	This species is generally recorded within tussock-grasslands but has also been noted to occur within heathland, swamps, coastal dunes, tree-lined creeks, treeless plains, mangrove fringes, grassy gaps between trees and crops and sugar cane plantation (Garnett and Crowley 2000; Pizzey and Knight, 1997). Within these habitats it sources a wide range of prey including birds, insects and terrestrial mammals. However, it feeds predominately on rodents and its population numbers can fluctuate wildly with the rise and fall of prey populations (Olsend and Doran, 2002). The fall of primary prey species following plague events (during which owl breeding increases) can result in widespread dispersal by the Owls with starvation also noted as the forage base reduces (Debus et al, 1998). Within the site it is considered that small areas of potential habitat occur in association with the western saltmarsh/sedgeland (Juncus, Baumea) communities. However these areas were regularly traversed and inspected during survey with no nests or individuals of the species noted. Call playback was also unsuccessful. As a result it is considered that the species is not currently utilising the site.	**Unlikely to be significantly affected by proposal. All areas of preferred habitat will be retained in association with the proposal.**
Eastern Long-eared Bat (*Nyctophilus bifax*)	Possible	This species of bat inhabits lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest with coastal rainforest and patches of coastal scrub particularly favoured (DEC, 2005; NPWS, 2002). Roosting occurs within tree-hollows, under bark and/or palm fronds and within dense foliage with a seasonal shift in roost sites from rainforest edges (summer) to the rainforest interior (winter) (NPWS, 2002; Parnaby in Strahan, 2002; Lunney et al, 1995). It is considered that the potential habitat for the species on site is limited to the swamp and coastal woodland/forest associations (Communities 6-8) which will be retained in association with the proposal. Surveys capable of detecting the species were undertaken in 2003 and 2006 with no recordings made.	**Unlikely to be significantly affected by proposal. All areas of preferred habitat will be retained in association with the proposal.**
Masked Owl (*Tyto novaehollandiae*)	Unlikely	The Masked Owl lives in eucalypt forests and woodlands from the coast, where it is most abundant, to the western plains (Kavanagh 2002b in NPWS, 2005). Within suitable habitat the species occupies a range of 5-10km2 where it forages mostly upon rodents and marsuipials although this may be supplemented by bandicoots, arboreal mammals (Sugar Glider, Common Ringtail Possum) and some birds with introduced rodents and rabbits becoming important in disturbed environments (Debus, 1993, Kavanagh, 1996; NPWS, 2005). Habitats containing stands of large, hollow bearing eucalypts are also critical to roosting and nesting (NPWS, 2005; Kavanagh and Murray, 1996). Whilst the species has been recorded in the region, the site is unlikely to represent significant habitat within its home range given the paucity of suitable forest/woodland and suitable hollow-bearing trees for roosting. The development of ~4.4ha of open grassed communities of the site is highly unlikely to represent a significant reduction in the potential regional forage base.	**Unlikely to be significantly affected by proposal. Insignificant area of potential foraging habitat to be impacted upon by the proposal.**

Large-footed Myotis (*Myotis adversus*)	Possible	The Myotis roosts within caves, tunnels, hollow-bearing trees, bridges, buildings and dense tree foliage always in close proximity to permanent water (NPWS, 2002; Richards, 2002). It forages over water bodies where it scoops insects and small fish from the water surface or catches insects aerially (DEH, 2005; Menkhorst, 1996; Richards, 2002). It has been recorded foraging over small creeks, coastal rivers, estuaries, lakes and inland rivers (Law & Anderson, 1999) and other smaller water bodies including farm dams (Law et al, 1998). Within the site potential foraging habitat is associated with the dredge pond and proximate water body areas of Christies Creek and the species is considered likely to utilise these areas . These environments will be retained in association with the proposal.	**Unlikely to be significantly affected by proposal. All areas of preferred habitat will be retained in association with the proposal.**

5.5 CRITICAL HABITAT

Critical habitat listed under the *Threatened Species Conservation Act 1995* includes:

- Bomaderry zieria within the Bomaderry bushland
- Eastern Suburbs Banksia Scrub Endangered Ecological Community
- Wollemia nobilis (the Wollemi pine)
- Gould's Petrel
- Little penguin population in Sydney's North Harbour
- Mitchell's Rainforest Snail in Stotts Island Nature Reserve

The proposed development is unlikely to impact upon any of these declared critical habitats.

5.6 INTERTIDAL-RIPARIAN ASSOCIATIONS & MARINE VEGETATION

Christies and Cudgen Creeks bound the site to the south and east with areas in the west of the site also subject to tidal inundation as a result of previous sandmining activities (containing dredge pond and tidal channels). The vegetation within these tidal zones are potentially of value to fisheries resources, migratory bird habitat, significant vegetation communities (as discussed above), other recorded and potentially occurring fauna and as a water based fauna linkage between the Cudgen Reserve and Cudgera Creek estuary.

In this regard it is important to ensure that the riparian and tidal vegetation communities be largely protected through the proposed development reflective of the current 7a zoning. It is noted that this is achieved by the development layout to a large degree with significant areas in the western portions of the site in the 2(e) zone also retained. It is, however, acknowledged that the following tidal areas will be modified:

- ~1341sqm of Saltwater Couch central to the site

Whilst not listed individually pursuant to the *Threatened Species Conservation Act 1995*, the saltwater couch to be removed as described are protected as marine vegetation pursuant to the *Fisheries Management Act 1994*. As such permission from DPI (Fisheries) will be required to remove these areas of saltrush/saltcouch. Please note that a site meeting was held between DPI officer Patrick Dwyer (Northern Regional Manager) and Planit employees (Adam Smith, Boyd Sargeant) in late 2006 where no objection to the proposed removal of these marine plants was raised subject to compensatory offsets.

5.7 ADJACENT CONSERVATION RESERVES

The west of the site is bounded by the Cudgen Nature Reserve which is documented to exhibit high levels of ecological significance (NPWS, 1998). The National Parks and Wildlife Act 1974 provides the following management principals for nature reserves:

(1) The purpose of reserving land as a nature reserve is to identify, protect and conserve areas containing outstanding, unique or representative ecosystems, species, communities or natural phenomena so as to enable those areas to be managed in accordance with subsection (2).

(2) A nature reserve is to be managed in accordance with the following principles:
(a) the conservation of biodiversity, the maintenance of ecosystem function, the protection of geological and geomorphological features and natural phenomena,
(b) the conservation of places, objects, features and landscapes of cultural value,
(c) the promotion of public appreciation, enjoyment and understanding of the nature reserve's natural and cultural values,
(d) provision for appropriate research and monitoring.

These principals differ from national parks insofar as the primary objective is the protection of existing values whereas national parks also cater for visitation for recreational purposes. Potential impact associated with the development of the subject land on the Cudgen Nature Reserve will be primarily inappropriate human activity and access (i.e. domestic animal walking, fires, dumping, motorbike/horse riding, camping etc).

To mitigate these impacts it is noted that the north-western tidal drain which leads to the dredge pond and ultimately to Christies Creek will be retained thus limiting easy access to the reserve. The retention of mangrove and wetland areas between the drain, dredge pond and the Cudgen Reserve boundary also provides an impediment to easy access. Further design and management measures are also proposed to discourage access and limit the need for access to the Cudgen Reserve for recreation:

- The development proposal will incorporate picnic facilities, a playground and open grassed areas for recreation in existing open grassland/paddock areas. Provision of suitable amenities and opportunities for recreation will reduce the need of the future residents to access the Cudgen Reserve for such purposes

- Signage will be incorporated within the open space areas promoting environmental education and awareness and the negative impacts associated with inappropriate access and activity within ecologically sensitive areas

5.8 FAUNA CORRIDORS/LINKAGES

Wildlife corridors can be defined as 'retained and/or restored systems of (linear) habitat which, at a minimum enhance connectivity of wildlife populations and may help them overcome the main consequences of habitat fragmentation' (Wilson & Lindenmayer, 1995). Corridors can assist ecological functioning at a variety of spatial and temporal scales from daily foraging movements of individuals, to broad-scale genetic gradients across biogeographical regions (Parsons Brinkerhoff, 2005).

Corridors serve a number of different functions in terms of biodiversity conservation including:

- providing increased foraging area for wide-ranging species
- providing cover for movement between habitat patches, particularly for cover dependent species and species with poor dispersal ability and enhancing the movement of animals through sub-optimal habitats
- reducing genetic isolation by maintaining continuity between sub-populations in a metapopulation and thereby preventing and /or reversing localised extinction

- facilitating access to a mix of habitats and successional stages to those species which require them for different activities (for example, foraging or breeding)
- providing refuge from disturbances such as fire
- providing habitat in itself (Wilson, A. & Lindenmayer 1995; Lindenmayer, 1994; Bennett, 1999).

How species use the corridor network will depend largely on the home and activity ranges of the species, their habitat requirements and the ecological characteristics of the corridor. For example, some large or mobile species may make direct movements through the corridor network, moving from one patch of habitat to another. These direct movements may be on the scale of a foraging expedition or a migration (Bennett 1990b). Other species may have movements by single individuals punctuated by pauses in the corridor, which can last anything from a small foraging or resting bout to weeks and even months. If the corridor contains sufficient resources to maintain a population, then continuity through the corridor may be through gene flow through the resident population (Bennett 1990b; Wilson, A. & Lindenmayer 1995).

For example a mobile species with a large home range (i.e. koala) may regularly traverse a corridor to move between favoured feeding grounds or in attempt to access mates, whereas a species with a comparably minor home range (i.e. antechinus) may spend its entire life within a portion of the same corridor.

It is noted that the site is nominated as being located within a regional corridor which links the estuarine environments of Cudgera Creek to the Cudgen and Round Mountain Nature Reserves. Whilst it is accepted that environments contained within the site are important for fauna movement it is considered that the areas of importance are largely confined to the existing forested areas in the western portions, the riparian zone of Christies Creek and the intertidal habitats in the eastern and western extents. The area of proposed development (within the 2e zone) is not considered to represent an important fauna corridor in the context of the site's habitats or the surrounding areas. It is also noted that the proposal will retain environments within the western portions of the 2e zone to provide greater buffering to the adjacent Nature Reserve.

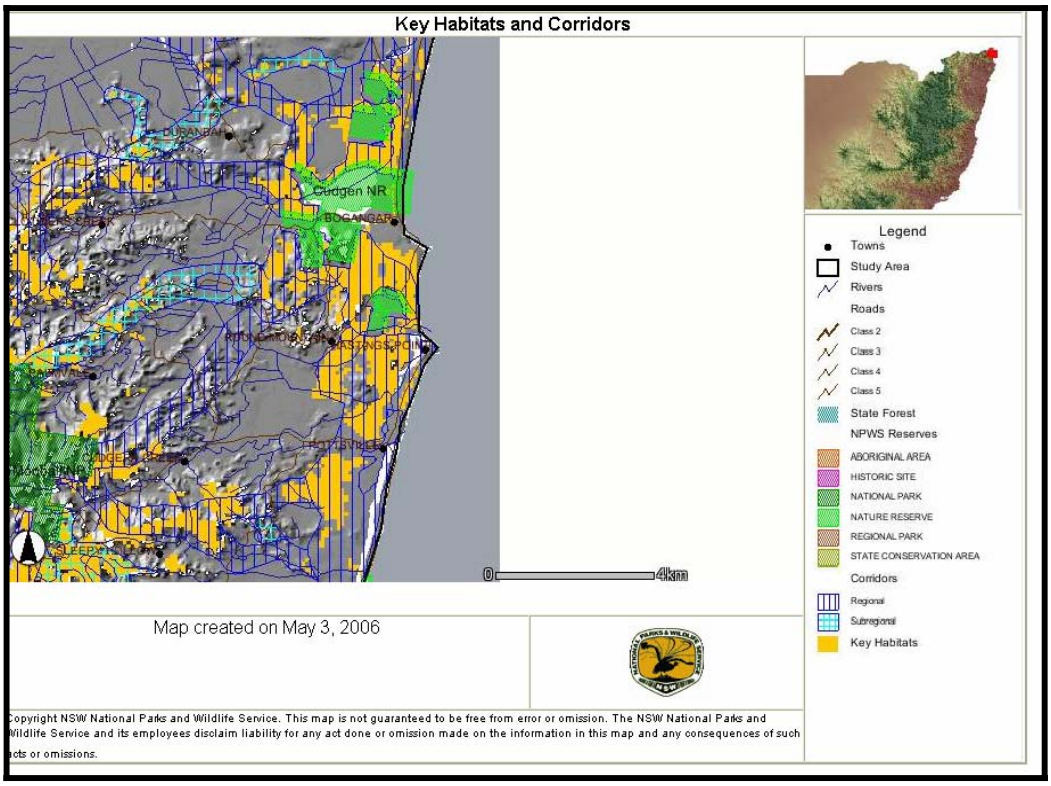


FIGURE 8: KEY HABITATS AND CORRIDORS MAP (SOURCE: HTTP://MAPS.NATIONALPARKS.NSW.GOV.AU/KEYHABS/DEFAULT.HTM)

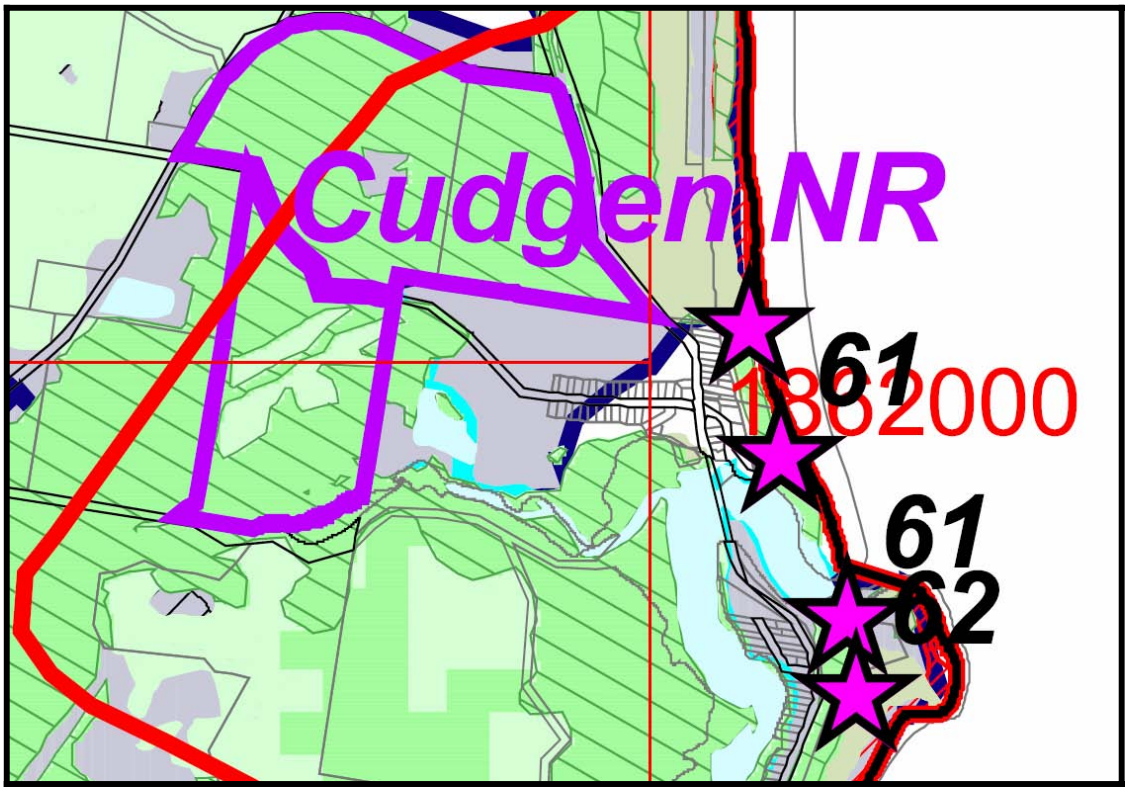


FIGURE 8A: TWEED VMP MAP 7 SHOWING LOCATION OF SITE WITHIN REGIONAL NPWS CORRIDOR

6.0 STATUTORY CONSIDERATIONS – THE 7-PART TEST OF SIGNIFICANCE

Further to the provisions of Schedules 1 and 2 of the *Threatened Species Conservation Act 1995*, Section 5A of the *Environmental Planning and Assessment Act 1979* (the '7-Part Test') is applied to assess any potentially adverse impacts of the site-proposal on threatened species, populations and/or communities occurring within the site or surrounding locality.

The Assessment of Significance is not a 'pass/fail' test or technique based on a scoring system. Instead, the outcome of each factor needs to be considered as to whether effects are likely and whether they are significant (NPWS 1996a).

It is further noted that a positive finding in respect of one or more factors of the 7-part test of significance does not necessarily lead to the conclusion that an SIS is then required (Talbot in Gales Holdings Pty Ltd v Tweed Shire Council [2006] NSWLEC 212). Rather it allows consideration as to whether a particular effect may be present or occur as a result of the development and whether that effect is likely to be significant.

The 7-Part Test is applied to scheduled flora, fauna, populations and communities (where applicable) to assess potentially adverse impacts of the proposal on threatened species, populations or communities identified on or likely to utilise the site based on available habitat components, geography and local environmental conditions.

Note that threatened species, populations and/or communities have been excluded from this assessment where:

- No direct observations of threatened species, populations or communities were made on the site during survey works;
- No previous sightings of threatened species, populations or communities within a 10-kilometre radius of the site have been registered within the NPWS database and scheduled under the *Threatened Species Conservation Act 1995*; and
- An abundance of primary habitat requirements for said species are not located on or within the locality of the proposal (refer previous sections)
- Potential habitat (feeding, roosting, nesting or refuge) will not be or will be minimally affected by the proposal (refer previous sections)

As such it is considered that, of the scheduled species, populations and/or communities described previously within this report, the following ten species of threatened fauna and four ecological communities were recorded on the site or are considered potential occurrences within the area based upon available habitat components and may have the potential to be significantly affected through any development of the site.

TABLE 14: THREATENED SPECIES AND COMMUNITIES SUBJECT TO 7-PART TEST		
Ecological Communities	Coastal Saltmarsh In The Nsw North Coast, Sydney Basin And South East Corner Bioregions Swamp Oak Floodplain Forest Of The Nsw North Coast, Sydney Basin And South East Corner Bioregions Subtropical Coastal Floodplain Forest Of The Nsw North Coast Bioregion Swamp Sclerophyll Forest On Coastal Floodplains Of The Nsw North Coast, Sydney Basin And South East Corner Bioregions	
Populations	N/A	
Flora	N/A	
Fauna	*Calyptorhynchus lathami*	Glossy Black-Cockatoo
	Miniopterus australis	Little Bentwing Bat
	Miniopterus schreibersii	Eastern Bentwing Bat
	Phascolarctos cinereus	Koala
	Pteropus poliocephalus	Grey-headed Flying Fox
	Pteropus alecto	Black Flying Fox
	Syconcteris australis	Common Blossom Bat
	Pandion haliaetus	Osprey
	Ephippiorhynchus asiaticus	Black-necked Stork

6.1.1 FACTORS OF ASSESSMENT 7-PART TEST

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

The National Parks and Wildlife Service (NPWS) describe a local population as one *"that occurs within the study area, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the boundary of the study area can be demonstrated."*

DECC (2007) & DPI (2008) further expands the local population definition to include:

- The *local population* of a threatened *plant* species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.

- The *local population* of *resident fauna* species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.

- The *local population* of *migratory or nomadic fauna* species comprises those individuals that are likely to occur in the study area from time to time.

DECC (2007) & DPI (2008) further states that the key assessment for this component is the "risk of extinction of the local population. The risk of extinction will increase if any factor operates to reduce population size or reproduction success." It is further noted that any known or presumed local population should be assumed to be viable for the purpose of this assessment unless otherwise proven.

Glossy Black-cockatoo

Local Population

Individuals of this species were recorded on site foraging within the SW corner (Community 6) and were also noted flying over the Cudgen Reserve to the west. Whilst they were recorded, it is considered that the Cockatoo is not genetically isolated on the subject site and forms part of a population within the wider region.

The NPWS database contains fifteen (15) records of this species within 10 kilometres of the site. A further eleven (11) records are contained within the Tweed LGA, the nearest of which occurs within the Cudgen Reserve (NPWS, 1998).

FIGURE 9: GLOSSY BLACK COCKATOO RECORDING LOCATIONS
(@555420, 6863110; 555419, 6862989 MGA94z56)

Stages of lifecycle potentially affected by development

Glossy Black Cockatoos (*Calyptorhynchus lathami*) are uncommon parrots found in scattered localities in the forests and woodlands of eastern Australia and Kangaroo Island (Forshaw, 1981). The eastern subspecies of Glossy Black Cockatoos seems thinly distributed through its range with the highest densities occurring in south-eastern Queensland and north-eastern New South Wales (Forshaw, 1989).

The main habitat of the eastern subspecies is *Eucalyptus* woodlands and forest with moderate-high densities of *Allocasuarina* which are required for feeding (Clout, 1989; Park & Borsboom, 1996; Forshaw & Cooper, 1989; Crome & Shields, 1992; Cleland & Sims, 1968; Garnett, 1992b; Blakers *et al*, 1984). Suitable senescent trees (large hollow within a live or dead Eucalypt: 10-20m, Depth: 40-120cm, Entry: ~21cm: Inside Dia: ~23cm (Forshaw, 1981; Gibbons & Lindenmayer, 2002)) are also required for nesting.

Within the site suitable habitat is located in the SW corner in association with Community 6 (Tall Open Forest Pink Bloodwood/Brushbox) which contains suitable foraging resources (*Allocasuarina torulosa*). Hollow bearing trees were, however, largely absent although several stems were noted within the adjacent Cudgen Reserve. Chewings typical of previous cockatoo presence (per Triggs, 2001) were recorded in this community in 2003 and 2006 with three individuals observed in 2006.

As this habitat will be retained in association with the proposal (and the development envelope is largely restricted to open grassland/paddock areas), the species is considered unlikely to be significantly impacted upon.

Likelihood of Local Extinction

Reviewing the above, it is considered unlikely that the proposed development will disrupt the lifecycle of the local population to the point that it is at risk of extinction.

Megachiropterans (Black Flying-fox, Grey-headed Flying-fox, Common Blossom Bat)

Local Population

As the noted mega-bat species are considered to be wide ranging in the region, it is considered that they are not genetically isolated on the subject site and form part of populations within the wider region.

Grey-headed Flying Fox

This species were recorded on site foraging commonly within Communities 6 and 7 on the site which contained flowering *Melaleuca quinquenervia*. They were also recorded foraging within scattered Melaleuca contained within Communities 1-5. Large numbers were also noted foraging within the adjacent Cudgen Reserve which contains extensive areas of Swamp Sclerophyll Forest.

The NPWS database contains eight (8) records of this species within 10 kilometres of the site. A further thirty-three (33) records are contained within the Tweed LGA.

Black Flying Fox

The NPWS database contains two (2) records of this species within 10 kilometres of the site. A further forty-two (42) records are contained within the Tweed LGA, the nearest of which occurs within the Cudgen Reserve (NPWS, 1998).

Common Blossom Bat

The NPWS database contains sixteen (16) records of this species within 10 kilometres of the site. A further six (6) records are contained within the Tweed LGA.

Stages of lifecycle potentially affected by development

The listed mega-bats forage on a variety of fruits and flowers with breeding and roosting occur within rainforest and/or riparian environments with a high fidelity shown towards roost sites. The site contains suitable flowering flora species capable of attracting the bats to the area (fruiting species are restricted in abundance) both within the western sclerophyll forests and scattered through other communities. Extensive flowering resources are also present adjacent the site in the Cudgen Reserve.

The proposed development will result in the removal of a small percentage of native flowering trees from the site with the majority retained within the open space designation. This removal is not considered to be a significant reduction in the regional foraging base for the bat species. Furthermore, as no roost sites of the bat species were recorded within the site, it is considered that breeding requirements will not be disturbed as part of the proposal.

Likelihood of Local Extinction

Reviewing the above, it is considered unlikely that the proposed development will disrupt the lifecycle of the local mega-bat population to the point that it is at risk of extinction.

Koala

Local Population

During the 2006 survey koala scats were recorded within the SW corner of the site (Community 6). Koala scats were also retrieved from the adjacent Cudgen Reserve during the 2003 survey. Whilst evidence of the species presence was recorded, it is considered that the Koala is not genetically isolated on the subject site and forms part of a population within the wider region. It is noted that a significant Koala population has been recorded in and around the adjacent Cudgen Reserve (NPWS, 1998). Scientific research regarding the species population densities, home ranges and movement patters indicate that it is highly unlikely that an isolated koala population could be restricted to the site.

The NPWS database contains seventy-six (76) records of this species within 10 kilometres of the site. A further one hundred and ninety-eight (198) records are contained within the Tweed LGA.

FIGURE 10: KOALA SCAT LOCATION
(@555409, 6862957 MGA94z56)

Stages of lifecycle potentially affected by development

This species primarily occurs within Eucalypt Forest and Woodlands containing a suitable density of favoured food trees within coastal eastern and southeastern Australia. Favoured habitat generally contains a high percentage of primary food trees although underlying geology and soil type can be an important factor. Eucalypt Forests associated with drainage lines and floodplains of richer soil types (i.e. moisture and nutrients) can also be favoured due to feed trees containing higher levels of nutrients and less potential for toxicity (Hindell & Lee, 1990; More & Foley, 2000).

Within SEQLD six primary foraging trees were identified by Pahl (1993); Tallowwood (*Eucalyptus microcorys*), Blue Gum (*E. tereticornis*), Scribbly Gum (*E. racemosa*), Grey Gum (*E. propinqua*), Red Mahogany (*E. resinifera*) and White Stringybark (*E. tindaliae*). Further research undertaken by Phillips & Callaghan (1996) in Tweed Shire indicates that Swamp Mahogany (*E. robusta*) and Blue Gum (*E. tereticornis*) [including hybrids of the two] on alluvial deposits and Quaternery and Neranleigh-Fernvale Group geomorphologies were considered to be primary habitats. Areas with sub-dominance of these species on Nerang-Fernvale alliances supporting Blue Gum (*E. tereticornis*), Tallowwood (*E. microcorys*) and/or Grey Gum (*E. propinqua*) comprised secondary habitat or primary habitat depending on the density of the latter two species.

Phillips & Callaghan (1998) also noted Tallowwood to be a primary browse species and two types of Grey Gum (*E. propinqua, E. biturbinata)* to be secondary browse species in Currumbin.

Within NSW SEPP 44 notes the following as being potential koala habitat trees:

Scientific Name	Common Name
Eucalyptus tereticornis	Forest red gum
Eucalyptus microcorys	Tallowwood
Eucalyptus punctata	Grey Gum
Eucalyptus viminalis	Ribbon or manna gum
Eucalyptus camaldulensis	River red gum
Eucalyptus haemastoma	Broad leaved scribbly gum
Eucalyptus signata	Scribbly gum
Eucalyptus albens	White box
Eucalyptus populnea	Bimble box or poplar box
Eucalyptus robusta	Swamp mahogany

Within utilized Eucalypt Forest habitat the koala spends most of its time in distinct home-ranges which may overlap if available habitat area is reduced. Males are territorial but a dominance-hierarchy exists and they may attack during the summer breeding season. Home ranges of the species are considered to be large and can vary dependent upon habitat quality and extent. Studies have shown various home range sizes exist with the males usually larger than the female (Male 135ha, Female: 110ha [Ellis et al, 2002], Male: 34.4ha, Female: 15ha [White, 1999]). As such, it is widely considered that extensive areas of suitable habitat are required to support a viable population of the species.

Within the site, koala habitat trees were present in low abundance and mostly restricted to the SW Tall Open Forest [Pink Bloodwood/Brushbox] (Community 6) and scattered trees occur within the open grassland/paddock (Community 3). These potential foraging resources included *Eucalyptus tereticornis, E. robusta and E. x kirtoniana*. Given that scats were retrieved the following species-specific survey work was undertaken:

- Spotlighting
- Eucalypt trunk trace analysis for characteristic scratch and slider marks
- Basal search of favoured browsing species for faecal pellets
- Diurnal canopy binocular search
- Amplified call playback

The above works failed to record a positive observation of the species although (as discussed) scats were retrieved. In this regard it is considered that the Koala does utilize potential foraging trees within the SW corner of the site as part of the larger habitats within the Cudgen Reserve. These areas will be retained in association with the proposal. In addition, the retention of the western sclerophyll (Communities 7 and 8) and intertidal (Communities 1, 2, 4 and 5) habitats will provide suitable buffering between the development envelope and Cudgen Reserve which contains and existing Koala population (NPWS, 1998).

Likelihood of Local Extinction

Reviewing the above, it is considered unlikely that the proposed development will disrupt the lifecycle of the local population to the point that it is at risk of extinction.

Threatened Microchiropteran Bats (Little Bent-wing Bat, Eastern Bentwing Bat)

As the noted micro-bat species are considered to be wide ranging in the region, it is considered that they are not genetically isolated on the subject site and form part of populations within the wider region.

Little Bent-wing Bat

This species was recorded within the western sclerophyll forests during the 2003 survey (Warren & Associates).

The NPWS database contains eighteen (18) records of this species within 10 kilometres of the site. A further sixteen (16) records are contained within the Tweed LGA, the nearest of which occurs within the Cudgen Reserve (NPWS, 1998).

Eastern Bentwing

The NPWS database contains one (1) record of this species within 10 kilometres of the site. A further thirty-three (four) records are contained within the Tweed LGA, the nearest of which is noted proximate to Cudgera Creek west of Potsville. It is noted that targeted micro-bat survey work undertaken by SKM in association with the Cudgera Creek Road Upgrade between the Pottsville/ Mooball Road and the Yelgun to Chinderah Pacific Highway interchange (2003) did not record the species.

Stages of lifecycle potentially affected by development

The habitat and roosting preferences of the nominated bat species are tabulated below:

Species	Habitat Preference	Roosting/Breeding
Little Bentwing Bat	This species utilises well-timbered habitats including rainforest, *Melaleuca* swamps and dry sclerophyll forests where it feeds on insects within the canopy (NPWS, 2002)	Depends upon caves, mines, stormwater drains and infrequently hollows bearing trees to roost and frequently shares breeding sites with the Common Bentwing Bat (Dwyer in Strahan eds, 2002; Schultz, 1997)
Eastern Bentwing Bat	Utilises a broad range of habits including wet and dry sclerophyll forest, open woodland, paperbark forests, rainforests and open grasslands (North & Pasic, 2005) where they forage upon insects.	Has been found to roost within caves, tunnels, stormwater culverts or disused mining areas (Strahan eds, 2002; DEH, 2005).

A review of the available habitats of the site indicates that general potential foraging habitats are available in the form of sclerophyll forest communities (Communities 6-8) and open grassland (Community 3). A small number of hollow bearing trees potentially providing roost sites were also recorded adjacent the SW corner and three such trees were also noted in the central grassland/paddock, Stag watching at dusk and spotlighting failed to record any evidence of roosting populations or emerging individuals from these areas. The noted microchiropteran bats previously recorded within the sub-region are considered to be wide ranging species and the proposal will result in only a minor modification of potential habitat within the area. This modification is largely restricted to Community 3 (Open Grassland/Paddock with

Scattered Trees) and is not considered to represent a significant reduction in the potential regional foraging base.

Extensive areas of preferred habitat types (Wet/Dry/Swamp Sclerophyll Forest and Rainforest) are conserved within the adjacent Cudgen Reserve.

Likelihood of Local Extinction

Reviewing the above, it is considered unlikely that the proposed development will disrupt the lifecycle of the local populations to the point that they are at risk of extinction.

Osprey

As the osprey is noted to be wide ranging in the region, it is considered that they would be unlikely to be genetically isolated on the subject site and form part of a population within the wider region.

Local Population

The NPWS database contains seventeen (17) records of this species within 10 kilometres of the site. A further three hundred and thirty-eight (338) records are contained within the Tweed LGA, the nearest of which occurs within the Cudgen Reserve (NPWS, 1998).

FIGURE 11: OSPREY RECORDING LOCATION
(@555447, 6863271 MGA94z56)

Stages of lifecycle potentially affected by development

The Osprey is predominately a coastal raptor frequenting estuaries, coastal rivers, bays, inlets, islands and rocky cliffs within all Australian states except for Tasmania and sporadically within Victoria (DEC, 2005; NPWS, 2002). It is noted however, that the species sometimes inhabits inland islands (Pizzey and Knight, 1997; Readers Digest, 2002). Within suitable environment it usually constructs a nest in an overhanging large tree or upon elevated man made structures such as platforms or telegraph poles.

The species preys almost exclusively on fish by usually hunting alone and traversing the water's surface for prey which it secures by swooping over the waters surface or plunging below (Readers Digest, 2002; Clancy, 2005). Studies of prey middens on Lizard Island within the Great Barrier Reef also noted that occasional Terns and crustaceans are sourced for food (Smith, 1985).

It is considered that the site is located within a suitable habitat area for the species which includes the estuaries, tidal creeks and foreshore associated with Christies and Cudgera Creeks. The fauna survey conducted failed to record the presence of this species within the subject site although nesting trees were actively searched for. However, the species was noted within the adjacent Cudgen Reserve perched on a stag tree overlooking the wetland areas and was previously recorded proximate to the onsite dredge pond in the 2003 survey (James Warren & Associates). Given these sightings and the proximate available habitat it is considered that the site falls within the home range of at least one pair of Ospreys. It is noted that the Osprey has been recorded within the Tweed Estuary to the north as well as within the Brunswick Estuary, Belongil Swamp, Broken Head, Tallow beach, Kings Forest, Pottsville and Round Mountain. Within the 1998 breeding season 21 nests were observed within the Tweed River area alone with 22 young ospreys fledged (Tweed Valley Osprey Group, 1998).

Furthermore, Ospreys have been previously noted in the locality nesting on artificial platforms proximate to creek lines and the urban interface. A recent record (Eremaea Birds atlas December 2009) notes a pair of adults and a fledgling to the east of the site at the Cudgera Creek estuary (http://www.eremaea.com/Lists.aspx?List=53138).

Osprey Nests on Towers at the Kingscliff Coast Guard Station
(Source: Australian Wetlands, 2005)

Osprey Nest from Eremaea Atlas Record
(http://www.eremaea.com/Lists.aspx?List=53138).

Notwithstanding the above, as the development proposal is primarily restricted to the open paddocked areas with buffers provide to Christies Creek, it is considered that the Ospreys presence in the area will not be threatened. Of the trees proposed to be removed that have sufficient height (>20m) to act as nesting trees, none were noted to contain Osprey nests. However, given that ospreys are common in the locality it is

proposed to install an additional raptor pole with platform adjacent to the existing Christies creekline and onsite lake/dredge pond as a potential future osprey nest site.

Black-necked Stork

As the Jabiru is noted to be wide ranging in the region, it is considered that it is unlikely to be genetically isolated on the subject site and forms part of a population within the wider region.

Local Population

An individual Jabiru was recorded on site during the survey period foraging within the shallow waters of the dredge pond. The NPWS database contains an additional one (1) record of this species within 10 kilometres of the site. A further twenty (20) records are contained within the Tweed LGA, the nearest of which occurs within the Cudgen Reserve (NPWS, 1998).

FIGURE 12: JABIRU RECORDING LOCATION
(@555629, 6863033 MGA94z56)

Stages of lifecycle potentially affected by development

The Jabiru is generally associated with wetlands, mudflats, mangroves, swamps and floodplains while it may also sometimes be found in open woodland environs where a grassy understorey is present (NPWS, 2002, Readers Digest, 2002; DEC, 2005). Irrigated lands are also occasionally a foraging resource and it has also been recorded foraging in artificial wetlands of sewerage treatment plants (ERM, 2001).

Jabiru's occupy a very large home range where they usually forage in a loose pair on a small family unit following fledging. Within its shallow wetland hunting grounds it forages predominately for fish although reptiles, frogs, crabs, rodents and carrion may be taken (Readers Digest, 2002). During breeding large, conspicuous nests are constructed from sticks and vegetative material usually over creeks/rivers, edges of swamps or other water bodies. Two to four eggs are laid in February-June with incubation and fledging of the young performed by both parents (Readers Digest, 2002).

It is considered that the site is located within a suitable habitat area for the species which includes the estuaries, tidal creeks and foreshore associated with Christies and Cudgera Creeks and the expansive freshwater wetland areas of the Cudgen Reserve.

During the fauna survey the species was recorded foraging within the shallow reaches of the onsite dredge pond. Subsequent to this recording searches within the riparian vegetation of the site and trees overhanging wetland areas were undertaken for indicative nests with no recordings made.

Notwithstanding the above, as the development proposal is primarily restricted to the open paddocked areas with buffers provide to Christies Creek and the wetland areas and dredge pond will be retained, it is considered that the Jabirus presence in the area will not be threatened. Careful management of stormwater in association with the development will, however, be required to ensure that adjacent foraging areas are not polluted which is a known threatening impact to the species.

Likelihood of Local Extinction

Reviewing the above, it is considered unlikely that the proposed development will disrupt the lifecycle of the local population to the point that it is at risk of extinction.

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

N/A. No endangered fauna populations listed under Part 2 Schedule 1 of the *Threatened Species Conservation Act 1995* are located on or within the vicinity of the site. As such, the proposed activity is unlikely to disrupt the lifecycle of any species constituting an endangered population or the viability of such a population. The endangered populations currently listed include the following:

Scientific Name	Common Name	Type of species
Acacia prominens - endangered population	*Acacia prominens* (Gosford wattle) population in the Hurstville and Kogarah LGAs	Plant > Endangered Populations
Adelotus brevis - endangered population	Tusked Frog population in the Nandewar and New England Tablelands Bioregions	Animal > Endangered Populations
Callitris endlicheri, Woronora Plateau population	Black Cypress Pine, Woronora Plateau population	Plant > Endangered Populations

Scientific Name	Common Name	Type of species
Callocephalon fimbriatum population in the Hornsby and Ku-ring-gai Local Government Areas	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai LGAs	Animal > Endangered Populations
Calyptorhynchus lathami - endangered population	Glossy Black-cockatoo population in the Riverina	Animal > Endangered Populations
Chorizema parviflorum Benth. (a shrub) population, Wollongong and Shellharbour local government areas	Chorizema parviflorum Benth. (a shrub) population, Wollongong and Shellharbour local government areas	Plant > Endangered Populations
Climacteris affinis - endangered population	White-browed Treecreeper population in the Carrathool LGA south of the Lachlan River and Griffith LGA	Animal > Endangered Populations
Darwinia fascicularis subsp. Oligantha - endangered population	*Darwinia fascicularis* subsp. *oligantha* population in the Baulkham Hills and Hornsby LGAs	Plant > Endangered Populations
Dillwynia tenuifolia - endangered population Baulkham Hills	*Dillwynia tenuifolia* (a shrub) population in the Baulkham Hills LGA	Plant > Endangered Populations
Dillwynia tenuifolia - endangered population Kemps Creek	*Dillwynia tenuifolia* (a shrub) population at Kemps Creek	Plant > Endangered Populations
Dromaius novaehollandiae - endangered population	Emu population in the NSW North Coast Bioregion and Port Stephens LGA	Animal > Endangered Populations
Eucalyptus camaldulensis	River Red Gum population in the Hunter Catchment	Plant > Endangered Populations
Eucalyptus oblonga - endangered population	*Eucalyptus oblonga* (Narrow-leaved Stringybark) population at Bateau Bay	Plant > Endangered Populations
Eucalyptus parramattensis subsp. parramattensis - endangered population	*Eucalyptus parramattensis* subsp. *parramattensis* population in the Wyong and Lake Macquarie LGAs	Plant > Endangered Populations
Eucalyptus seeana - endangered population	Narrow-leaved Red Gum population in the Greater Taree LGA	Plant > Endangered Populations
Eudyptula minor population - endangered population	Little Penguin population in the Manly point area	Animal > Endangered Populations
Glycine clandestina - endangered population	Nambucca Glycine population in the Nambucca LGA	Plant > Endangered Populations
Keraudrenia corrolata var. denticulata - endangered population	*Keraudrenia corrolata* var. *denticulata* population in the Hawkesbury LGA	Plant > Endangered Populations
Lespedeza juncea subsp. sericea - endangered population	*Lespedeza juncea* subsp. *sericea* population in the Wollongong LGA	Plant > Endangered Populations

Scientific Name	Common Name	Type of species
Long-nosed potoroo - endangered population	Long-nosed potoroo population at Cobaki Lakes and Tweed Heads West	Animal > Endangered Populations
Marsdenia viridiflora subsp. viridiflora - endangered population	Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Plant > Endangered Populations
Mastacomys fuscus - endangered population	Broad-toothed Rat at Barrington Tops in the Gloucester, Scone and Dungog LGAs	Animal > Endangered Populations
Menippus fugitivus - endangered population	*Menippus fugitivus* (a beetle) population in the Sutherland Shire	Animal > Endangered Populations
Perameles nasuta population - endangered population	Long-nosed Bandicoot population at North Head	Animal > Endangered Populations
Petaurus norfolcensis - endangered population Barrenjoey Peninsula	Squirrel Glider population on the Barrenjoey Peninsula, north of Bushrangers Hill	Animal > Endangered Populations
Petaurus norfolcensis - endangered population Wagga Wagga	Squirrel Glider population in the Wagga Wagga LGA	Animal > Endangered Populations
Phascolarctos cinereus - endangered population Hawks Nest and Tea Gardens	Koala population in the Hawks Nest and Tea Gardens area	Animal > Endangered Populations
Phascolarctos cinereus - endangered population Pittwater	Koala population in the Pittwater LGA	Animal > Endangered Populations
Pomaderris prunifolia - endangered population	*Pomaderris prunifolia* (a shrub) population in the Parramatta, Auburn, Strathfield and Bankstown LGAs	Plant > Endangered Populations
Prostanthera spinosa	Spiny Mint-bush	Animal > Endangered Populations
Pultenaea villifera - endangered population	*Pultenaea villifera* population in the Blue Mountains LGA	Plant > Endangered Populations
Wahlenbergia multicaulis - endangered population	Tadgell's Bluebell population in the Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield LGAs	Plant > Endangered Populations
Weeping Myall population in the Hunter catchment	Weeping Myall population in the Hunter catchment	Plant > Endangered Populations
Zieria smithii - endangered population	*Zieria smithii* population at Diggers Head	Plant > Endangered Populations

Sourced 16 October 2008 online @ http://www.threatenedspecies.environment.nsw.gov.au/tsprofile /speciestype_list.aspx?type=Endangered+Populations

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

DEC (2007) notes the following with regard to EECs:

Ecological communities are usually defined by two major components – the geographical distribution and the species composition which influences the physical structure and ecological function of the ecological community. The relative importance of the geographical distribution and the species composition varies according to the specific listed ecological community. Hence this factor provides for consideration of two criteria:
(i) local occurrence of the ecological community
(ii) modification of the ecological community's composition.

Interpretation of key terms used in this factor:

Local occurrence: the ecological community that occurs within the study area. However the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.

Risk of extinction: similar to the meaning set out in factor (a), this is the likelihood that the local occurrence of the ecological community will become extinct either in the short-term *or* in the long-term as a result of direct or indirect impacts on the ecological community, and includes changes to ecological function.

Composition: both the plant and animal species present, and the physical structure of the ecological community. Note that while many ecological communities are identified primarily by their vascular plant composition, an ecological community consists of all plants and animals as defined under the TSC and FM Acts that occur in that ecological community.

SWAMP SCLEROPHYLL FOREST ON COASTAL FLOODPLAINS OF THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS

It is considered that Community 7 [Very Tall Open Forest (Broad-Leaved Paperbark)] located within the south- and north-western portions of the site are reflective of the above listed EEC as described by the Scientific Committee (further discussion is provided in Section 3.2.1 above).

The local occurrence of this EEC is considered to be that occurring on the site (~0.33ha in two patches) and also that occurring within the study area (per Kingston et al mapping, 2004). Kingston et al (2004) notes the presence of 1154 ha of this vegetation type (described types TVMP401 & 402, CRA 112-'Paperbark') within the Tweed LGA.

The proposed development will ensure the retention of mapped Community 7 within an open space/environmental protection designation. It is noted that the closest

encroachment of development (NW corner) is ~130m from the mapped community and separated by Saltmarsh vegetation and a copse of native trees within the pasture/paddock. Retention and management of this buffer is proposed to manage the impact of 'edge effects.' It is to be noted that the two patches of this EEC are currently only impacted to a minor degree by exotic plant (weed) invasion. Staged removal of existing weeds is recommended in this regard.

This EEC may be potentially impacted by uncontrolled changes to hydraulic regime as a result of modifications to surface and groundwater hydrology, particularly during construction. A detailed hydraulic report and stormwater quality management plan has been prepared by Opus Qantec McWilliam in this regard.

Conclusion

With regard to the above it is therefore considered that the action proposed is unlikely to modify or adversely effect the existing mapped Vegetation Community 7 such that its local occurrence is placed at risk of extinction.

Impact mitigation is discussed within subsequent sections of the report but specifically relate to this EEC as follows:

- Avoidance of existing mapped Vegetation Community 7
- Mitigation: the mitigation of potential 'edge effects' is proposed through the establishment of buffers to the EEC.
- Enhancement of existing habitats i.e. weed management and rehabilitation works shall be undertaken in the retained EEC to improve the potential for long-term viability

SWAMP OAK FLOODPLAIN FOREST OF THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS

Community 8 [Mid-High/Tall Open Forest (Swamp Oak)] located within seven small patches onsite is considered to be reflective of the above listed EEC as described by the Scientific Committee (further discussion is provided in Section 3.2.1 above).

The local occurrence of this EEC is considered to be that occurring on the site (0.693ha in seven fragmented patches) and also that occurring within the study area (per Kingston et al mapping, 2004). Kingston et al (2004) notes the presence of 666 ha of this vegetation type (described types TVMP 601, CRA 143-'Swamp Oak') within the Tweed LGA.

The proposed development will ensure the retention of mapped Community 8 and a modification to the previous layout has been made to avoid a small area of previous encroachment. Setbacks from the development envelope ranging from 10m to >100m will be achieved with the closest being the northern most patch which sits adjacent to the dredge pond. The fill platform and boardwalk/walkway for the residential estate have been designed ensure existing casuarinas will be retained and protected in this area.

It is to be noted that the seven patches of this EEC are currently only impacted to a minor degree by exotic plant (weed) invasion. Staged removal of existing weeds is recommended in this regard.

This EEC may be potentially impacted by uncontrolled changes to hydraulic regime as a result of modifications to surface and groundwater hydrology, particularly during construction. A detailed hydraulic report and associated management/mitigation techniques has been prepared by Qantec McWilliams in this regard.

Conclusion

With regard to the above it is therefore considered that the action proposed is unlikely to modify or adversely effect the existing mapped Vegetation Community 8 such that its local occurrence is placed at risk of extinction.
Impact mitigation is discussed within subsequent sections of the report but specifically relate to this EEC as follows:

- Avoidance of mapped Vegetation Community 8

- Mitigation: the mitigation of potential 'edge effects' is proposed through the retention of buffers to most areas of Community 8. However, development is proximate (within the zoned 2e residential lands) to that portion of the community at the northern end of the dredge pond (~10 metres). Implementation of construction management, stormwater quality, weed management and revegetation management plans is proposed to ensure protection of the existing communities and reduction of edge impacts (i.e. such as weed invasion);

- Enhancement of existing habitats i.e. weed management and rehabilitation works shall be undertaken in the retained EEC to improve the potential for long-term viability

SUBTROPICAL COASTAL FLOODPLAIN FOREST OF THE NSW NORTH COAST BIOREGION

It is considered that Community 6 [Very Tall Open Forest (Pink Bloodwood/Brushbox)] located within the southwestern portions of the site is reflective of the above listed EEC as described by the Scientific Committee (further discussion is provided in Section 3.2.1 above).

The local occurrence of this EEC is considered to be that occurring on the site (~0.523ha) and also that occurring within the study area (per Kingston et al mapping, 2004). Kingston et al (2004) notes the presence of 489ha of this vegetation type (described types TVMP302 Coastal Pink Bloodwood / Brush Box Open Forest to Woodland, CRA 106-'Open Coastal Brushbox') within the Tweed LGA.

The proposed development will ensure the retention of mapped Community 6 within an open space/environmental protection designation. It is noted that the closest encroachment of development is >140m from the mapped community and separated by estuarine vegetation types. Retention and management of this buffer is proposed to manage the impact of 'edge effects.' It is to be noted that the existing patch of this EEC is currently only impacted to a minor degree by exotic plant (weed) invasion. Staged removal of existing weeds is recommended in this regard.

This EEC may be potentially impacted by uncontrolled changes to hydraulic regime as a result of modifications to surface and groundwater hydrology, particularly during construction. A detailed hydraulic report and stormwater quality management plan has been prepared by Opus Qantec McWilliam (2008) in this regard.

Conclusion

With regard to the above it is therefore considered that the action proposed is unlikely to modify or adversely effect the existing mapped Vegetation Community 6 such that its local occurrence is placed at risk of extinction.

Impact mitigation is discussed within subsequent sections of the report but specifically relate to this EEC as follows:

- Avoidance of existing mapped Vegetation Community 6
- Mitigation: the mitigation of potential 'edge effects' is proposed through the establishment of buffers to the EEC. It is noted that the development envelope is >140m from the SW patch of Community 6
- Enhancement of existing habitats i.e. weed management and rehabilitation works shall be undertaken in the retained EEC to improve the potential for long-term viability

COASTAL SALTMARSH IN THE NSW NORTH COAST, SYDNEY BASIN AND SOUTH EAST CORNER BIOREGIONS

Community 2 [Low/Mid-High Closed Grassland (Saltwater Couch)], Community 4 [Tall-Very Tall Rushland (Salt Rush)] and Community 5 [Mid-High/Tall Sedgeland/Rushland (Bare Twigrush)] are considered to be reflective of this EEC as described by the Scientific Committee (further discussion is provided in Section 3.2.1 above).

The local occurrence of this EEC is considered to be that occurring on the site (~3.85ha in 9 patches) and also that occurring within the study area (per Kingston et al mapping, 2004). Kingston et al (2004) notes the presence of 337ha of this vegetation type (described types TVMP 603, CRA 77-'mangrove) within the Tweed LGA.

The development proposes the following retention and removal of this EEC:

TABLE 15: PROPOSED MANAGEMENT OF SALTMARSH EEC

Vegetation Community Reflective of Coastal Saltmarsh EEC	Existing Extent	Extent Modified	Management
Community 2 [Low/Mid-High Closed Grassland (Saltwater Couch)],	1.64ha	1341sqm	Balance areas retained adjacent to development envelope in NW & SE portions of site.

TABLE 15: PROPOSED MANAGEMENT OF SALTMARSH EEC			
Vegetation Community Reflective of Coastal Saltmarsh EEC	**Existing Extent**	**Extent Modified**	**Management**
Community 4 [Tall-Very Tall Rushland (Salt Rush)]	1.23ha	0	All retained with development setbacks ranging from 15-85m
Community 5 [Mid-High/Tall Sedgeland/Rushland (Bare Twigrush)]	0.98ha	0	All retained with development setbacks ranging from 95-140m
TOTAL	3.85ha	0.1341ha	-

Overall it is noted that ~1341sqm of 3.85ha onsite and 337ha within Tweed Shire will be modified as a result of the proposal. This equates to 3.5% and 0.05% respectively.

Conclusion

With regard to the above it is therefore considered that the action proposed is unlikely to modify or adversely effect the existing mapped Coastal Saltmarsh EEC such that its local occurrence is placed at risk of extinction.

Impact mitigation is discussed within subsequent sections of the report but specifically relate to this EEC as follows:

- Avoidance of the majority of the EEC is proposed. Only those areas of salt couch grassland within the slashed paddock which are also within the zoned 2e lands will be modified. 4655sqm of this EEC also within the 2E zone will be retained.

- Mitigation: the mitigation of potential 'edge effects' is proposed through the retention of buffers to most areas of the EEC. However, development is proximate (within the zoned 2e residential lands) to those retained portions of the EEC in the northwestern areas of the site. Implementation of construction management, stormwater quality, weed management and revegetation management plans is proposed to ensure protection of the existing communities and reduction of edge impacts (i.e. such as weed invasion). Formalised boardwalks and walkways throughout the estate shall also be provided to discourage access to the retained saltcouch grasslands

- Enhancement of existing habitats i.e. weed management and rehabilitation works shall be undertaken in the retained EEC to improve the potential for long-term viability

- Offsets/Compensation: it is proposed that the modification of ~0.1341ha of Community 2 within the 2e zoned lands be offset through the restoration of ~1.94ha of currently degraded lands (within the southern riparian zone of Christies Creek and the NW areas of the site) which will then be augmented to the open space/environmental protection designations/zoning. This 1.94ha shall include re-creation of the four EECs and extend the current riparian vegetation zone of Christies Creek. Further, the proposed offset will join currently fragmented habitats. Further discussion is provided in Section 8.