Westfield Group

Westfield Tuggerah and Gateway Site
Ecological Assessment

June 2014

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 Overview

Following the recent gazettal of the Wyong Local Environmental Plan (LEP) 2013, the NSW Department of Planning and Infrastructure (DoPI) is undertaking a rezoning of the land within the Tuggerah Town Centre identified as a "deferred matter" and known as the Westfield Tuggerah and Gateway site.

The Westfield Tuggerah and Gateway site is located adjacent to Wyong Road, Tuggerah in the Wyong Local Government Area (LGA), New South Wales (NSW) (Figure 1). It includes three component areas:

- The Gateway site: a parcel of land at the junction of the F3 Freeway and Wyong Road that Westfield plans to develop as a mixed-use precinct. It comprises 2 component areas:
  - Area 1 – open agricultural land;
  - Area 2 – bushland and grazing land; and
- Area 3 – planted and native vegetation and disturbed lands adjoining the existing Tuggerah Westfield Shopping Centre, including existing 3A commercial zoned lands with an area recently approved for alterations and additions to the Shopping Centre and an existing 7(a) Environmental Protection zone.

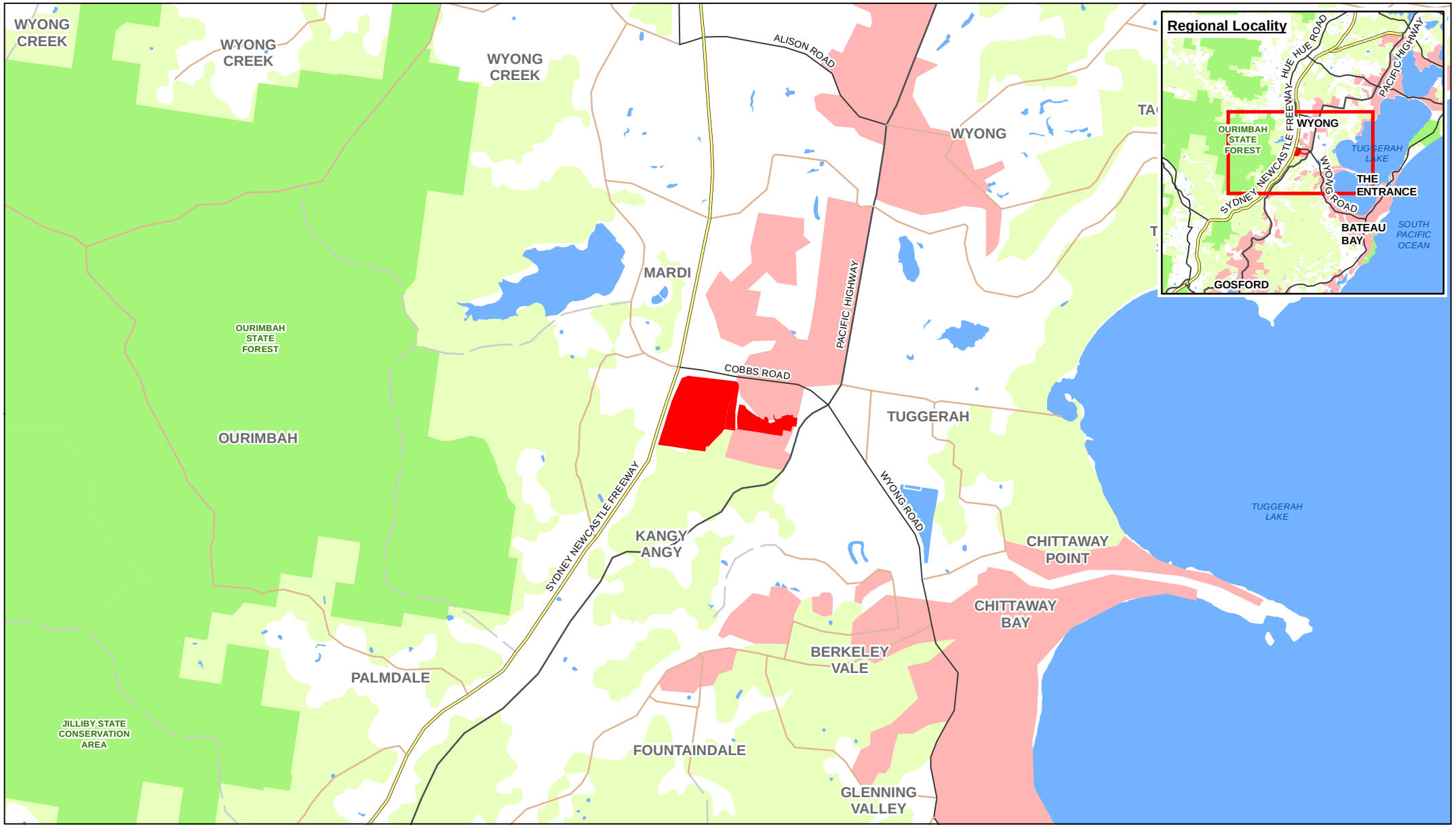
This Ecological Impact Assessment has been prepared to support the rezoning planning study for the Westfield Tuggerah and Gateway site and the approval processes under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for subsequent development applications for the land.

It provides a consolidated account of the ecological investigations undertaken to date on the Westfield Tuggerah and Gateway site (hereafter referred to as 'the site'), and assesses the current proposal indicated on Figure 2, including proposed rezoning to accommodate future development and operational needs and to conserve native vegetation, enhance connectivity and offset biodiversity impacts on the site. For the purposes of preliminary impact and offset assessment, future development of the site comprises the following as indicated on Figure 10:

- Development of lands within proposed B4 and RU6 transition zones within the Gateway site;
- Potential future development of an indicative footprint in the proposed B3 zoned land within Area 3 if required.

1.2 Proposed rezoning

The proposed rezoning of the Westfield Tuggerah and Gateway Site presented for consideration and assessed in this report aims to achieve an appropriate balance between development and conservation, providing for a sound ecological outcome for this significant site in the growth and development of the Wyong LGA. The proposed rezoning has been formulated with consideration of future development on the site, the results of previous ecological assessments, and consultation with the Department of Planning and Environment, Wyong Council and the Office of Environment and Heritage during the development of the Wyong LEP.



Paper Size A4

0 250 500 1,000 1,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- The Site
- Dual Carriageway
- Principal Road
- Secondary Road
- Minor Road
- Track
- Built Up Area
- Waterbody
- Reserves
- Native Vegetation Areas

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Westfield Tuggerah and Gateway Site

Job Number 21-23343
Revision 1
Date 10 Mar 2014

Site Location

Figure 1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Data source: ESRI: Aerial, 2013; LPI: DBTB, 2012; Geoscience Australia: 250K Topographic Data Series 3, 2006. Created by: tmorton, fmackay

Paper Size A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- The Site
- Approved Westfield expansion (DA 514/2013)

Proposed rezoning

- B3 Commercial Core
- B4 Mixed Use Precinct
- RU6 Transition
- E2 Environmental Conservation

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Westfield Tuggerah and Gateway Site

Job Number 21-23343
Revision 1
Date 17 Jun 2014

Site layout and proposed rezoning **Figure 2**

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Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com

Data source: ESRI: Aerial, 2013; LPI: DBTB, 2012; Geoscience Australia: 250K Topographic Data Series 3, 2006. Created by: tmorton, fmackay

1.2.1 Key aspects of the rezoning

Key aspects of the proposed rezoning of the Tuggerah Westfield and Gateway Site as indicated on Figure 2 include:

- Creation of a B4 mixed use precinct circa. 13 ha, straddling both Area 1 and 2 resulting in the removal of isolated patches of variously degraded vegetation and retention of a vegetated buffer along the northern boundary of the Gateway site containing the threatened plant *Melaleuca biconvexa*;
- Creation of an E2 Environmental Conservation zoned corridor, through the rear of the site to more formally conserve habitats of high biodiversity value on site, consolidate existing environmental protection areas, maintain habitat connectivity and to offset impacts on biodiversity values. Creation of the E2 corridor will involve:
  - Conservation of a large portion of Area 3 through the rezoning of land from 3a Commercial and 7a Environmental Protection to E2 Environmental Conservation,
  - Conservation of vegetation along the south-eastern boundary of Area 1 through rezoning of land from 10A Investigation Precinct and 7a Environmental Protection to E2 Environmental Conservation. This will retain a corridor of conserved vegetation through the rear of the site and maintain existing connectivity with adjoining environmental and open space zoned lands to the south. Part of this area will be rehabilitated via a Vegetation Management Plan (VMP) to improve vegetation condition and to enhance the connectivity of vegetation through the site;
- Rezoning the remainder of Area 1 to RU6 transition; and
- Provision for a new detention basin within the north-western portion of Area 1 to manage upstream and downstream flows for flood mitigation and designed with riparian buffers and features to provide habitat for birds, reptiles and amphibians.

The extent of each of the proposed zones within the site is indicated in Table 1.

Table 1 Extent of each proposed zone within the site

	Area (hectares) of each proposed zone within each area				Total Area
	B3 Commercial Core	B4 Mixed Use Precinct	RU6 Transition	E2 Environmental Conservation	
Area 1		12.0	25.3	2.0	**39.4**
Area 2		1.0	1.1	0.1	**2.2**
Area 3	3.4			3.2	**6.5**
Whole site	**3.4**	**13.0**	**26.4**	**5.3**	**48.1**

Proposed E2 Ecological Corridor

The ecological assessments carried out on the Westfield Tuggerah and Gateway site have determined that part of Area 3, currently zoned 7(a) Environmental Protection, located along the southern boundary of this land should remain in a conservation zoning. The northern boundary of the current 7(a) zoned land would be extended to incorporate some additional land currently

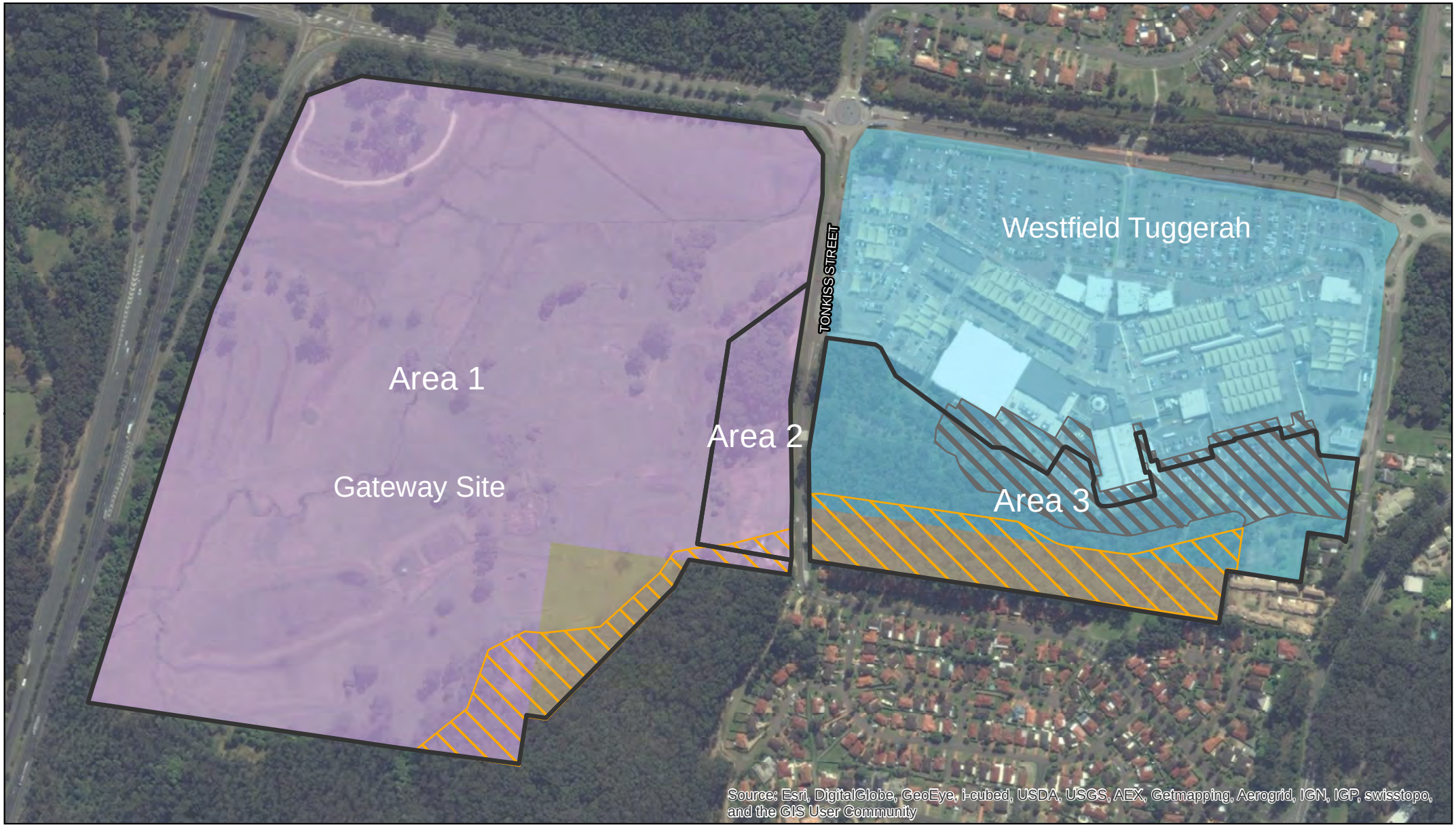
zoned 3A Commercial and proposed for zoning as B3 Business Core (refer Figure 3) located between the existing 7(a) land and the rear of the shopping centre. The proposed revised boundary for the conservation zone within Area 3 has been determined taking in to consideration future development potentially required to assist in the operation of the shopping centre, including access, carparking, bus movements, servicing and road connections (refer Table 10). The area at the rear of the shopping centre has historically been zoned commercial and identified as a location for future expansion of the centre in the Wyong Shire Council development Control Plan No. 80 – Tuggerah Precinct (refer Figure 4). Use of this area to potentially provide traffic relief for Wyong Road and access to the remainder of the Gateway Site area has been previously recognised by DoPI and RMS.

A corridor of land along the south-eastern boundary of the Gateway Site, part of which is already zoned 7(a) Environmental Protection (refer Figure 3) is also identified for protection within a conservation zone. The area of land is irregular in shape and follows an existing tree line within that part of the land. It adjoins significant parcels of government owned land locate to the south of the site zoned for Public Recreation RE1, E2 Environmental Conservation and E3 Environmental Management.

The intention is to protect a vegetated corridor, along the southern boundary of the Westfield land which will conserve native vegetation with high biodiversity values and assist in offsetting impacts associated with the proposed development on the site. The proposed corridor will maintain connectivity through the site and with environmental and open space lands to the south. It is not an unbroken corridor as it is currently split by Tonkiss Street, a cleared area around an existing dwelling, west of Tonkiss Street, and by a pedestrian pathway which links the residential community south of the Tuggerah Shopping Centre with the eastern part of the Centre, within the 7a land to the east of Tonkiss Street.

It is proposed to rezone the ecological corridor to E2 Environmental Conservation. Under the Wyong LEP 2013, E2 Environmental Conservation applies to the most environmentally valuable land, including SEPP 14 Coastal Wetlands, SEPP 26 Littoral Rainforests, Endangered Ecological Communities and land subject to conservation agreements or land acquired by Council for conservation purposes. This would identify the corridor within the most environmentally valuable lands within the Wyong LGA. As illustrated in the Wyong LEP 2013, environmental zoned lands held in private ownership are generally zoned E3 (Environmental Management) and this zone has been applied to lands in the LGA previously zoned 1(c), 7(a), 7(b) (east of the F3), 7(e), 7(f) and 7(g).

A Vegetation Management Plan (VMP) would be prepared to provide for rehabilitation of the disturbed area of the corridor west of Tonkiss Street that currently supports the dwelling and associated infrastructure (see Section 7.4.2). The existing dwelling and any associated infrastructure would be demolished and removed and the area rehabilitated through replanting and weed management to increase the extent and condition of native vegetation and enhance connectivity within the corridor.



Paper Size A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

The Site

Approved Westfield expansion (DA 514/2013)

Proposed E2 zone

Westfield Tuggerah and Gateway Site existing zoning Wyong LEP 1991

7A Environmental Protection (Conservation)

3A Business General

10A Investigation Precinct

Westfield Ltd
Westfield Tuggerah and Gateway Site

Job Number 21-23343
Revision 1
Date 17 Jun 2014

Existing zoning with proposed E2 corridor overlaid

Figure 3

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Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com

Data source: ESRI: Aerial, 2013; LPI: DBTB, 2012; Geoscience Australia: 250K Topographic Data Series 3, 2006. Created by: tmorton, fmackay

Figure 4 **Excerpts from a) the WYONG DCP (Tuggerah Precinct) and b) Wyong LEP 1991 showing the area at the rear of Tuggerah Westfield identified for future expansion of the Westfield site and the current zoning under LEP 1991.**

Comparison with proposed environmental zoning under Draft LEP 2013

The proposed E2 corridor provides a better ecological outcome for the site than that presented in the draft Wyong LEP as exhibited in February 2013. The environmental protection zones suggested in the draft LEP are based on historical vegetation mapping (Bell and Driscoll 2008) that has not been ground-truthed and that is inconsistent with the findings of the more recent vegetation mapping undertaken on the site as part of the ecological investigations for the Westfield Tuggerah and Gateway Site.

Under the draft LEP zoning, two small 'islands' of native vegetation would be conserved within E2 zones in Areas 1 and 2 of the Gateway Site. These patches of vegetation are already isolated by cleared land and their biodiversity value is further limited by their small size, large edge to area ratio and existing levels of disturbance and modification. The long-term viability of these stands of vegetation would be uncertain given these considerations and that future development of the remainder of the Gateway site would result in these small, vegetated pockets being totally surrounded by developed land.

The exhibited zoning within Area 3, would result in areas of high biodiversity value at the rear of the shopping centre zoned E3 Environmental Management which affords less protection than the E2 Environmental Conservation zone. The proposed E2 zoning is also impractical from a planning and management perspective, incorporating areas of planted vegetation, creating a narrow corridor of conserved land surrounded by B2 local centre zoned land and an island of B2 land surrounded by conserved lands.

As noted above, the proposed rezoning of the site as presented in this assessment (Figure 2) provides for a consolidated ecological corridor along the southern boundary of the Westfield land that will be zoned E2 Environmental Conservation. The proposed rezoning aims to conserve native vegetation with high biodiversity values and maintain and enhance connectivity through the site and with environmental and open space lands to the south to promote the long term viability and persistence of the ecological communities present. The proposed reasoning will achieve an appropriate balance between conservation and development lands allow for the offset of impacts associated with future development and thereby deliver a sound ecological outcome for the site.

1.3 Relationship to previous ecological assessments

The Westfield landholdings at Tuggerah have been the subject of numerous ecological studies and assessments undertaken for various phases of the Westfield Tuggerah and Gateway Site project over the past seven years. The findings of this body of work have been reviewed and are used in this report to identify the biodiversity values of the site, the likely impacts associated with the proposed rezoning and future development and appropriate offset to compensate for such impacts and improve or maintain biodiversity values.

The two most recent ecological assessments undertaken on the site are outlined below.

1.3.1 Tuggerah Town Centre Masterplan

GHD has previously prepared a comprehensive ecological assessment of the site as part of consideration of the Tuggerah Town Centre State Significant Site study (GHD, 2011). The Master Plan for that study comprised the current Westfield Tuggerah and Gateway site (Areas 1, 2 and 3) and two additional landholdings, Areas 4 and 5, located east of Westfield Tuggerah, previously referred to as the 'Eastern Town Centre'. Areas 4 and 5 are not included as components of the current proposal.

The assessment built on earlier ecological investigations conducted by URS (2007) and was undertaken to determine the conservation significance of the site, identify any likely impacts of

the project on flora and fauna, including threatened biota, and recommend appropriate measures to manage such impacts, including measures to avoid, mitigate and offset potential impacts on native biota.

The Ecological Impact Assessment concluded that the proposed Tuggerah Town Centre Project would not have a significant impact on threatened biota (GHD 2011a). Onsite and offsite biodiversity offsets were identified and agreed in consultation with Council and OEH that contained an appropriate suite of threatened biota and habitats to compensate for residual impacts arising from the proposed development and to ensure regional biodiversity values were improved or maintained.

A preliminary draft of the Tuggerah Town Centre ecological assessment was submitted as supporting information for a Referral of the project to the then Commonwealth Department of Sustainability, Environment, Water, Populations and Communities (now the Department of the Environment). The Department of the Environment (DotE) provided a determination on 31 August 2010 that deemed the Tuggerah Town Centre project 'not a controlled action' within the meaning of the EPBC Act.

1.3.2 Alterations and Additions to Westfield Tuggerah

Subsequent to the ecological investigations undertaken for the Tuggerah Town Centre Master Plan (GHD 2011a), Area 3 of the project site has been subject to an ecological assessment undertaken as part of Development Application (DA) 514/2013 for alterations and additions to the shopping centre and associated parking/bus interchange at the rear of the site (GHD, 2013). The approved development area is indicated on Figure 2. It is situated on land currently zoned 3A Commercial and identified in historical planning policies of Wyong Council for future expansion of the Westfield site (refer Figure 4).

The ecological assessment concluded that the proposed development was unlikely to result in a significant impact on threatened biota listed under the TSC or EPBC Acts (GHD, 2013), including Swamp Sclerophyll Forest and River-flat Eucalypt Forest threatened ecological communities and the threatened plant *Meleleuca biconvexa*. The DA was approved by the Hunter Central JRPP in December 2013.

1.4 Glossary

1.4.1 Project Definitions

The following definitions apply to this assessment:

- '*the site*' : Westfield's landholdings that are the subject of this assessment: the Westfield Tuggerah and Gateway Site, comprising the Gateway Site (Areas 1 and 2) and Area 3 as indicated on Figure 2;
- '*the proposal*': the proposed rezoning and future development and conservation of portions of the Westfield Tuggerah and Gateway Site;
- '*study area'* : the area covered by the current assessment, including the site, adjoining areas of the natural environment which were included in the literature review for this assessment;
- *'the E2 corridor*': the portion of Areas 1 and 2 and Area 3 that would be formally conserved within E2 conservation zones to offset impacts on biodiversity as a result of the rezoning and development on the site; and
- *'the locality'*: the area within a 10 km radius around the site.

1.4.2 Abbreviations

DBH	Diameter at Breast Height
DECC	NSW Department of Environment and Climate Change (now OEH)
DECCW	NSW Department of Environment, Climate Change and Water (now OEH)
DEWHA	Commonwealth Department of Environment, Water, Heritage and the Arts (now known as DotE)
DoPE	NSW Department of Planning and Environment
DotE	Commonwealth Department of the Environment (formerly DSEWPaC)
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Populations and Communities (now DotE)
EEC	Endangered Ecological Community
EPA Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act 1994*
LEP	Local Environment Plan
LGA	Local Government Area (Wyong Council)
NOW	NSW Office of Water and Energy
OEH	NSW Office of Environment and Heritage (formerly known as DECCW)
RMS	NSW Roads and Maritime Services
TSC Act	NSW *Threatened Species Conservation Act 1995*
VMP	Vegetation Management Plan

2. Legislative Framework for Ecological Assessment

2.1 Environmental Planning & Assessment Act 1979

The NSW *Environmental Planning and Assessment Act* (EPA Act) forms the legal and policy platform for development assessment and approval in NSW and aims to, *inter alia*, 'encourage the proper management, development and conservation of natural and artificial resources'. All development in NSW is assessed in accordance with the provisions of the EPA Act and *EPA Regulation 2000*.

The following ecological impact assessments for component areas of the site for previous phases of the Westfield Tuggerah and Gateway site project have been undertaken in accordance with relevant provisions of the EPA Act:

- An ecological impact assessment for the Tuggerah Town Centre Project (GHD 2011a), incorporating the current proposal area and an additional landholding (Area 5), prepared with reference to the DEC and DPI (2005) threatened species assessment guidelines for development applications under Part 3A of the Act as part of the State Significant Site Study for the Tuggerah Town Centre; and
- An ecological impact assessment (GHD 2013), including assessments of significance pursuant to Section 5A of the Act (7-part tests) for the recent approved development application under Part 4 of the Act for alterations and additions to the Shopping Centre and associated parking and bus interchange within Area 3.

A preliminary assessment of the likely impacts of the current rezoning proposal and associated future development on the site and the likely significance of impacts on threatened biota has been undertaken for this report and is presented in Section 6.7. Future development on the site would require formal assessment of the likely significance of impacts on threatened biota pursuant to Section 5A of the EPA Act (7-part tests) at the respective Development Application stages.

2.2 Threatened Species Conservation Act 1995

The NSW *Threatened Species Conservation Act 1995* (TSC Act) provides legal status for biota of conservation significance in NSW. The Act aims to, *inter alia*, 'conserve biological diversity and promote ecologically sustainable development'. It provides for:

- The listing of 'threatened species, populations and ecological communities', with endangered species, populations and communities listed under Schedule 1, 'critically endangered' species and communities listed under Schedule 1A and vulnerable species and communities listed under Schedule 2;
- The listing of 'Key Threatening Processes' (under Schedule 3);
- The preparation and implementation of Recovery Plans and Threat Abatement Plans; and
- Requirements for the preparation of Species Impact Statements (SIS).

The TSC Act has been considered in this report through:

- Desktop reviews to determine the threatened species, populations or ecological communities that have been previously recorded or are predicted to occur within the locality of the site and hence could occur subject to the habitats present;
- Field surveys for threatened biota listed under the Act;
- Recommendations for suitable impact mitigation and environmental management measures for threatened biota, where required; and
- Preliminary assessment of potential impacts on threatened biota.

2.3 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations.

The FM Act lists threatened species of freshwater fish, aquatic invertebrate and macro invertebrate species, endangered populations and aquatic ecological communities and key threatening processes. The FM Act has been addressed in this report through:

- Desktop assessments to identify the threatened aquatic biota that have been previously recorded within 'the locality' of the site and hence have the potential to occur at the site and be affected by 'the project subject to the presence of suitable habitat;
- Habitat assessments, to determine the conservation significance of aquatic habitats at the site;
- Recommendations for suitable impact mitigation and environmental management measures for aquatic biota, where required; and
- Preliminary assessment of potential impacts on aquatic biota.

2.4 Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* (NW Act), provides for the declaration of noxious weeds by the Minister of Agriculture. Noxious weeds may be considered noxious on a National, State, Regional or Local scale. All private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land under Part 3 Division 1 of the NW Act. As such, if present, noxious weeds on the site should be controlled in accordance with the control category specifications.

2.5 State Environmental Planning Policy 44 – Koala Habitat Protection

State Environmental Planning Policy 44 (SEPP 44) 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".

Schedule 1 of SEPP 44 lists the local government areas to which SEPP 44 applies. The site is within Wyong LGA. Wyong LGA is listed under Schedule 1.

SEPP 44 requires that, before granting consent for a Development Application under Part 4 of the EP&A Act, on land over 1 hectare in area, a consent authority must be satisfied as to whether or not the land is 'potential' and 'core' Koala habitat.

Under the SEPP, potential Koala habitat is defined as 'an area of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component'. Schedule 2 lists the main koala feed tree species.

Core Koala habitat, is defined as 'an area of land with a resident breeding population of Koalas, evidenced by attributes such as breeding females and recent sightings and historical records of a population'.

The potential for the site to comprise potential and core Koala habitat as defined under SEPP 44 has been assessed (see Section 4.6).

2.6 Environment Protection and Biodiversity Conservation Act

The purpose of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to ensure that actions likely to cause a significant impact on 'matters of national environmental significance' undergo an assessment and approval process. Under the EPBC Act, an action includes a project, undertaking, development or activity. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Government Minister for the Environment (the 'Minister').

The EPBC Act identifies MNES as:

- World heritage properties
- national heritage places
- wetlands of international importance (Ramsar wetlands)
- threatened species and ecological communities
- migratory species
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- a water resource, in relation to coal seam gas development and large coal mining development.

Potential impacts on any MNES must be subject to assessments of significance pursuant to the EPBC Act Significant Impact Guidelines (DotE, 2013). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Minister.

The requirements of the EPBC Act with respect to the assessment of impacts on MNES have been considered in this report through:

- Desktop review to identify the matters of MNES recorded or predicted to occur within the locality of the site;
- Field surveys for threatened species and migratory species listed under the Act;
- Preliminary assessment of potential impacts on threatened or migratory species;
- Recommendations for suitable impact mitigation and environmental management measures for relevant threatened biota, where required; and
- Preliminary assessment of the likely significance of impacts arising from the project on relevant MNES.

A Referral for the previous Tuggerah Town Centre Project was submitted to the Department of the Environment (then DSEWPaC) in 2010 (GHD, 2010) primarily regarding impacts on approximately 1140 stems of the EPBC Act listed threatened plant *Melaleuca biconvexa*. Based on the findings of the assessments undertaken, the project was considered unlikely to have a significant impact on this species and DotE provided a determination on 31 August 2010 that

the Tuggerah Town Centre project was not a controlled action within the meaning of the EPBC Act (EPBC Ref. 2010/5562).

The project area for the Tuggerah Town Centre Referral included the current project area, comprising Areas 1, 2, and 3 as well as Areas 4 and 5, comprising additional landholdings located to the east of Gavenlock Road. Areas 4 and 5 do not form part of the current project area. The removal of these areas from the current project area involves a substantial reduction in the total number of *M. biconvexa* to be removed than assessed in the earlier Referral. Given that only approximately 17 stems of *M. biconvexa* would be removed within the indicative future development footprint within Area 3 (if required), the current proposal is unlikely to result in a significant impact on this species and be deemed a controlled action under the EPBC Act.

3. Methodology

This report provides a consolidated account of the ecological values of the site and a preliminary assessment of potential impacts associated with the current proposal, based on the findings of previous studies completed on the site, including the following:

- *Ecological Impact Assessment for the Tuggerah Town Centre State Significant Site Study* (GHD, 2011a);
- *EPBC Act Referral for proposed development for the Tuggerah Town Centre* (GHD 2010); and
- *Ecological Impact Assessment for the proposed extension of the Tuggerah Shopping Complex* (GHD, 2013).

3.1 Literature Review

The above studies have been reviewed to determine the conservation significance of the site and to identify threatened flora and fauna species, populations and ecological communities listed under the NSW TSC Act (threatened biota) and ecological Matters of National Environmental Significance listed under the Commonwealth EPBC Act (ie threatened biota and migratory species) that may be affected by future development on the site. The literature review has involved review of the following documentation:

- URS (2007a) *Preliminary Tuggerah Gateway Flora and Fauna Assessment*;
- URS (2007b) *Westfield Tuggerah Eastern Extension -Flora and Fauna Assessment*;
- Department of the Environment (DotE) Protected Matters Search Tool for relevant Matters of National Environmental Significance (MNES) listed under the EPBC Act (20 June, 2013 – within a drawn polygon centred on the site, buffered at 10km);
- The NSW Office of Environment and Heritage Wildlife Atlas database (OEH, 2013a) for threatened species listed under the NSW TSC Act (December 2013 – within a 10km radius of the site);
- OEH (2013b) online threatened biodiversity profiles for threatened ecological communities (TECs) known to occur within the region (Wyong CMA sub region);
- The BioNet database (BioNet, 2005) for fish listed under the NSW FM Act; and
- Lower Hunter and Central Coast Regional Environmental Management Survey (LHCCREMS) (2000) *Vegetation Survey, Classification and Mapping Lower Hunter and Central Coast Region.*
- Duncan (2001) *The conservation of Melaleuca biconvexa Byrnes (Myrtaceae) within Wyong Shire*. Masters Thesis, University of New England, Armidale.

3.2 Field Surveys

GHD ecologists have performed three targeted flora and fauna surveys within the study area:

- Survey one (21 to 24 December 2009) and survey two (15 to 16 February 2010) conducted throughout Areas 1, 2 and 3 as part of the State Significant Site Study (GHD, 2011); and
- Survey 3 (21 June, 2013) focussing on Area 3 as part of the *Development Application for the proposed extension of the Tuggerah Shopping Complex* (GHD, 2013).

The survey methodology is described below.

3.2.1 Flora Surveys

The primary objectives of flora surveys undertaken during surveys 1 and 2 were to:

- Map and describe the vegetation types occurring within the study area;
- Compile a flora list of those species occurring within the vegetation types, identifying any threatened species and communities; and
- Assess the likely impacts of the project and provide recommendations to assist in minimising impacts on flora in the study area.

All vascular plants (i.e. not mosses, lichens or fungi) observed were recorded on pro-forma field data sheets. Plant specimens that could not be identified quickly in the field were collected and subsequently identified using standard botanical texts and where required were compared with voucher specimens held in the National Herbarium of NSW Online Reference Collection. Structural vegetation communities were described according to classifications made by Specht (1970). Plant identifications were made according to nomenclature in Harden (1990, 1991, 1992, and 1993).

On the basis of previous investigations, air photo interpretation, and field habitat assessment, the site was divided into stratification units i.e. functionally similar units for the purposes of environmental assessment according to the OEH guidelines (DEC 2004). Survey effort included five 20m x 20m quadrats positioned to define native vegetation communities at the site. Plant species were recorded on pro forma field data sheets. Each species list was accompanied by a detailed biophysical description, including vegetation structure, soils, geology and geomorphology, habitat and fire and disturbance history.

Random meander transects were used to compile a species list in areas of native vegetation previously defined by URS (2007a, 2007b) or through regrowth, planted and/or highly disturbed communities. Additional random meander surveys were also performed through all of the study area traversed on foot, noting any species not detected in other surveys as well as any threatened species. Targeted searches for *Melaleuca biconvexa* were undertaken to ground truth previously identified stands and to identify any new patches (if present).

The location of field survey quadrats and significant species, habitat and communities were captured with a handheld GPS unit. The locations of the vegetation survey quadrats are shown in Figure 5.

Additional surveys undertaken in Area 3 in June 2013 (survey 3) involved a site walkover to ground-truth previous mapping of vegetation type and condition (GHD, 2011) and to inspect stands of *Melaleuca biconvexa* and recount stem numbers. Random meander surveys targeting threatened plants were also conducted in areas of suitable habitat.

Weather conditions were suitable for the detection of the majority of plant species at the site during the site surveys. There was good rainfall in the months preceding field surveys 1 and 2: Gosford received 228.8 mm between 21st November and 21st December 2009, and 60mm between 15th January and 15 February 2010. Accurate daily rainfall data was not available for Gosford for the month of May 2013 (survey period 3); however the station received about 106.6 mm over the month of May, and 28.2 mm from June 1 to 20, 2013.

3.2.2 Fauna Surveys 1 and 2 (Areas 1, 2 and 3)

The fauna survey design for surveys 1 and 2 was based on existing survey effort for the site and recommendations made by URS (2007a), the likelihood of threatened species identified in the desktop review occurring on site and the initial habitat assessment. Methods included diurnal bird counts, Anabat recording, harp trapping, active searches, nocturnal call playback, stag watches, spotlighting, opportunistic observations and track and scat identification. Survey effort

is presented on Figure 5. The timing of the field surveys was consistent with OEH guidelines which recommend surveys between October and March for bats, frogs and reptiles (DEC 2004). All observations were recorded on appropriate pro forma field data sheets.

Weather during the December 2009 and February 2010 field survey was generally warm to hot and humid. No rain fell during survey one (December 2009), though 22.4 mm fell in the 72 hours preceding (Table 1). There was some standing water in drainage ditches, dams and wetlands across the site, though few frogs were actively calling. Survey conditions were thought to be sub-optimal for the detection of frogs at the site since a number of species previously recorded on site (URS, 2007a) were not heard calling. Temperatures throughout this survey period were favourable for the detection of both diurnal and nocturnal reptiles potentially present at the site. Wind during dawn bird surveys was light to moderate and so would not have hampered the detection of bird species. There was a one-quarter moon throughout survey 1.

Gosford recorded 3.2 mm of rain on the first day of survey 2 (February 2009). A further 85.6 mm had fallen in the 72 hours preceding (Table 1). Dams, drainage lines and wetlands on the site contained standing water, and conditions were favourable for the detection of frogs. The majority of frog species detected by URS (2007a) were calling. The warm temperatures during survey two were favourable for the detection of diurnal and nocturnal reptiles. There was a moderate strength wind during morning bird surveys. There was no moon present during the nocturnal surveys.

Throughout the survey periods, there was moderate to high light spill from artificial sources across the entire site and high background noise. Traffic along Wyong Road and the F3 was heavy throughout all evening surveys, with several hundred vehicle movements per hour, including heavy trucks. Conditions during the nocturnal surveys were sub-optimal for the detection of small nocturnal fauna, because these species are less likely to be active in light or noisy environments, however were adequate for observing nocturnal birds and larger mammals, because these species are generally less sensitive to disturbance.

Table 2 Daily weather observations at Gosford during the survey periods (BOM 2014).

Date	Minimum temp (Deg Celsius)	Max temp (Deg Celsius)	Rainfall (mm)
Survey 1			
18-20/12/09	16.3	29.6	22.4
21/12/09	15.6	27.3	0
22/12/09	15.5	33.9	0
23/12/09	15.4	31.7	0
24/12/09	15.7	33.7	0
Survey 2			
12-14/02/2010	20.4	36.3	85.6
15/02/2010	20.6	33.3	3.2
16/02/2010	18.1	25.8	0
Survey 3			
21/06/2013	8.6	15.8	0

Diurnal Bird Counts

Diurnal bird counts consisted of area searches through areas of representative habitat on site. Searches were conducted at dawn and dusk, for at least 40 minutes over approximately 1 ha consistent with the OEH guidelines (DEC 2004). Opportunistic observations of bird species were recorded throughout the duration of all surveys on the site. Species were identified by

visual observation and call and were documented along with numbers of individuals, behaviour, breeding activity and habitat type where appropriate in field note books.

Trees were also scanned for nests, whitewash and roosts and the locations of habitat resources for birds captured with a handheld GPS unit.

Active Searches

Active searches for frogs and reptiles were performed within and adjacent to the site focussing on wetlands and areas with suitable substrate. Wetland areas were systematically searched and semi-aquatic vegetation was visually scanned. Shelter sites were carefully lifted and replaced, trunks and decorticating bark were scanned and visual scanning of vegetation for active and foraging specimens was undertaken. Frogs were identified by sight and by call.

Microchiropteran Bat Survey

Fixed Anabat recordings were undertaken, recording from half an hour before dusk until the following morning. Two Anabat units were placed for three nights on 21, 22 and 23 December. Overall six full nights of bat call recordings were taken. Additional walked transects were undertaken on the evenings of 22 and 23 December for approximately 2 hours after dusk, targeting identified fly ways, water sources and potential roost trees.

Calls were identified to species level where possible and were reported as ‘definite’, ‘probable’ or ‘possible’ depending on the confidence of the identification.

Call Playback

Call playback was performed over two nights in Areas 1 and 2 during survey one targeting the Yellow-bellied Glider (*Petaurus australis*), Koala (*Phascolarctos cinereus*), Masked Owl (*Tyto novaehollandiae*), Sooty Owl (*Tyto tenebricosa*) and Powerful Owl (*Ninox strenua*). During survey 2, call playback in Area 3 targeted the Squirrel Glider (*Petaurus norfolcensis*) in addition to the species above.

Call playback was undertaken at a fixed location and included at least five minutes broadcasting and 10 minutes listening for each species per night plus additional listening and spotlighting at the beginning and end of the call playback period in accordance with OEH guidelines (DEC 2004).

No call playback for threatened frogs was conducted in Areas 1 and 2 because of the sub-optimal survey conditions and previous targeted surveys under appropriate conditions conducted by URS (2007). Call playback for threatened frogs was not undertaken in Area 3 due to a lack of suitable breeding habitat.

Camera Traps

Fixed motion sensing cameras were left in place from the evening of 21 December till mid-morning on 24 December 2009. Two cameras were attached to tree trunks and aimed towards buried baits of sardines.

Stag Watching

Hollow-bearing stags were identified during daytime habitat assessments and then watched at dusk. Stags were monitored for approximately 30 minutes before dusk and 60 minutes after nightfall. All fauna species noted during this period were recorded and any usage of roosts or hollows was recorded as appropriate.

Spotlighting

Spotlighting surveys were performed on the evenings of 21, 22 and 23 December 2009 and 15 February 2010 and involved walking transects for at least one hour. Nocturnal mammals, birds and frogs were targeted during the spotlight period by systematically scanning native vegetation. Opportunistic spotlighting was performed each evening when deemed appropriate.

Fauna Habitat Assessment

Habitat assessments were conducted across the entire study area in order to determine the conservation significance of fauna habitats and to assess the potential presence of native fauna (and especially threatened species) not directly observed during the surveys.

An assessment of the quality of habitats present for native fauna was made across the entire site. Habitat quality was based on the level of breeding, nesting, feeding and roosting resources available. Indicative habitat criteria for targeted threatened species (i.e. recorded in the TSC and EPBC Act searches) were identified prior to fieldwork. Criteria were based on information provided in TSC Act species profiles, field notebooks and the knowledge and experience of GHD field ecologists. This technique is important in assisting in the compilation of a comprehensive list of fauna that are predicted within the vicinity of the site, rather than relying solely on one off surveys that are subject to seasonal limitations and may only represent a snapshot of the species present.

Habitat assessments included active searches for:

- trees with bird nests or other potential fauna roosts;
- rock outcrops providing potential shelter sites for fauna;
- burrows, dens and warrens;
- hollow-bearing trees and logs which provide refuge, nest and den sites for a range of threatened fauna species;
- hollow-bearing trees for evidence (e.g. guano or bat droppings or pellets) of roosting microbats;
- forest owl roost sites as evidenced by white wash and regurgitated pellets;
- distinctive scats or latrine sites (of particular relevance for the Spotted-tailed Quoll (*Dasyurus maculatus maculatus*);
- tracks or animal remains;
- evidence of activity such as scats, feeding scars, scratches and diggings;
- specific food trees and evidence of foraging;
- Koala food trees and evidence of scratches or scats;
- leaf litter and fallen timber suitable for gastropod and reptile habitat; and
- presence of potential habitat for frog species.

The locations and quantitative descriptions of significant habitat features, such as habitat trees and wetlands, were captured with a handheld GPS unit and photographed where appropriate. For the purpose of this assessment ‘habitat tree’ was defined as a tree with one or more of the following characteristics: Diameter at Breast Height (DBH) >100cm; visible hollows; cracks, fissures or shedding bark that may provide roost sites; large concentrations of blossoms or fruit; visible nest(s) or roost(s); and/or visible evidence of fauna occupation.

Ground debris searches

Ground debris searches were undertaken during the survey period while incidentally traversing the site. These included active searches for small fauna and opportunistic observation of scats, tracks, burrows or other traces.

Opportunistic Observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. Survey effort was concentrated on suitable areas of habitat throughout the course of the flora survey, for instance paddock trees and dams were scanned for roosting birds.

3.2.3 Survey 3 (Area 3)

Additional diurnal fauna habitat assessment surveys were undertaken in Area 3 during June 2013. This involved a site walkover confirming the locations of habitat features of relevance for threatened fauna, including habitat trees and logs, searches for signs of fauna activity (eg scats, tracks, nests, burrows) and opportunistic observations of fauna species. Weather conditions during survey 3 were cool, with 11 mm of rain recorded in Gosford in the 48 hours prior to the survey.

3.3 Conservation significance

Conservation status of species and communities recorded in the study area were determined with reference to the following:

- The NSW TSC Act and FM Acts for State significance; and
- The EPBC Act for National significance.

3.4 Staff Qualifications

Field surveys were undertaken by qualified GHD field ecologists. Staff qualifications and experience are presented in Table 3 below.

Table 3 GHD ecology personnel and qualifications

Name	Position / Project Role	Qualifications	Relevant Experience
Ben Harrington	Ecologist / field surveys 1 and 2 and reporting (GHD 2011a)	Bachelor of Science, Masters of Science (Physical Geography), Macquarie University	10+ years
Craig Grabham	Senior Ecologist / field survey 1, Anabat recording analysis and technical review (GHD 2011a)	Bachelor of Applied Science (Hons), Charles Sturt University	10+ years
Rowena Hamer	Graduate Ecologist / field survey 2 (GHD 2011a)	BSc (Hons1) Biological Science, University of NSW	3+ years
Arien Quin	Ecologist / field survey 3 and reporting (GHD 2013)	BABsC, University of Melbourne	7+ years
Elise Budden	Graduate Ecologist / field survey 3 and reporting (GHD 2013)	Bachelor of Science, University of Newcastle	2+ years

Jayne Tipping	Principal Ecologist / quality assurance and technical review	BSc, MEnvLaw, University of Sydney	20+ years

3.5 Survey limitations

It is possible that some species utilise the study area but were not detected during the survey periods. These species are likely to include flora species that flower after rainfall as well as annual, ephemeral or cryptic species and frogs which call at other times of year or after rainfall. Some fauna species are also mobile and transient in their use of resources and it is likely that not all species (resident or transitory) were recorded during the survey periods. The habitat assessments conducted for the site allow for identification of habitat resources for such species and their likelihood of occurrence. As such, the survey was not designed to detect all species, rather to provide an overall assessment of the ecological values on site in order to predict potential impacts of the proposal.

Paper Size A4

0 25 50 100 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- The Site
- Anabat
- Call Playback
- Harp trap
- Remote camera
- Vegetation Quadrat

Westfield Ltd
Westfield Tuggerah and Gateway Site

Job Number 21-23343
Revision 1
Date 11 Jun 2014

Survey Effort (GHD 2011)

Figure 5

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: ESRI: Aerial, 2013; LPI: DBTB, 2012; Geoscience Australia: 250K Topographic Data Series 3, 2006. Created by: tmorton, fmackay

4. Existing Environment

4.1 Site Context

4.1.1 Site Location and Layout

The site is approximately 48.1 ha in size and is made up of three component areas (Areas 1, 2 and 3) adjacent to Wyong Road, Tuggerah in the Wyong local government area (LGA), NSW (see Figure 1). The layout of the site, including proposed zonings and approved development lands, is shown on Figure 2.

Areas 1 and 2 collectively comprise the Gateway Site which is bordered by: Westfield Tuggerah to the east; the F3 Motorway to the west; Wyong Road, vegetated Crown Reserve to the north; and land zoned for open space and environmental management and conservation to the south. Area 1 is approximately 39.40 ha in area and contains extensively cleared agricultural land leased for cattle grazing. Area 2 is 2.20 ha in area and contains remnant native vegetation, fenced paddocks and a single residence.

Area 3 is approximately 6.50 ha in area. It is located directly south of the Westfield Tuggerah site and is bordered by Tonkiss Road to the west and residential areas to the south and east. Area 3 contains a strip of planted vegetation along the northern boundary and a residence, playground, pathway and informal car park near its eastern end. The remainder of the area generally supports intact native vegetation.

The locality contains residential, commercial and light industrial development to the northeast, east and southeast and native vegetation to the southwest, west and northwest.

The study area is located within the Central Coast as defined in the *Interim Biogeographic Regionalisation for Australia* (Thackway and Cresswell, 1995). This bioregion comprises the lower, eastern slopes of the Great Dividing Range and the coastal floodplain.

4.1.2 Geology, Soils and Topography

The majority of the site consists of broad, alluvial flats of the Wyong Soil Landscapes Series (Murphy, 1993). These are composed of Quaternary alluvial sediments that form deep (>200 cm) and poorly drained Yellow and Brown Podzolic soils (Murphy, 1993).

The north-western and south-eastern corners of the Tuggerah Gateway site slope upwards into the Erina Soil Landscapes Series. These areas feature outcropping Narrabeen Group Sandstone with Yellow Earth soils. Soil depth varies with slope position, from 50cm on crests and near outcropping sandstone to 150cm on foot slopes (Murphy, 1993). The landform in the central-eastern portion of Area 1 has been shaped by infrastructure associated with a former abattoir. There are also substantial areas of dumped fill on site, possibly from the nearby Westfield Tuggerah development. This fill covers soils in the south-eastern portion of Area 1 and forms a substantial mound in the northern corner. This mound has substantially changed the hydrology of this portion of the area which would have originally been a poorly drained swampy area.

The remainder of the site consists of highly modified landscapes covered by infrastructure, bare earth or exotic plants.

4.1.3 Hydrology

The site is dissected by small drainage lines with associated topographic features, including levees and intermittent marshes. Local drainage has been substantially modified by previous earthworks, paving and drain construction.

Drainage lines flow from the southwest corner of Area 1, northwards and from the western boundary east. These channels join in the northern portion of Area 1 and flow eastwards to a stormwater drain which drains to Tuggerah Lake. Three dams exist at the site. These dams could potentially provide habitat for native frog species, including threatened species, although none have been recorded during field investigations (refer Section 5.3).

Area 3 contains low-lying poorly drained alluvial flats supporting treed wetlands with a number of small ephemeral depressional marshes. It does not contain any drainage lines or semi-permanent wetlands. Area 3 slopes gently to the northeast and drains to the lowest lying areas of treed wetlands within the site.

4.1.4 Climate

Weather statistics have been taken from the nearest weather station to the site (Gosford) (BOM, 2010). The area experiences a mean maximum annual temperature of 23.0^{o} Celsius and a mean minimum annual temperature of 11. 0^{o} C. The average annual rainfall is 1316.4 mm at Gosford.

4.2 Flora

4.2.1 Flora Species

A flora species list for the study area has been compiled from the results of the flora quadrat surveys and opportunistic observations made during random meander surveys, during surveys 1, 2 and 3. A total of 257 plant species were recorded during the field surveys, of which 169 are native. The total plant species list recorded during the field survey is presented in Appendix 1. The number of flora species detected in each area was:

- Area 1: 90 species, including 56 natives;
- Area 2: 57 species, including 48 natives;
- Area 3: 110 species, including 97 natives; and

One threatened flora species was recorded: the Biconvex Melaleuca (*Melaleuca biconvexa*), which is listed as Vulnerable under the TSC Act and the EPBC Act. Its occurrence on site and local and regional distribution and abundance is discussed further in Section 5.1.1.

4.2.2 Vegetation Types

Vegetation types mapped within the study area are shown on Figure 6 and described below. Native vegetation occurs as isolated remnant patches at the site, surrounded by existing disturbance, including agricultural land, light industry, suburban residences, the Westfield shopping centre and transport infrastructure. The largest intact vegetation patch is located within Area 3 to the south of the Tuggerah Westfield shopping centre. Most of the other native vegetation in the proposed surface disturbance area occurs as small isolated, remnant patches or comprises the edges of vegetation patches that extend off site. These isolated patches are moderately to severely degraded by ongoing disturbance and edge effects.

Vegetation types were described according to LHCRREMS (NPWS 2000) map units where applicable. The definitions and mapping of URS (2007a) was confirmed on the majority of the site during surveys 1 and 2. Two small patches of remnant native vegetation within Area 1 were sampled by supplementary vegetation quadrats and identified as ‘Degraded Swamp Mahogany-Paperbark Forest’, in contrast to the original identification of URS (2007a) as ‘Melaleuca Scrub’. The GHD identification reflects recognition of these patches as highly modified forms of the Swamp Sclerophyll Forest EEC listed under the TSC Act. OEH (2010e) identification guidelines

for EECs require the identification of highly modified or degraded EECs and mapping according to the likely original vegetation type.

Vegetation types identified and mapped at the site are summarised in Table 4.

Table 4 Vegetation types

Vegetation type	Map Unit (LHCCREMS, 2000)	TSC Act Status*	EPBC Act Status	Distribution
Coastal Narrabeen Moist Forest	MU 6	-	-	Areas 1 and 2
Alluvial Tall Moist Forest	MU 5	EEC (River Flat Eucalypt Forest)	-	Area 1 (and adjoining) and Area 3
Spotted Gum Ironbark Forest	MU 15	-	-	Areas 1, 2 and 3
Swamp Mahogany – Paperbark Forest	MU 37	EEC (Swamp Sclerophyll Forest)	-	Area 3
Degraded Swamp Mahogany – Paperbark Forest	-	EEC (Swamp Sclerophyll Forest) in low condition	-	Areas 1 and 3
Freshwater Wetlands	MU 46	-	-	Area 1
Derived Grassland	-	-	-	Areas 1 and 2
Planted Native Vegetation	-	-	-	Area 3
Exotic Vegetation	-	-	-	Area 3

* EEC = endangered ecological community

Coastal Narrabeen Moist Forest

Coastal Narrabeen Moist Forest (LHCRREMS MU 6) occurs on site as an isolated patch within Area 2 and the disturbed edges of small patches that extend off site into the road reserves along the north-western and south-western boundaries of Area 1 of the Gateway site. This vegetation type is associated with free-draining sandy soils on lower slopes. It is likely that this community occupied extensive areas of Area 1 prior to historic clearing given the presence of remnant Blackbutt (*Eucalyptus pilularis*) paddock trees which are characteristic of the overstorey of this community.

It is a tall forest with a dense canopy dominated by mature (25-35m tall, Diameter Breast Height (DBH) 60-120cm) *Eucalyptus pilularis* along with Turpentine (*Syncarpia glomulifera*) and (White Mahogany) *E. acmenoides*.

The patch in Area 2 features a characteristic dense small tree stratum of Cheese Tree (*Glochidion ferdinandii*) and Forest Oak (*Allocasuarina torulosa*). There is a sparse shrub layer, including *Breynia oblongifolia* and Narrow-leaved Geebung (*Persoonia linearis*). Native groundcover is moderate to dense and diverse, including native herbs, ferns and grasses. There is also a considerable diversity of scramblers, twiners and climbers, including Apple Berry (*Billardiera scandens*), Wombat Berry (*Eustrephus latifolius*) and Monkey Vine (*Parsonsia straminea*).

The small tree stratum is largely absent from the patch of Coastal Narrabeen Moist Forest within Area 1, probably due to grazing. There is a very sparse shrub layer, comprising a few individuals of Prickly Moses (*Acacia ulicifolia)* and Corkwood (*Duboisia myoporoides)*. The ground layer is dominated by bare earth and rock with exotic pasture species and environmental weeds. There is a moderate diversity but patchy cover of native herbs, twiners and grasses.

Alluvial Tall Moist Forest

Alluvial Tall Moist Forest (LHCCREMS MU 5) occurs to the north and west of Area 1 in the adjoining road reserves as well as in the central portion of Area 3. It is associated with transitional areas between free-draining sandy soils on lower slopes and adjoining poorly-drained alluvial flats. It features a canopy consisting of tall, mature *E. pilularis, Syncarpia glomullifera,* Rough-barked Apple *(Angophora floribunda)* and Sydney Red Gum (*A. costata)*. This vegetation type comprises a form of River Flat Eucalypt Forest on Coastal Floodplains, which is listed as an EEC under the TSC Act. It is possible that only portions of this community as it occurs within Area 3 are commensurate with the EEC River Flat Eucalypt Forest, given some parts do not fall on the coastal floodplain (instead being elevated by about 30 m in height on a small ridge that runs through the site). For the purposes of this assessment, a conservative approach has been taken and all areas of Alluvial Tall Moist Forest have been classed as River Flat Eucalypt Forest.

The lower vegetation strata are much better developed in Area 3 than in Area 1. There is a dense, highly diverse small tree stratum, including *Glochidion ferdinandii, Allocasuarina torulosa, Melaleuca* species, Red Ash (*Alphitonia excelsa*), River Bottlebrush (*Callistemon salignus*), Scrub Turpentine (*Rhodamnia rubescens*) and Scrub Myrtle (*Backhousia myrtifolia*). There is a localised patch of the threatened *Melaleuca biconvexa*. The understorey includes a dense, highly diverse mix of native sedges, herbs, ferns and grasses. There is also a considerable diversity of scramblers, twiners and climbers, including *Parsonsia straminea*, *Geitonoplesium cymosum* and *Stephania japonica* var. *discolor*.

Spotted Gum Ironbark Forest

Spotted Gum Ironbark Forest (LHCRREMS MU 15) is present in the southeastern corner of Area 1 and western edge of Area 3. It is associated with clay soils on moderately steep mid and upper slopes. It features a canopy of Spotted Gum (*Corymbia maculata*) and *Allocasuarina torulosa*. The composition of the shrub-small tree and groundcover strata varied significantly with the extent of grazing pressure. In areas south of the stock fence, there was a sparse shrub layer of native shrubs, including *Daviesia ulicifolia* and Prickly Moses (*Acacia ulicifolia*), and a diverse groundcover of native grasses and herbs. Within Area 3, the shrub layer has been highly disturbed and the groundcover has relatively low diversity of native grasses and herbs. Common species include *Imperata cylindrica* (Blady Grass), *Pratia purpurascens* (Whiteroot), *Pteridium esculentum* (Bracken) and *Cymbopogon refractus* (Barbwire Grass).

Exotic species present within this community are *Lantana camara* (Lantana), *Bidens pilosa* (Cobblers Pegs), *Setaria* sp. (Pigeon Grass), *Conyza bonariensis* (Purpletop), *Sida rhombifolia* (Paddy's Lucerne), *Pennisetum clandestinum* (Kikuyu) and *Plantago lanceolata* (Plantain).

Swamp Mahogany-Paperbark Forest

Swamp Mahogany- Paperbark Forest (LHCCREMS MU 37) occurs in the eastern section of Area 3. This vegetation type comprises a form of Swamp Sclerophyll Forest on Coastal Floodplains (Swamp Sclerophyll Forest), which is listed as an EEC under the TSC Act. It is associated with moist, sandy soils on poorly-drained alluvial flats. Remnants of this community in Area 3 would probably have been part of a larger patch prior to clearing and development of the locality. The canopy includes Swamp Mahogany (*Eucalyptus robusta*), Smooth-barked

Apple (*Angophora costata*), Cheese Tree (*Glochidion ferdinandii*) and Flaxed-leaved Paperbark (*Melaleuca linariifolia*). There are occasional dense patches of *Melaleuca biconvexa*. The community featured a diverse, highly variable understorey, including very dense patches of Tall Swa-sedge (*Gahnia clarkei*) or Tall Sedge (*Carex appressa)*, patches of shrubs such as Golden Wattle (*Acacia longifolia longifolia*) and Lemon-scented Ti-tree (*Leptospermum polygalifolium*).

The groundcover includes a diverse mix of native grasses and herbs; common species include Bordered Panic (*Entolasia marginata*), Bracken (*Pteridium esculentum*), Soft Bracken (*Calochlaena dubia*), Blady Grass (*Imperata cylindrica*), Spiny-headed Mat-rush (*Lomandra longifolia*), Weeping Grass (*Microlaena stipoides*), Kidney Weed (*Dichondra repens*), Whiteroot (*Pratia purpurascens*) and Twining Glycine (*Glycine clandestina*).

There is a moderate diversity of exotic species, particularly along tracks and the site boundary. Common species include Lantana (*Lantana camara*), which occurs in dense infestations throughout this community, as well as a number of other exotic species present along tracks and the edges of the site.

Degraded Swamp Mahogany-Paperbark Forest

There are patches of highly modified native vegetation at the site which comprise a degraded form of Swamp Mahogany-Paperbark Forest, based on remnant native species and geomorphic setting. These areas would qualify as a low-condition form of the EEC Swamp Sclerophyll Forest (DECCW, 2010e). Patches of degraded Swamp Mahogany-Paperbark Forest at the site include:

- *Eucalyptus amplifolia* and *E. robusta* with an understorey of the exotic grass *Pennisetum clandestinum* and herbaceous environmental weeds in Area 1;
- *Melaleuca linariifolia* with an understorey of *Pennisetum clandestinum* and native herbs and sedges in Area 1; and
- Remnant *E. robusta* with no understorey vegetation in the eastern end of Area 3.

These areas were initially identified from URS (2007a, 2007b) and were sampled with supplementary vegetation quadrats to confirm the current identification.

Freshwater Wetlands

Freshwater Wetlands (LHCCREMS MU 46) at the site include three farm dams in Area 1. These dams are clearly artificial features created through human alteration of local drainage. These dams do not qualify as the TSC Act-listed EEC 'Freshwater wetlands on coastal floodplains' as they are located too high in the landscape and are not on the coastal floodplain.

Two of the large farm dams within Area 1 that support a near-permanent closed wetland dominated by Cumbungi (*Typha orientalis*) with occasional Finger Rush (*Juncus subsecundus*) and *Cyperus polystachyos*. There is a patchy understorey of moisture-loving herbs such as Pale Knotweed (*Persicaria lapathifolia*) and Lesser Joyweed (*Alternanthera denticulata*). There is a third, smaller wetland in an occasionally flooded depression that is dominated by the noxious weed Water Hyacinth (*Eichornia crassipes*) with occasional native herbs such as Water Pepper (*Persicaria hydropiper*).

Derived Grassland

Derived Grassland features improved pasture, herbaceous environmental weeds, exotic sedges and grasses, and native herbs, sedges and grasses. These areas are probably derived from historic clearing of forest and treed wetlands. Vegetation structure is highly variable, including localised dense patches of Lantana, native and exotic sedges or herbaceous environmental weeds. The groundcover is the tallest continuous vegetation strata. It is dominated by Kikuyu

with a sparse, patchy cover of native forbs, including *Dichondra repens* and *Vittadenia cuneata* and exotic herbs, including Dandelion (*Taraxacum officianale*) and Sowthistle (*Sonchus oleraceus*).

There are occasional isolated remnant trees, including *Eucalyptus pilularis, E. amplifolia* subsp *amplifolia, E. robusta, Angophora floribunda, A. costata, Syncarpia glomulifera* and *Melaleuca linariifolia*. There is very little regrowth of these remnant canopy species due to ongoing grazing or human activities.

There are also patches of native trees with an understorey of cleared pasture within Area 1. These patches were sampled by quadrats and random meander transects. Due to the small size of the patches, high level of disturbance and paucity of native understorey components they were not classed as specific vegetation communities. The following stands were identified:

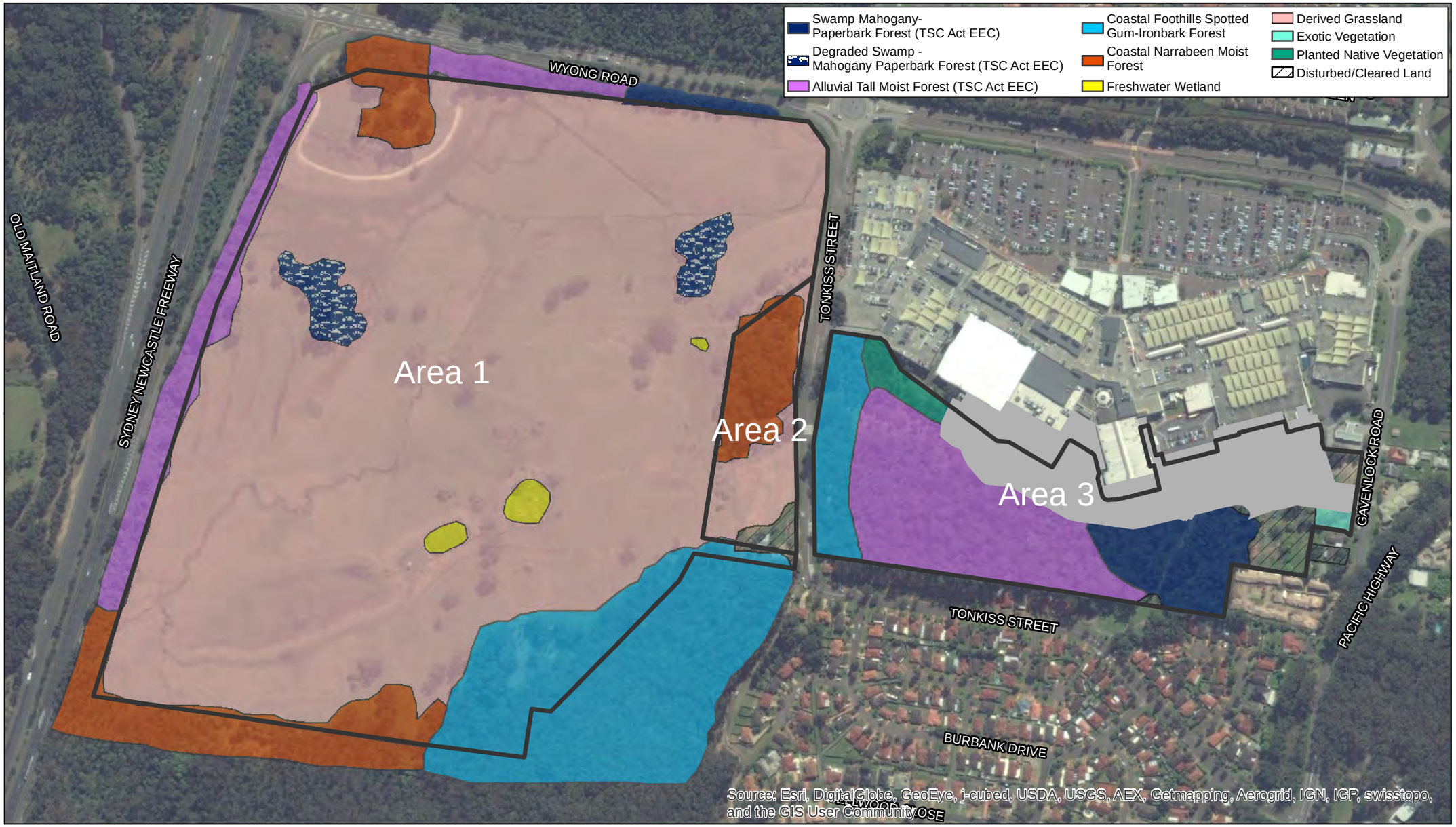
- Planted *Casuarina glauca* with an understorey of herbaceous environmental weeds; and
- Remnant *E. pilularis* and *A. floribunda* with an understorey of Kikuyu, herbaceous environmental weeds, exotic sedges and grasses, the noxious weed *Lantana camara* and native herbs and grasses.

Planted Native Vegetation

On the road batter along the northern boundary of Area 3 there is a strip of planted native vegetation, which can be clearly identified by the age of the plants and presence of stakes and irrigation systems. This area contains native species that are representative of vegetation communities in the local area and would provide habitat resources for native fauna associated with these communities. However, they have low species diversity, may not be of local provenance and are established on imported soil. Imported soil would not contain the suite of micro-organisms nor the representative soil seed bank associated with naturally occurring stands of these vegetation communities. Therefore they are mapped separately from intact native vegetation and do not qualify as EECs despite containing some native plant species representative of EECs present at the site. Common species within this area of planted vegetation include Swamp Mahogany (*Eucalyptus robusta*), Blackbutt (*E. pilularis*), *Acacia* species, Leptospermum species and Water Vine (*Cissus hypoglauca*) planted on a drain and cutting between Area 3 and the existing shopping centre car park.

Disturbed / Cleared Land

The remainder of the site has been subject to major disturbance through past development. This category includes roads, footpaths, buildings and other infrastructure and is mapped collectively as disturbed/cleared land.



Paper Size A4

0 25 50 100 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Legend

The Site

Approved Westfield expansion (DA 514/2013)

Westfield Ltd
Westfield Tuggerah and Gateway Site

Job Number 21-23343
Revision 1
Date 11 Jun 2014

Vegetation Types

Figure 6

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Data source: ESRI, Aeril, 2013; LPI: DBTB, 2012.. Created by: tmorton, fmackay

4.2.1 Noxious Weeds

The *Noxious Weeds Act 1993* provides for the declaration of noxious weeds in local government areas. Landowners and occupiers must control noxious weeds according to the control category specified in the Act. Public authorities must control noxious weeds according to the control category to the extent necessary to prevent their spread to adjoining land.

The site contains four species declared as noxious weeds in the Wyong LGA as shown in Table 5. These noxious species generally occurred in low numbers in disturbed areas of the site; however there were infestations of Lantana growing in dense thickets throughout Alluvial Tall Moist Forest and Swamp Mahogany Paperbark Forest vegetation in Area 3, in which there was a low density of native herbs and limited or absent native midstorey.

Table 5 Declared noxious weeds of the Wyong LGA recorded during the field survey.

Scientific Name	Common Name	Control category*
Rubus fruticosus spp. agg.	Blackberry	4
Lantana camara	Lantana	5
Oxalis corniculata	Creeping Oxalis	5
Ageratina adenophora	Crofton Weed	4

* For Category 4: 'the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority'. For Category 5: 'the requirements in the NW Act for a notifiable weed must be complied with'.

4.3 Fauna

4.3.1 Fauna Species

A moderate diversity of native fauna has been recorded at the site, including 31 mammals, 74 species of bird, 8 frogs and 7 reptiles as listed in Appendix A.

Birds

There was a moderate diversity of native birds recorded on the site, representing a range of guilds (ie species with different niches or lifestyles). Guilds and species observed included:

- Small woodland species, including the Yellow thornbill (*Acanthiza nana*), Red-browed Finch (*Neochmia temporalis*) and Silvereye (*Zosterops lateralis*);
- Aggressive honeyeaters common in urban vegetation remnants and agricultural landscapes such as the Noisy miner (*Manorina melanocephala*), Bell miner (*Manorina melanophrys*) and Yellow-faced Honeyeater (*Lichenostomus chrysops*);
- Open country species such as the Australian Magpie (*Gymnorhina tibicen*), Pied Butcherbird (*Cracticus nigrogularis*) and Australian Raven (*Corvus coronoides*);
- Wetland birds, including the Chestnut Teal (*Anas castanaea*), White-necked Heron (*Ardea pacifica*) and Masked Lapwing (*Vanellus miles*);
- Parrots common in suburban and agricultural landscapes such as the Rainbow Lorikeet (*Trichoglossus haematodus*), Galah (*Eolophus roseicapillus*) and Eastern Rosella (*Platycercus adscitus eximius*);

- The forest parrots Glossy Black-cockatoo (*Calyptorhynchus lathami*) and Yellow-tailed Black-cockatoo (*Calyptorhynchus funereus*);
- Raptors, including the Nankeen Kestrel (*Falco cenchroides*), Brown Goshawk (*Accipiter fasciatus*), Black-shouldered Kite (*Elanus axillaris*); and White-bellied Sea Eagle (*Haliaeetus leucogaster*); and
- The nocturnal, predatory species Tawny Frogmouth (*Podargus strigoides*).

One threatened bird species, the Glossy Black Cockatoo (*Calyptorhynchus lathami*) was recorded at the site. This species and other threatened bird species that may potentially occur on site are discussed further in Section 5.3.

Mammals

A moderate abundance and a high diversity of native mammals were observed during field surveys. Approximately 31 species were recorded on the site, including 'possible' Anabat recordings and species identified to the genus level based on scats or unclear visual observations. Common Brushtail Possums (*Trichosurus vulpecula*) were present in all native vegetation at the site. Scats of a large macropod, probably the Swamp Wallaby (*Wallabia bicolor*) were collected in Area 1 and URS (2007) also recorded the Eastern Grey Kangaroo (*Macropus giganteus*) in this portion of the site. A Common Wombat (*Vombatus ursinus*) and a Short-beaked Echidna (*Tachyglossus aculeatus*) were observed in Area 1.

Bat diversity and abundance was relatively high during surveys: 12 species were confirmed from trapped individuals and/or definite or probable Anabat recordings; and a further five species were tentatively identified based on possible Anabat recordings. Up to ten individuals per trap-night were captured in harp traps, including the Lesser Long-eared Bat (*Nyctophilus geoffroyii*), Eastern Broad-nosed Bat (*Scotorepens orion*) and Gould's Wattled Bat (*Chalinolobus gouldii*). Bat activity on Anbabats was high within Areas 1 and 2. Threatened bats species recorded at the site or that may potentially occur are discussed in Section 5.3.

Signs of bandicoot activity, including characteristic diggings and calls were noted in Area 3, however due to the density of the vegetation positive visual identification was not possible.

There are records of both the Sugar Glider (*Petaurus breviceps*) and the Squirrel Glider (*Petaurus norfolkensis*) within the locality (DECCW, 2009a). These gliders could potentially occur in forested stands on site that are contiguous with larger patches of vegetation that extend off site to the south.

Common exotic mammal species were observed across the site, including the Red Fox (*Vulpes vulpes*), Brown Hare (*Lepus capensis*) and Rabbit (*Oryctolagus cuniculus*).

Reptiles and frogs

A moderate number and diversity of reptiles were recorded at the site, including the Eastern Bluetongue (*Tiliqua scinoides*) and Garden Sunskink (*Lampropholis guichenoti*). Six Eastern Snake-necked Turtles (*Chelodina longicollis*) were observed in drainage lines in Area 1 during the December surveys.

A moderate diversity and abundance of native frogs were recorded within Area 1 during survey 1. Eastern Dwarf Treefrogs were calling in dams with *Typha orientalis* and Common Eastern Froglets (*Crinia signifera*), were calling from moist, low-lying grassland.

During survey 2, Eastern Dwarf Treefrogs (*Litoria fallax*), Peron's Treefrog (*Litoria peroni*) and Dusky Toadlets (*Uperolia fusca*) were calling from ephemeral wetlands. Striped Marsh Frogs (*Limnodynastes peronii*), Eastern Banjo Frogs (*Limnodynastes dumerilii*) and Spotted Marsh

Frogs (*Limnodynastes tasmaniensis*) were calling from drainage lines and or moist, low lying grassland in Area 1.

The URS (2007) targeted frog surveys identified nine native frog species in Areas 1 and 2, including Verreaux's Tree Frog (*Litoria verreauxii*) and Tyler's Tree Frog (*Litoria tyleri*) in addition to the species recorded during the GHD surveys. URS (2007) noted in excess of 100 individual frogs during each night of survey effort and all nine species were actively calling, indicating local breeding populations.

No threatened frog or reptile species have been recorded during the field surveys undertaken on the site.

Fish

The field surveys did not include any targeted aquatic surveys however a number of fish were observed opportunistically. The exotic pest species Plague Minnow / Mosquito Fish (*Gambusia holbrookii*) was abundant in all drainage lines across Area 1. A Long-finned Eel (*Anguilla reinhardtii*) was observed in moist grassland adjoining a large pool in the central portion of Area 1 and two other fish were identified to the morpho-species level (i.e. noted as distinct from Plague Minnow but not identified with certainty).

4.4 Fauna habitats

Habitat features and resources are described in terms of the native fauna they may support with specific reference to threatened species potentially present in the study area. Important habitat resources are mapped on Figure 7.

The habitat types identified on site are described below.

4.4.1 Forest

Coastal Narrabeen Moist Forest, Alluvial Tall Moist Forest and Spotted Gum Ironbark Forest at the site are likely to have equivalent habitat value for native fauna and so are described together.

Forest at the site is in moderate to good condition. It contains healthy, mature trees forming a canopy with a forest or open forest structure (Specht, 1980) equivalent to undisturbed examples of these vegetation communities (LHCCREMS, 2000). Areas 2 and 3 feature moderate recruitment of juveniles and seedlings, however regeneration was suppressed by grazing in Area 1. Based on these structural attributes forest at the site would be expected to support a diverse range of native birds, microbats and arboreal mammals. The value of forest habitat would be partially limited by fragmentation as discussed below.

There are large numbers of mature *Eucalyptus pilularis, E. robusta* and *Corymbia maculata* at the site which would provide foraging resources for native fauna, including native parrots and arboreal mammals. Forest at the site provides potential shelter and foraging resources for gliders, including the common Sugar Glider and Koalas which are known from the locality.

Small trees and shrubs are important for many bird species and arboreal mammals such as the Sugar Glider and Squirrel Glider. These vegetation layers provide shelter and foraging resources such as nectar, sap and fruits. Small trees and shrubs are sparse to absent within the majority of Area 1 due to grazing. Forest in the fenced, far southern portion of Area 1 and areas 2 and 3 are excluded from cattle grazing and feature well-developed and structurally diverse lower vegetation strata. Notably, *Allocasuarina torulosa* is present in the small tree stratum throughout Area 2 and Area 3 and the site provides foraging resources for local populations of the Glossy Black Cockatoo. The species is known to frequent preferred feed trees which are mature, healthy, in dense stands and bear good quantities of fruit (DECCW, 2010b).

There are good quantities of hollow-bearing trees in forest at the site. Large, habitat trees are plotted on Figure 7 and discussed in greater detail below.

A number of woodland birds have previously been recorded in the locality, including the Speckled Warbler (*Pyrroholaemus sagittatus*) and Grey-crowned Babbler (*Pomatostomus temporalis* subsp. *temporalis*). These species would likely have been recorded in drier, grassy woodlands in agricultural land to the west of the site and are very unlikely to occur in the moist forests present on the site.

There are number of threatened species known to frequent rainforest in the locality of the site, including the Golden-tipped Bat (*Kerivoula papuensis*), Superb Fruit-dove (*Ptilinopus superbus*) and Giant Barred Frog (*Mixophyes iteratus*). Forest within the site is structurally similar to rainforest and contains habitat resources such as fruiting climbers and mesic trees which could support mobile species such as the Golden-tipped Bat and Superb Fruit-dove. The site is isolated from intact rainforest by extensive areas of cleared and disturbed land and/or drier forest on upper slopes and so less-mobile rainforest species such as the Giant Barred Frog would not occur at the site.

4.4.2 Treed Wetlands

Treed wetlands within Areas 1 and 3 are in varying conditions, and include both natural features that qualify as the EEC Swamp Sclerophyll Forest (areas mapped as Swamp Mahogany-Paperbark Forest and Degraded Swamp Mahogany- Paperbark Forest) as well as artificial features that do not meet the criteria for inclusion as an EEC. Nonetheless, all of these vegetation types provide shelter and roost sites for wetland birds, including migratory species. Patches within the site are too small and fragmented to support large breeding aggregations of wetland birds but they may support solitary nesting species.

E. robusta is an autumn and winter-flowering species and may provide seasonal nectar resources for migratory species, including the Swift Parrot (*Lathamus discolor*), Regent Honeyeater (*Anthochaera phrygia*) and Painted Honeyeater (*Grantiella picta*).

Casuarina glauca is not a preferred feed tree for the Glossy Black-cockatoo (DECCW, 2010b). Local populations of the species were observed feeding in *Allocasuarina torulosa* in dry forest at the site and are likely to use these trees in preference to *C. glauca*.

4.4.3 Modified Environments

Derived native grasslands at the site would support open country bird species and a limited suite of native reptiles and mammals. This vegetation type provides minimal shelter opportunities and foraging resources due to the sparse and patchy cover of native trees, shrubs and herbs. Ongoing grazing by Cattle (*Bos taurus*) would limit the value of Area 1 for native mammals and granivorous birds. Dust, altered hydrology and increased nutrient loading associated with livestock grazing are also likely to reduce the value of these areas for native fauna.

Patches of planted native vegetation and exotic plants provide foraging resources for fauna. However there is virtually no natural shelter such as rock fragments, tree hollows or woody debris and very patchy vegetation cover. Where these vegetation types occur adjacent to native vegetation they may have a value as a buffer or as supplementary habitat for the native forest and wetland fauna described above. Smaller patches are only likely to support opportunistic species tolerant of fragmented landscapes. These may include native bird species such as the Australian Magpie and Australian Magpie-lark and exotic fauna such as the European Rabbit and Red Fox.

Previous cleared areas such as residential properties, roads and hardstand areas contain very limited resources for both native and exotic animals.

4.4.4 Aquatic and Wetland Habitat

The Gateway Site features areas of aquatic and wetland habitat, including drains, intermittent creeks and marshes and farm dams (refer Figure 6).

URS (2007) identified wetland habitats within Area 1 and assessed their value for threatened frogs. There is a small depression in the east of Area 1 which is shallow, intermittent, densely vegetated and filled by surface water runoff. This combination of habitat features makes this depression excellent habitat for native frogs and is consistent with the habitat requirements of the threatened Green-thighed Frog (Ehmann, 1997). Based on the absence of the species in the URS (2007) January and February 2007 targeted surveys and the relatively small area of nearby moist forest at the site the site is probably not likely to support a local population of this species. This wetland supports large numbers of breeding frogs of up to nine species following heavy rainfall (GHD January field survey; URS, 2007a, 2007b) and appears to be a valuable resource for local populations of native frogs.

There are two larger farm dams in Area 1. Each is approximately 50 metres in diameter with grassy-sloped earth banks and dense cover of *Typha orientalis*. They are very shallow due to the accumulation of plant roots and organic matter. This provides a deep, moist mat of substrate that provides excellent shelter and foraging habitat for native frogs and reptiles. These dams contain potentially suitable habitat for native frog species, including the TSC/EPBC Act listed Green and Golden Bell Frog which inhabits permanent water bodies which contain dense Bull-rush growth and are free of *Gambusia* (Ehmann, 1997). This species has experienced a massive decline within its former range due to a complex range of factors, including the influence of Plague Minnow (*Gambusia holbrookii*) and the Chytrid fungus (DECCW, 2010b; Ehman, 1997). The locations of remnant populations within the Sydney Basin are relatively well recognised. The Green and Golden Bell Frog has declined to a small number of recognised sites in recent years such that the habitat requirements outlined above can no longer be regarded as a reliable indicator of its presence (White, 1995). The URS (2007a) January targeted surveys did not detect the species and records in the locality are greater than ten years old. There were no Wildlife Atlas records of the species in the vicinity of the site (DECCW, 2010a), nor any recognised local populations in the area (DECCW, 2010b; Ehman, 1997). It is unlikely that the species occurs on the site.

Stands of *Typha orientalis* in wetlands at the site provide refuge and foraging habitat for wetland birds, including the Buff-banded Rail and White-faced Heron observed during field surveys. Wetlands at the site have good cover of aquatic and semi-aquatic vegetation but are surrounded by cleared land and busy roads. They may provide foraging habitat for shelter-dependant wetland birds such as Australian Painted Snipe (*Rostratula australis*) and Australasian Bittern (*Botaurus poiciloptilus*) though the surrounding disturbed areas, traffic and other human activities would limit their value for such species. Dams and ponds at the site are unlikely to support open water species such as the Blue-billed Duck (*Oxyura australis*) and Freckled Duck (*Stictonetta naevosa*) as they prefer large, permanent wetlands with dense fringing vegetation (DECCW, 2010b). These wetlands support large breeding populations of frogs and would also support native reptiles and invertebrates.

Dams and drainage lines at the site would provide foraging habitat for microbats including the four threatened species recorded at the site and potentially also the Southern Myotis (*Myotis macropus*) (see Section 5.3).

Drainage lines flow from the southwestern corner of Area 1, northwards and from the western boundary east. These channels join in the northern portion of Area 1 and flow eastwards to a

stormwater drain which drains to Tuggerah Lake. These drainage lines are small, channel confined streams. They are in poor condition; riparian vegetation has been completely removed and the banks and channel have been degraded by sedimentation, grazing and trampling by cattle. Instream and bank vegetation is dominated by exotic grasses and the noxious aquatic weed *Eichornia crassipes*. There is a moderate diversity of native wetland and aquatic plants though at low densities and low cover abundance. The combination of native and exotic plants provides suitable shelter and foraging opportunities for aquatic fauna. The field surveys did not include any targeted aquatic surveys however a number of fish were observed opportunistically. The exotic pest species Plague Minnow is most abundant, however a moderate diversity of native fish and invertebrates are also likely to occur.

The drainage line through the site would qualify as 'Class 3 - Minimal fish habitat' i.e. an unnamed waterway with intermittent flow and potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies); a minor waterway that interconnects with wetlands or recognised aquatic habitats (NSW Fisheries, 1999).

4.4.5 Other Habitat Resources

The OEH guidelines (DEC, 2004) identify "special habitats" (e.g. large, mature or hollow bearing trees, rocky outcrops and cliffs) that are likely to support specific fauna assemblages. These resources may be significant for threatened species (DECCW, 2010b). Notably, tree hollows are important for native fauna as diurnal or nocturnal shelter sites, for rearing young, for feeding, for thermoregulation, and to facilitate ranging behaviour and dispersal. An estimated 15% of all terrestrial vertebrate fauna in Australia are dependent upon tree hollows and for many of these species the relationship is obligate i.e. no other habitat resource represents an adequate substitute (Gibbons and Lindenmayer, 2002). Tree hollows are important resources for many species of threatened fauna and may be limiting at a site (DECCW, 2010) i.e. local populations of a threatened fauna species may be reliably excluded from occurring at a site on a permanent basis if these resources are not present. Accordingly, the field survey included a targeted survey of specific habitat resources in addition to the assessment of the communities described above.

The site contains 54 identified habitat trees, both within forest remnants and as mature paddock trees, including hollow-bearing trees and stags (refer Figure 7). There are 36 habitat trees within the proposed disturbance area. Ground-based field surveys may underestimate the quantity of important tree hollows present in a vegetation community. Conversely, many hollows visible from the ground may not have the required depth, orientation or other attributes required to constitute suitable shelter (Gibbons and Lindenmayer, 2002). Therefore the above assessment should be considered an estimate of the quality and quantity of tree hollows on site. Overall the study area is likely to contain sufficient quantities of these resources to support local populations of hollow-dependant fauna.

Hollow-bearing trees may provide suitable diurnal roost sites for tree-roosting microbats, including the threatened Eastern Freetail Bat and Yellow-bellied Sheathtail Bat and may provide diurnal shelter for cave-roosting species such as the Eastern Bentwing-bat and Little Bentwing-bat. They are also likely to provide roost and nest sites for native parrots, including the Red-rumped Parrot and Galah, observed nesting during the field surveys and potentially also threatened species such as the Glossy-black Cockatoo and Little Lorikeet.

The site contains reasonable amounts of standing and fallen dead timber, which would provide shelter and foraging resources for native invertebrates, reptiles and small terrestrial mammals.

The majority of the site is located on alluvial flats with no rock outcrops. There are some rock outcrops on upper slopes within Area 1, though no substantial cliff lines, fissures, caves or overhangs large or sheltered enough to provide suitable roost sites for microbats. These rock outcrops are also too gently sloping, too small and too disturbed by historical clearing and

grazing to provide habitat for the Brush-tailed Rock Wallaby (*Petrogale penicillata*). There are a number of threatened reptile and frog species predicted as occurring in the locality of the site (DEWHA, 2010a), including the Broad-headed Snake (*Hoplocephalus bungaroides*), Giant Burrowing Frog (*Heleioporus australiacus*), and Littlejohns Treefrog (*Litoria littlejohni*). Records of these species within the region are from Hawkesbury Sandstone substrates at higher elevations. These species depend on specific habitat resources from these environments that are not present on the subject site and hence would not occur at the site (DECCW, 2010b; Ehman, 1997).

Some cave-roosting microbats such as the Eastern Bentwing Bat may also utilise man-made habitats such as road culverts, storm-water tunnels and other man-made structures as roost sites (DECCW 2010b). There are some culverts at the site, however they are all small (under 1 m diameter), below the surrounding ground surface level and heavily vegetated with exotic grasses and wetland plants. Based on this combination of structural attributes these artificial structures are unlikely to be important to local populations of cave-roosting microbats.

4.5 Patch Size and Connectivity

Forest at the site occurs as relatively small patches (<10 ha) surrounded by extensive developed areas. Connectivity is good to the south, where Area 1 adjoins a large area of intact vegetation zoned for open space and environmental management and conservation. This habitat is partially connected to smaller remnants within Area 1 and through Area 2 into Area 3. Habitat to the west of the site is isolated by the F3 freeway and to the north is isolated by Wyong Road. Lands farther to the east and northeast are dominated by residential and commercial development and feature only fragmented patches of habitat. Areas 1, 2 and 3 collectively comprise the northeastern, terminal end of a regionally significant habitat corridor. These portions of the site would also have value as stepping stone patches of habitat for more mobile fauna such as bats and birds.

While small, isolated patches of vegetation within Area 2 will be removed, the long-term ecological connectivity of the Westfield Site and Gateway site will be enhanced with the rezoning of part of the RU6 Transition land along the southeastern boundary to E2 conservation. This will protect a vegetated corridor that will maintain existing connectivity with vegetation to the south and enhance connectivity with the E2 conservation zone and other retained vegetation within Area 3 (see Figure 2).

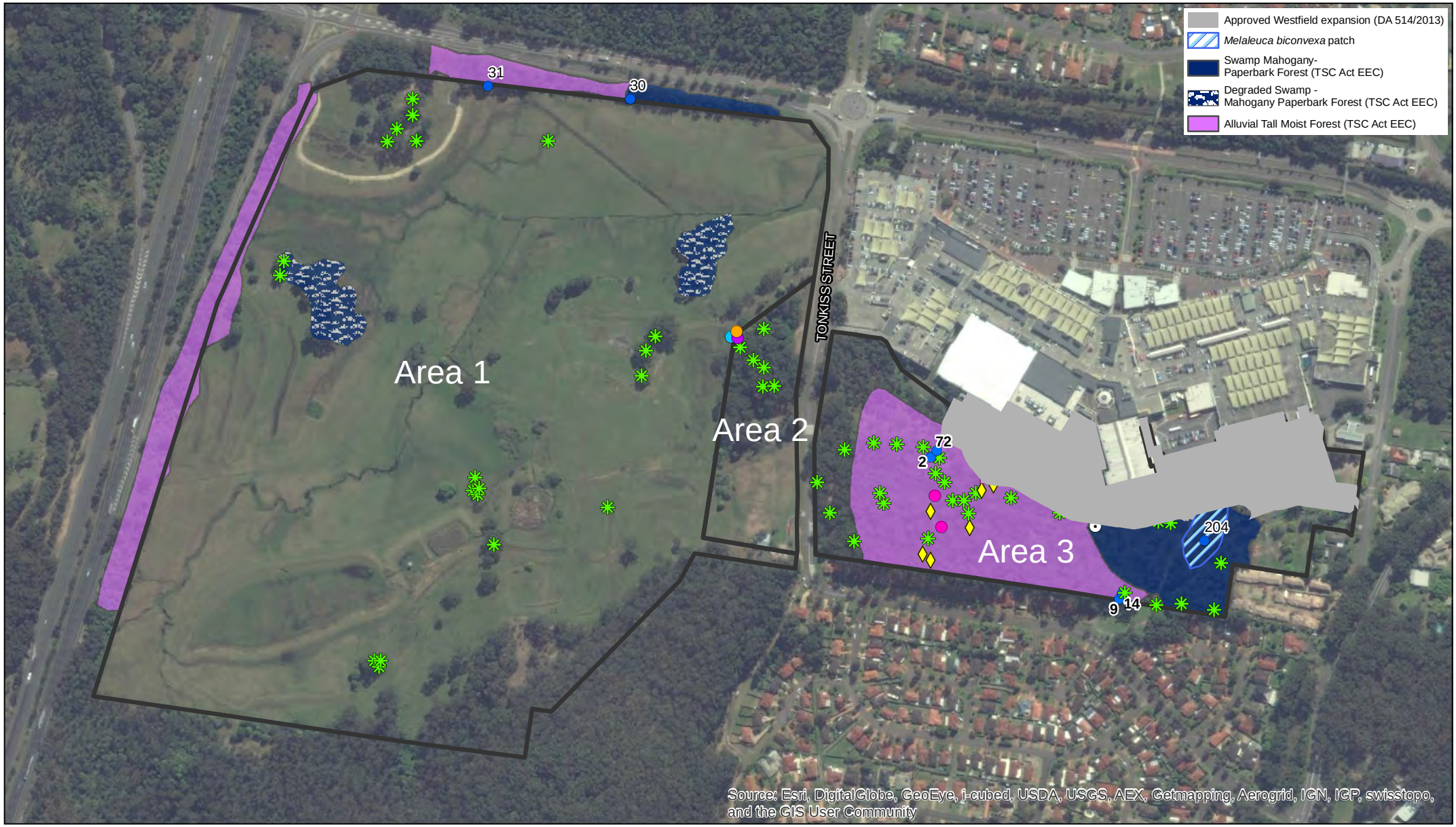
Edge effects are likely to reduce the value of habitat remnants at the site, allowing feral predators and introduced flora species to intrude into native vegetation. Developed areas, especially the F3 Freeway and Wyong Road, would constitute a barrier to the movement of many non-volant native fauna species. Further, the site is dominated by mobile and adaptable fauna species able to tolerate disturbance. These include species like the Noisy Miner, Rainbow Lorikeet, Grey Butcherbird and Common Ringtail Possum which were abundant during field surveys and are common and widespread in fragmented native vegetation of the Central Coast. These species are aggressive and competitive and may suppress the occurrence of other native fauna species. Notably a limited diversity of native forest and woodland birds were recorded at the site. Forest at the site may support more mobile and robust threatened species such as the Swift Parrot (*Lathamus discolor*), Little Lorikeet (*Glossopsitta pusilla*) and Powerful Owl (*Ninox strenua*) on an occasional basis, though there is no direct evidence of local populations.

Smaller, isolated remnants of vegetation on the site are unlikely to support local populations of species which require shelter to move across the landscape and to forage within their home ranges such as the Long-nosed Potoroo (*Potorous tridactylus tridactylus*) and Eastern Pygmy-possum (*Cercartetus nanus*).

4.6 SEPP 44

The site represents 'Potential Koala habitat' as defined under SEPP 44 as 'an area of native vegetation where the trees of the types listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component'. The site contains one Koala feed tree species listed on Schedule 2 of SEPP 44, namely Swamp Mahogany (*Eucalyptus robusta*). *E. robusta* comprises at least 75% of the canopy cover in areas of Swamp Mahogany Paperbark Forest and over 15% of the total number of trees in the upper or lower strata of the tree component within the forest areas as a whole.

Core Koala habitat, is defined under SEPP 44 as 'an area of land with a resident breeding population of Koalas, evidenced by attributes such as breeding females and recent sightings and historical records of a population'. Targeted surveys for Koalas and searches for signs of recent Koala activity were conducted in the GHD (2011, 2013) and URS (2007a;b) site surveys. No evidence of the species was detected. There are no OEH (2010a) records of Koalas at or in the immediate vicinity of the site, nor any other evidence that the site supports a local population of the Koala, including breeding females. Therefore the site does not constitute "core Koala habitat" as defined under the SEPP. The proposed E2 corridor will protect areas of potential habitat for the Koala on the site and maintain connectivity with this vegetation and more extensive stands of vegetation to the south.



Paper Size A4

0 25 50 100 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- The Site
- Fallen Logs
- Wombat Warren
- Glossy Black-cockatoo Feed Tree
- Glossy Black-cockatoo
- Habitat tree
- Eastern Freetail- bat
- Little Bentwing- bat
- Eastern Bentwing- bat
- Yellow- bellied Sheathtail bat
- *Melaleuca biconvexa* (no. of stems)
- *Melaleuca biconvexa* located in 2011 surveys, not identified in 2013 surveys

Westfield Ltd
Westfield Tuggerah and Gateway Site

Job Number 21-23343
Revision 1
Date 10 Mar 2014

Threatened biota and habitat trees Figure 7

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Data source: ESRI, Aeril, 2013; LPI: DBTB, 2012.. Created by: tmorton, fmackay

4.7 Threatening processes

A 'key threatening process' is defined under the TSC Act as 'a threatening process specified on Schedule 3' of the Act. A 'threatening process' is defined as 'a process that threatens, or may have the capability to threaten the survival or evolutionary development of species, populations or ecological communities'.

There is evidence of the following key threatening processes (KTPs) currently operating at the site:

- Predation by the European Red Fox; and
- Competition and grazing by the feral European Rabbit.

The following processes would have operated previously, given the modified landscapes and vegetation communities present at the site:

- Clearing of native vegetation;
- Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands;
- Invasion of native plant communities by exotic perennial grasses;
- Loss of hollow-bearing trees; and
- Removal of dead wood and dead trees.

Development within the site would contribute to the operation of the following KTPs:

- Clearing of native vegetation;
- Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands;
- Loss of hollow-bearing trees; and
- Removal of dead wood and dead trees.

The following KTPs may also be of potential relevance to the project:

- Invasion of native plant communities by exotic perennial grasses;
- Infection of native plants by *Phytophthora cinnamomi*;
- Introduction and establishment of Exotic Rust Fungi of the order *Pucciniales* pathogenic on plants of the family *Myrtaceae*; and
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis

Provided the soil and weed management measures outlined in Section 7 are followed, the project should not result in the operation of, or increase the impact of KTPs associated with invasive species or pathogens.

The likely extent and severity of the operation of the above KTPS as a result of the project is described in Section 6.6.

5. Conservation Significance

5.1 Threatened Flora Species

5.1.1 Melaleuca biconvexa

One threatened flora species was recorded at the site: the Biconvex Melaleuca (*Melaleuca biconvexa*), which is listed as a Vulnerable species under both the TSC and EPBC Acts. *M. biconvexa* occurs in localised dense stands in areas of suitable habitat, including as 'suckers' (adventitious stems arising from near-surface roots) from parent trees (pers. obs.). This habit makes it difficult to distinguish suckers from individual juvenile plants. Therefore estimated counts of *M. biconvexa* at the site refer to numbers of stems rather than numbers of individuals.

The distribution of *M. biconvexa* on the site is as follows:

- Area 1 contains approximately 37 stems of the species along the northern boundary. Stems within this area were visibly damaged by cattle and subject to ongoing grazing pressure. The population within Area 1 is a localised extension of a population of mature plants within the fenced road reserve north of the site. Potentially suitable habitat within these areas is of limited value for this species given existing grazing;
- Area 2 contains no *M. biconvexa*;
- Area 3 contains approximately 284 stems of *M. biconvexa*, including approximately 204 stems in a relatively dense stand (refer Figure 7). (Note: this stem total does not include stems that occur within the recently approved development footprint adjoining the rear of the existing shopping centre in Area 3). Individuals ranged from juveniles less than 50cm tall to mature trees 10-15m tall and 250mm D.B.H. The majority of stems counted in this area during the 2013 survey of the site were young suckers less than 1 metre tall.

The recent surveys of Area 3 (GHD, 2013) recorded a larger number of stems of *M. biconvexa* than previously recorded (GHD, 2011). This is to be expected, given the time that has passed since the original surveys and the emergence of young suckers. Conversely, a number of individual specimens recorded in the central-western portion of Area 3 during the GHD (2011) assessment were unable to be relocated during the recent surveys (Figure 5). These specimens were small and isolated and may have gone undetected or may no longer persist in the area.

The regional population of *M. biconvexa* consists of many thousands of individuals across a variety of land tenures and includes many OEH (2013a) Wildlife Atlas records within a 10 km radius of the site (refer Figure 8). Duncan (2001), in a detailed study of *M. biconvexa* in the Wyong Shire, identified five populations, including 'population 3' within the Tuggerah area. Population 3 comprised ten sub-populations, including a 'medium abundance/immature age stand' south of Wyong Road (Area 4 of previous Tuggerah Town Centre – GHD 2011) and a 'medium abundance/mature age stand' west of the F3 and north of Wyong Road (immediately north of Area 1 of this study). The smaller stands of *M. biconvexa* that occur in Area 1 or 3 of the current project area were not mapped by Duncan (2011).

The subpopulation on site is likely to be somewhat isolated from other identified subpopulations by the F3 motorway to the west, drier forest at higher elevations to the south, residential development to the east and Wyong Road to the north. There is the potential for some cross-pollination between local sub-populations, although the dominant mode of reproduction in the Wyong Area is through vegetative means (suckering) (Duncan 2001) and the patches of *M. biconvexa* on the site and within Area 4 have large numbers of stems present and genetic diversity is likely to be low.

The occurrences of *M. biconvexa* on the site or on lands to the east and north are not identified as priority conservation areas for the species in the Wyong area by Duncan (2001) Given the above considerations, the *M. biconvexa* on site is not considered an 'important' local sub-population.

5.1.2 Additional Threatened Flora Species

The desktop literature review indicates a further 27 threatened plant species that have been previously recorded, or are predicted to occur in the locality. The full list of threatened plant species predicted to occur or previously recorded in the locality, including their habitat requirements and conservation status is presented in Appendix B. The majority of these species are considered unlikely to occur on the site as they have limited ranges and/or habitat requirements, which are not present. None of these species was recorded within the study area despite suitable survey conditions during two of the three surveys (i.e. early Summer with 228.8mm rainfall (BOM, 2010) in preceding weeks).

A likelihood of occurrence assessment was undertaken to determine the likelihood that these threatened species occur within the site, based on the habitats present. Twenty one species were considered unlikely to occur, however there is potentially suitable habitat for five threatened plant species at the site (in addition to *M. biconvexa*, which was identified within the site). These are listed in Table 6.

Table 6 Threatened flora species recorded or that may occur on site

Species	TSC Act	EPBC Act
Biconvex Melaleuca (*Melaleuca biconvexa*)*	V	V
Eastern Underground Orchid (*Rhizanthella slateri*)	E	V
Leafless Tongue Orchid (*Cryptostylis hunteriana*)	V	V
Rough Double Tail (*Diuris praecox*)	V	V
Maundia triglochinoides	V	
Magenta Lily Pily (*Szygium paniculatum*)	E	V

* Recorded on site; V = vulnerable species; E = endangered species

Potentially suitable habitat for these species is present in native forest at the site. These threatened plants may exist in the soil seed bank or as dormant individuals and so there is the potential for impacts on these species through the removal of habitat within the proposed development footprint. They are very unlikely to occur in disturbed land at the site due to historic removal and modification of the soil seed bank and ongoing grazing and competition from exotic species.

5.2 Endangered Ecological Communities

The desktop literature review indicates 16 EECs listed under the TSC Act and/ or EPBC Act that are known or predicted to occur in the Wyong CMA Sub-Region (Appendix B). Three of these EECs were recorded on site (as shown on Figure 7):

- Swamp sclerophyll forest; and
- River-flat Eucalypt forest.

5.3 Threatened Terrestrial Fauna Species

5.3.1 Threatened fauna Species Recorded

One threatened bird species was recorded: the Glossy Black Cockatoo (*Calyptorhynchus lathami*). Two individuals, probably a mated pair, were noted briefly resting in a large habitat tree in Area 1, and a pair and juvenile were recorded feeding extensively for at least 9 hours in two large Forest She-oak (*Allocasuarina torulosa*) in Area 3. A number of feed trees were identified from chewed cones. Observations and feed trees are shown on Figure 7. No direct evidence of roosting or nesting behaviour was observed. Drier woodland and forest vegetation at the site would comprise more suitable foraging or resting habitat for local populations of the species.

Four species of threatened microbat were identified through Anabat surveys based on Probable or Confident Anabat ultrasonic call recordings. The Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*), Eastern Bentwing-bat (*Miniopterus orianae oceanensis*) and Little Bentwing-bat (*Miniopterus australis*) were confidently identified as a result of call analysis. The Eastern Freetail Bat (*Micronomus norfolcensis* syn. *Mormopterus norfolcensis*) was also probably identified through call analysis, but definite identification was not possible due to the quality of the call recording. A further three threatened microbat species were recorded as possibly occurring: the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Southern Myotis (*Myotis macropus*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*). The poor quality of the calls and the probability of confusion with other species meant that these species could not be confidently identified.

5.3.2 Threatened fauna species that may potentially occur

The desktop review indicates the potential presence of a further 63 threatened fauna species listed under the TSC Act, as Wildlife Atlas records in the locality (refer Figure 9), and/or under the EPBC Act and predicted to occur in the local area. The full list of threatened fauna, including their conservation status, habitat requirements, previous records and likelihood of occurrence is presented in Appendix B. The locality encompasses estuarine and marine environments and so the search yielded a number of threatened marine species such as whales, sea turtles and sea birds. There are no habitat resources for these species within the study area and the development would not result in indirect effects on marine habitats and so these species were excluded from this assessment. A review of the specific habitat requirements of terrestrial and freshwater species, and the habitat present within the study area, allowed a number of these species to be eliminated as having a low likelihood of occurrence at the site.

A total of 38 threatened fauna species were considered to have a medium likelihood of occurrence at the site based on the presence of potentially suitable habitat. This includes three threatened microbat species that were tentatively recorded at the site based on 'possible' Anabat call identification: Eastern False Pipistrelle, Southern Myotis and Greater Broad-nosed Bat. There is no evidence, such as recent records in the immediate vicinity of the site or specific habitat resources that suggests the site supports permanent local populations of any of these 38 fauna species and given the landscape context and that much of the vegetation occurs as isolated remnants in close proximity to developed areas the majority are not likely to occur other than on an opportunistic basis. The majority of these species would be most likely to occur in more intact vegetation to be retained within the proposed E2 corridor which is contiguous with more extensive stands of native vegetation to the south of the site.

Threatened fauna species recorded on site or that may utilise habitat at the site on an occasional basis are presented in Table 7 below.

Table 7 Threatened fauna species recorded on site or that may possibly occur

Common Name (Species Name)	TSC Act Status	EPBC Act Status
Australasian Bittern (*Botaurus poiciloptilus*)	V	
Barking Owl (*Ninox connivens*)	V	
Black Bittern (*Ixobrychus flavicollis*)	V	
Black-necked Stork (*Ephippiorhynchus asiaticus*)	E	
Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)	E	
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	V	
Eastern Freetail-bat (*Mormopterus norfolkensis*)	V	
Eastern Pygmy Possum (*Cercartetus nanus*)	V	
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	V	
Giant Dragonfly (*Petalura australis*)	E	
Glossy Black-cockatoo (*Calyptorhynchus lathami*)	V	E (SA population only)
Golden-tipped Bat (*Kerivoula papuensis*)	V	
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V	
Grey-headed Flying-fox (*Pteropus poliocephalus*	V	V
Koala (*Phascolarctos cinereus*)	V	V
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	V
Little Bentwing-bat (*Miniopterus australis*)	V	
Little Lorikeet (*Glossopsitta pusilla*)	V	
Masked Owl (*Tyto novaehollandiae*)	V	
Osprey (*Pandion haliaetus*)	V	
Painted Honeyeater (*Grantiella picta*)	V	
Pale-headed Snake (*Hoplocephalus bitorquatus*)	V	
Powerful Owl (*Ninox strenua*)	V	
Regent Honeyeater (*Anthochaera phrygia*)	CE	E. M
Rosenberg's Goanna (*Varanus rosenbergi*)	V	
Sooty Owl (*Tyto tenebricosa*)	V	
Southern Brown Bandicoot (*Isoodon obesulus obesulus*)	E	E
Southern Myotis (*Myotis macropus*)	V	
Spotted-tailed Quoll (*Dasyurus maculatus*)	V	V
Square-tailed Kite (*Lophoictinia isura*)	V	
Squirrel Glider (*Petaurus norfolcensis*)	V	
Stephen's Banded Snake (*Hoplocephalus stephensi*)	V	
Superb Fruit-dove (*Ptilinopus superbus*)	V	
Swift Parrot (*Lathamus discolor*)	E	E
Varied Sittella (*Daphoenositta chrysoptera*)	V	
Wompoo Fruit-dove (*Ptilinopus magnificus*)	V	
Yellow-Bellied Glider (*Petaurus australis*)	V	
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	V	

V = vulnerable species; E = endangered species; threatened = listed marine species under the EPBC Act.

5.4 Threatened Aquatic Fauna Species

The desktop review did not reveal any threatened freshwater fish species known or predicted to occur in the locality of the site (DEWHA, 2010a). Based on a general review of the distribution and habitat requirements of threatened fish of NSW it is very unlikely that any threatened fish

species could potentially occur at the site. Therefore aquatic habitats at the site have moderate habitat value for native aquatic biota but have low overall conservation value since they are only likely to support non-threatened species.

5.5 Matters of National Environmental Significance

5.5.1 Approach

A number of EPBC Act listed threatened and migratory species have previously been recorded or are predicted to occur in the locality (Appendix C). The NSW Wildlife Atlas (DECC, 2010a) also revealed records of EPBC Act listed threatened species previously recorded in the locality (refer Figure 8 and Figure 9). EPBC Act listed biota known from the study area are presented in Appendix B along with an assessment of their habitat requirements, likelihood of occurrence in the study area and potential for impacts arising from the project. A number of the EPBC Act listed biota may potentially occur at the site and be affected by the project. Potentially affected threatened and migratory biota are identified in Table 7 and discussed below.

There are no EPBC Act Threatened Ecological Communities known or predicted to occur in the region and no Ramsar Sites or World Heritage Sites within the same catchments as the study area.

5.5.2 Threatened Flora Species

One vulnerable plant species, the Biconvex Paperbark (*Melaleuca biconvexa*), listed under the EPBC Act was recorded at the site. This species is also listed under the TSC Act and is discussed in Section 5.1.

There is potentially suitable habitat for four other EPBC Act listed plant species which were not recorded on site: Magenta Lily Pily (*Szygium paniculatum*); Leafless Tongue Orchid (*Cryptostylis hunteriana*); Eastern Underground Orchid (*Rhizanthella slateri*) and Rough Double Tail (*Diuris praecox*). There is potential for removal of habitat for these plant species within surface disturbance areas, however, the most suitable potential habitat would occur within the less disturbed and fragmented vegetation within the proposed E2 corridor. These four species are also listed under the TSC Act and are discussed above in Section 5.1.

No other species of EPBC Act listed flora are likely to occur at the site or be affected by the project (Appendix B).

5.5.3 Threatened Fauna Species

No EPBC Act listed fauna species were recorded during site surveys and there is no evidence such as recent records or important habitat resources to suggest that permanent local populations occur at the site. Based on desktop and habitat assessments seven EPBC Act-listed fauna species are likely to, or may occur at the site on an occasional or opportunistic basis: the Koala (*Phascolarctos cinereus*), Swift Parrot (*Lathamus discolor*); Regent Honeyeater (*Anthochaera phrygia*); Southern Brown Bandicoot (*Isoodon obesulus obesulus*), Large-eared Pied Bat (*Chalinolobus dwyeri*); Spotted-tailed Quoll (*Dasyurus maculatus*); and Grey-headed Flying-fox (*Pteropus poliocephalus*). There is potential for removal of foraging habitat for some of these species, including the Grey-headed Flying Fox, Swift Parrot and Regent Honeyeater and possibly the Koala within surface disturbance areas. Higher quality habitat on site occurs within the less disturbed and fragmented vegetation within the proposed E2 corridor.

5.5.4 Migratory Species

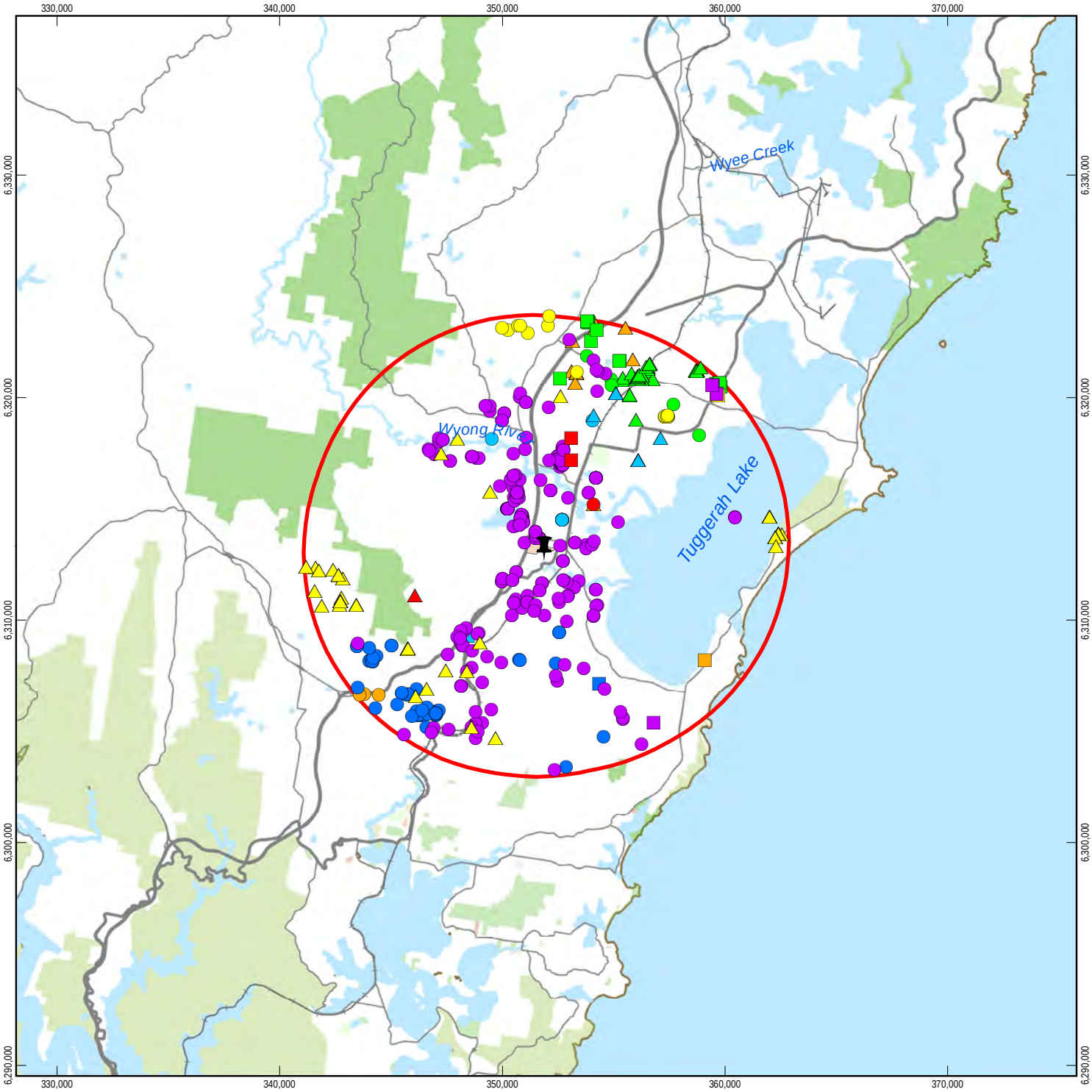
The site provides potential habitat for migratory bird species protected under the provisions of International treaties and/or the EPBC Act. These include the Wood Duck, White-faced Heron

and Masked Lapwing, which were observed during field surveys. Native vegetation and wetlands at the site are likely to be used by a range of migratory species on a periodic basis. This would potentially include use of foraging resources by threatened migratory species, including the Regent Honeyeater.

The proposed development would remove small areas of potential habitat for these migratory species within construction footprints.

5.5.5 Threatened Aquatic Species

No threatened freshwater fish were predicted to occur at the site by the PMST (2010b). A general review of the distribution and specific habitat requirements of EPBC Act listed freshwater species known from NSW and the findings of the aquatic habitat assessment led to the conclusion that none of the species are likely to occur at the site.



LEGEND

Site location

Threatened flora

- *Angophora inopina*
- *Caladenia tessellata*
- *Callistemon linearifolius*
- *Diuris praecox*
- *Epacris purpurascens var. purpurascens*
- *Eucalyptus camfieldii*
- *Eucalyptus oblonga*
- *Eucalyptus parramattensis subsp. parramattens*
- *Eucalyptus pumila*
- *Grevillea parviflora subsp. parviflora*
- *Hibbertia procumbens*
- *Maundia triglochinoides*
- *Melaleuca biconvexa*
- *Prostanthera askania*
- *Rutidosis heterogama*
- *Senna acclinis*
- *Syzygium paniculatum*
- *Tetratheca juncea*
- *Thelymitra* sp. *adorata*
- 10km radius of site

1:250,000(at A4)

0 2.5 5 10

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

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Job Number 21-23343
Revision A
Date 24 Mar 2014

Threatened flora recorded in the locality (OEH Wildlife Atlas 2010)

Figure 8

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

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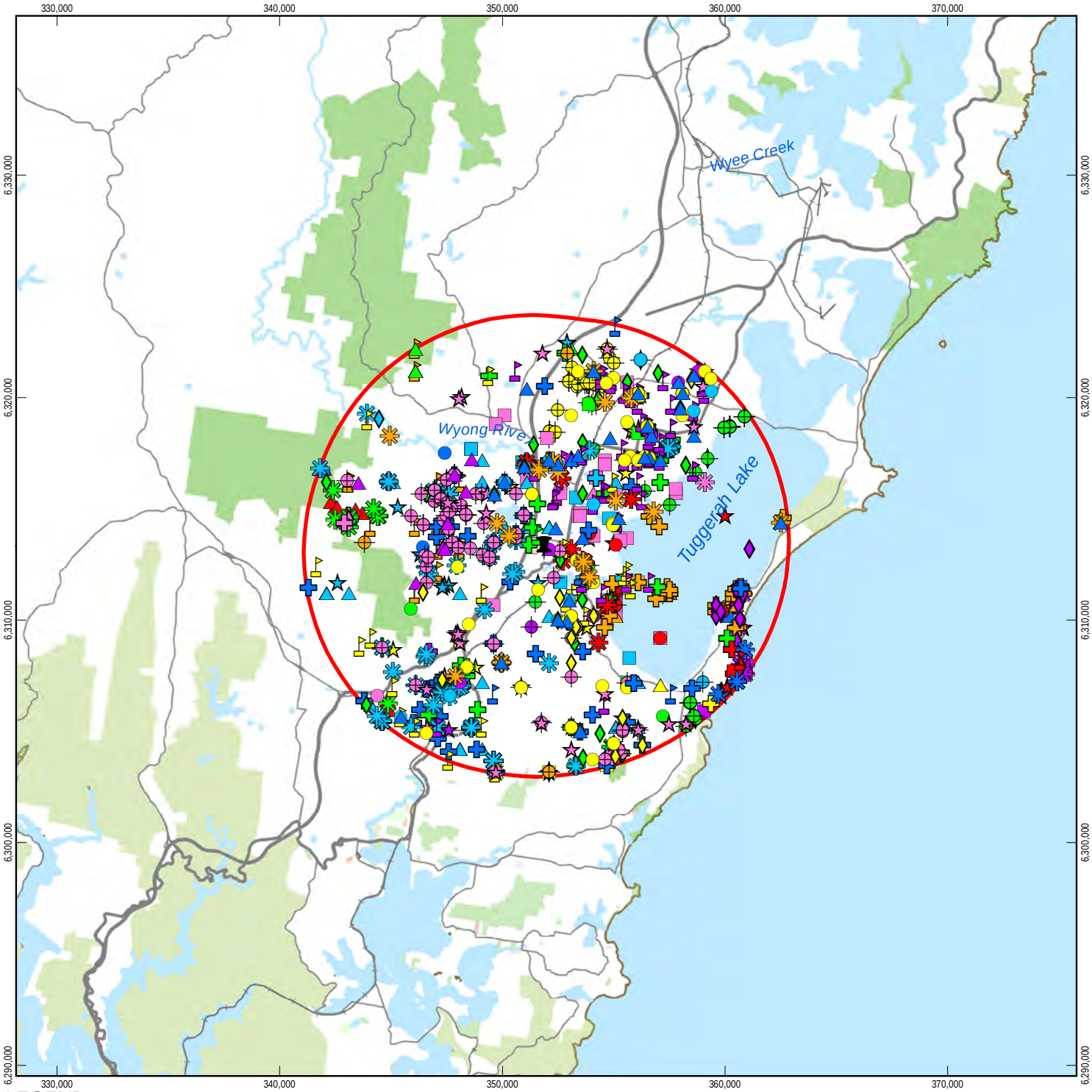
Data source: Wildlife Atlas, DECC. Created by: Cwilson, cwilson, bahambly



LEGEND

Site location

Threatened fauna

- Australasian Bittern
- Australian Fur-seal
- Barking Owl
- Black Bittern
- Black-browed Albatross
- Black-necked Stork
- Black-tailed Godwit
- Broad-billed Sandpiper
- Bush Stone-curlew
- Comb-crested Jacana
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Eastern Pygmy-possum
- Flesh-footed Shearwater
- Gang-gang Cockatoo
- Giant Barred Frog
- Giant Burrowing Frog
- Giant Dragonfly
- Glossy Black-Cockatoo
- Golden-tipped Bat
- Gould's Petrel
- Great Knot
- Greater Broad-nosed Bat
- Greater Sand-plover
- Green Turtle
- Green and Golden Bell Frog
- Green-thighed Frog
- Grey-crowned Babbler (eastern subspecies)
- Grey-headed Flying-fox
- Humpback Whale
- Kermadec Petrel (west Pacific subspecies)
- Koala
- Lesser Sand-plover
- Little Bentwing-bat
- Little Lorikeet
- Little Tern
- Littlejohn's Tree Frog
- Loggerhead Turtle
- Long-nosed Potoroo
- Masked Owl
- New Zealand Fur-seal
- Osprey
- Painted Honeyeater
- Pale-headed Snake
- Parma Wallaby
- Pied Oystercatcher
- Powerful Owl
- Red-crowned Toadlet
- Regent Honeyeater
- Rosenberg's Goanna
- Sooty Owl
- Sooty Oystercatcher
- Southern Brown Bandicoot (eastern)
- Southern Myotis
- Southern Right Whale
- Speckled Warbler
- Sperm Whale
- Spotted-tailed Quoll
- Square-tailed Kite
- Squirrel Glider
- Stephens' Banded Snake
- Stuttering Frog
- Superb Fruit-Dove
- Swift Parrot
- Terek Sandpiper
- Wallum Froglet
- Wandering Albatross
- Wompoo Fruit-Dove
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat
- 10km radius of site

1:250,000(at A4)

0 2.5 5 10

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

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Westfield Tuggerah and Gateway Site

Job Number	21-23343
Revision	A
Date	24 Mar 2014

Threatened fauna recorded in the locality (OEH Wildlife Atlas 2010)

Figure 9

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Data source: Wildlife Atlas, DECC. Created by: Cwilson, cwilson, bahambly

6. Preliminary Impact Assessment

6.1 Overview

This section presents a preliminary assessment of impacts associated with the Westfield Tuggerah and Gateway Site proposal as indicated on Figure 2 and discussed in Section 1.3. It provides a summary of likely impacts associated with the proposed rezoning and future development for the Gateway Site (Areas 1 and 2) as well as those associated with an indicative development footprint that may potentially be required to assist in the future operation of the Westfield Tuggerah Shopping Centre within Area 3 (see Figure 10). The indicative development footprint in Area 3 is located within land previously zoned 3A Business General that is proposed to be rezoned as B3 Commercial Core.

The impacts on native vegetation associated with future development of the Gateway Site (Areas 1 and 2) in accordance with the rezoning proposal represent a worst case scenario having been calculated based on the removal of all vegetation within the RU6 Transition and B4 Mixed Use zones for future development. The area of native vegetation to be cleared is likely to be less in reality given the retention of vegetation within proposed open space and buffer areas for drainage and flooding works within the Gateway site as discussed below. A formal assessment of ecological impacts based on final footprints for subsequent developments on the site in accordance with Section 5A of the EPA Act would be undertaken at the respective Development Application stages.

6.2 Vegetation Clearing and Construction Impacts

6.2.1 Flora and Ecological Communities

The area of vegetation likely to be cleared within proposed indicative development areas is shown on Figure 10.

Clearing of native vegetation would be required for:

- Development of lands within proposed B4 and RU6 transition zones within the Gateway site; and
- Potential future development of a portion of the proposed B3 zoned land within Area 3 (if required for future operation of the shopping centre).

The development area as presented on Figure 10 would have a combined surface disturbance area of approximately 40.4ha. The majority of this area (approximately 34.96 ha) is derived grassland within the Gateway Site or disturbed, cleared land (approximately 0.11 ha), which contains little native vegetation cover and has limited habitat value for native plants. Vegetation clearing in these areas would remove pasture grasses, a small number of individuals of non-threatened native plants and noxious and environmental weeds.

The proposal would require the clearing of approximately 5.33 ha of native vegetation as a result of direct surface disturbance during the construction. This disturbance footprint includes approximately 1.23 ha of Swamp Sclerophyll Forest EEC (of which 0.86 ha is a degraded form of the community) and 0.89 ha of River Flat Eucalypt Forest EEC. Vegetation clearing in these communities will involve removal of a moderately diverse range of non-threatened native plants, including mature trees. The vegetation to be removed for the most part comprises small, isolated remnant stands or the disturbed edges of remnant stands (refer Figure 8).

The proposal would remove approximately 17 stems of the threatened plant *Melaleuca biconvexa*. Approximately 321 stems would remain on the site, including approximately 210 stems within the proposed E2 zoned corridor in Area 3, a further 74 stems in commercial zoned land outside of the indicative development footprint for possible future operational requirements of the shopping centre and approximately 37 stems in a proposed vegetation buffer along the northern boundary of Area 1. There is also an estimated 50-100 stems in the road reserve north of Area 1 some of which occur in close proximity to the northern site boundary.

As noted above, this represents a worst case scenario having been calculated based on the removal of all vegetation within Areas 1 and 2 outside of the E2 conservation corridor for future development. Areas of native vegetation within the Gateway Site are likely to be retained and rehabilitated within future open space and landscaped areas. The proposed detention basin in the north-eastern area of the Gateway Site and riparian buffer areas will include the reinstatement of native riparian and wetland vegetation and aquatic habitat features. Mature trees will also be retained and protected through the construction process and integrated within the revegetated landscape where possible.

Appropriate mitigation measures would be applied to minimise the potential for adverse impacts on native biota in retained habitats on site and on adjoining lands. These measures and proposed vegetation retention and protection to offset unavoidable residual impacts are discussed in Section 7.

6.2.2 Fauna

The development would require the clearing of habitat for native fauna, including native vegetation and habitat resources for native biota as shown on Figure 7. The proposed clearing of this habitat is likely to have impacts on local fauna populations that use the site, including displacement or mortality of individuals and removal of habitat resources within disturbance footprints. The magnitude of these 'likely' impacts is assessed below.

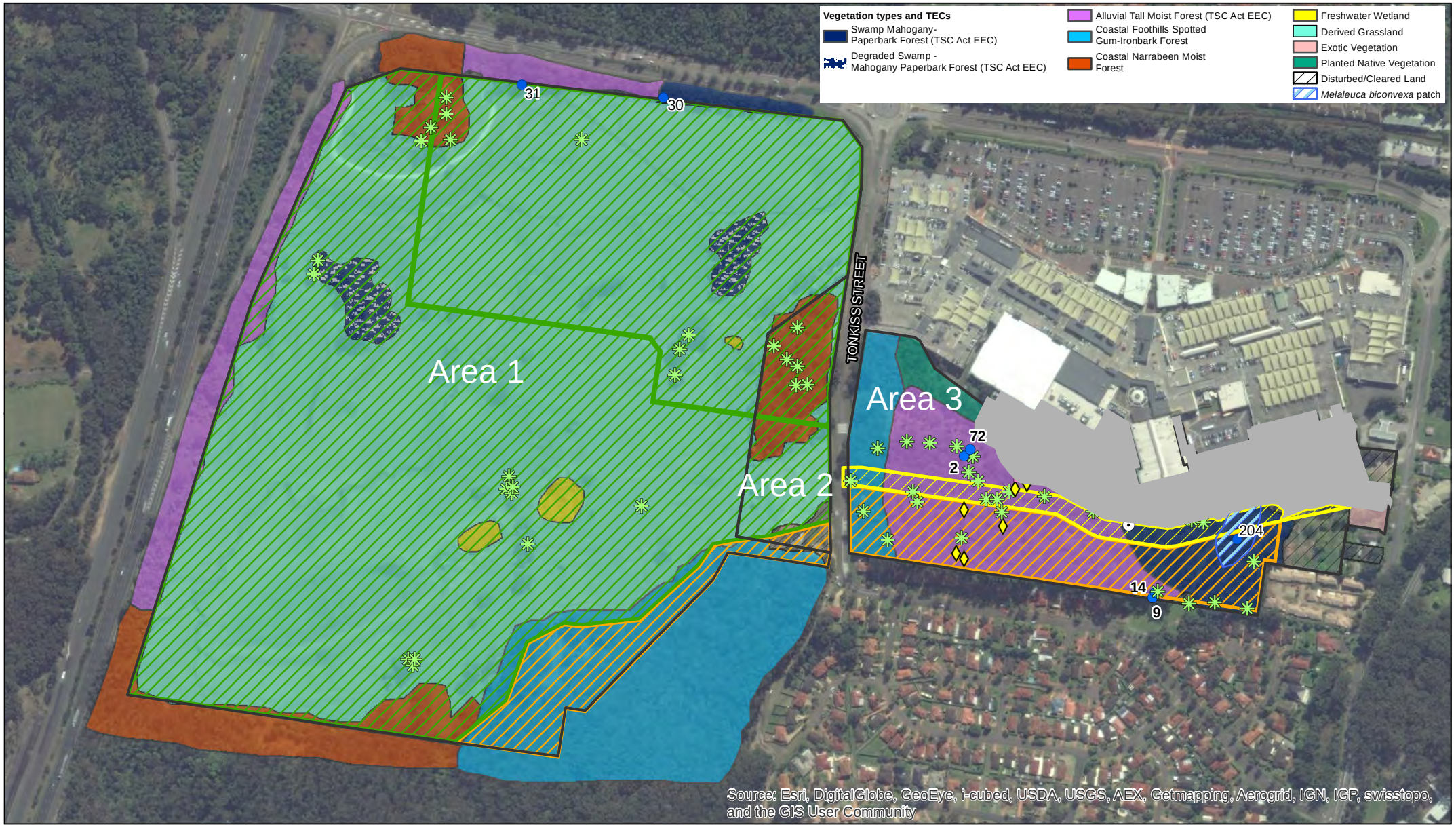
The majority of the disturbance footprint for the project falls within disturbed or cleared land. These areas have been extensively modified by previous development and/or agricultural activities and would have limited value for native fauna. The development would require the clearing of up to approximately 5.33 ha of native vegetation as a result of direct surface disturbance during future construction activities. Native vegetation would have greater habitat value for native fauna and there is an increased risk of injury or mortality of native fauna which may be sheltering in this habitat during the construction period. Fauna are less likely to be resident in the smaller patches of disturbed, isolated vegetation within the Gateway site. There is considerable scope for native fauna that may use native vegetation in areas to be disturbed to evade injury and/or seek alternative habitat in adjoining retained native vegetation, including extensive areas of intact vegetation to the south of the site.

A considerable abundance and diversity of native bird species use the site and will be affected by the removal of native vegetation, wetland habitats and other habitat resources. The majority of these species are mobile, widespread and common. Further, there are large quantities of equivalent habitat and resources in the locality. Overall it is likely that the impact on local populations of native birds will be minor.

Only large terrestrial mammals are likely to occur in the majority of the development footprint (including the derived grassland areas). Larger mammals would readily evade injury in these areas since construction would occur during daylight hours and there would be opportunity to escape into alternative habitats to the south of the site. There is the potential for adverse effects on smaller or less mobile terrestrial mammals sheltering within native vegetation or beneath woody debris to be removed as a result of direct surface disturbance during the construction.

Table 8 Areas of vegetation on site within indicative development areas as shown on Figure 10.

Vegetation Type	Status	Total area of vegetation on Site (ha)	Vegetation within proposed development areas (ha)		
			Tuggerah Gateway Site (Areas 1 & 2)	Westfield Tuggerah Indicative Future Development Area (Area 3)	Total vegetation to be removed
Alluvial Tall Moist Forest	River Flat Eucalypt Forest EEC	3.78	0.36	0.53	0.89
Swamp Mahogany-Paperbark Forest	Swamp Sclerophyll Forest EEC	1.34	0.04	0.33	0.37
Degraded Swamp - Mahogany Paperbark Forest	Swamp Sclerophyll Forest EEC	0.86	0.86	0	0.86
Coastal Foothills Spotted Gum-Ironbark Forest	Native Vegetation	3.38	0.51	0.08	0.59
Coastal Narrabeen Moist Forest	Native Vegetation	2.31	2.31	0	2.31
Freshwater Wetland	Native Vegetation	0.31	0.31	0	0.31
Derived Grassland	Exotic Vegetation	34.96	34.96	0	34.96
Planted Native Vegetation	Planted vegetation	0.33	0	0	0
Exotic vegetation	Exotic vegetation	0.03	0	0	0
Disturbed/Cleared Land	Exotic Vegetation	0.81	0.07	0.04	0.11
Total native vegetation		**11.5**	**4.39**	**0.94**	**5.33**
Total all types		**48.11**	**39.42**	**0.98**	**40.40**



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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- Site Boundary
- Approved development (DA 514/2013)
- Indicative future development footprint in B3 commercial land
- Development areas in proposed B4 and RU6 zoned lands
- Proposed E2 environmental conservation corridor

Threatened biota and habitat

- Fallen Logs
- Habitat Tree
- Wombat Warren
- Glossy Black-cockatoo Feed Tree *
- *Melaleuca biconvexa* (no. of stems)

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Westfield Tuggerah and Gateway Site

Job Number 22-23343
Revision 1
Date 13 Jun 2014

Development and conservation areas

Figure 10

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Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Data source: ESRI, Aeril, 2013; LPI: DBTB, 2012.. Created by: tmorton, fmackay

Arboreal mammals occur in areas of forest at the site. A number of microbats were also recorded at the site and would forage across the entire site and potentially roost within forest habitats. The project will remove foraging habitat for these species as well as potential roost sites in the 36 habitat trees that occur within the likely disturbance footprint. There is the potential for impacts on individuals that may be sheltering in tree hollows on site during clearing activities for future development. Mitigation measures outlined in Section 7.3 would partially ameliorate impacts on these species. The removal of hollow-bearing trees is more serious because of the time it takes for these resources to develop in regenerating vegetation. However given the extensive areas of alternative habitat surrounding the site, this development would affect a minor proportion of available habitat resources for hollow-dependant fauna in the locality. Further, many of hollow-bearing trees to be removed are within isolated paddock trees in areas of derived grassland. These hollows would have less value than equivalent trees within intact woodland or forest and are considerably less likely to support threatened species.

A moderate diversity and abundance of native frogs and reptiles occur on the site. Species recorded during field surveys are widespread and common (Cogger, 1996) (see Appendix B). It is likely that individuals will be adversely affected during clearing, particularly species sheltering amongst semi-aquatic vegetation or those which burrow or shelter beneath woody debris. Mitigation measures outlined in Section 8 would partially ameliorate these impacts. The proposed detention basin on the Gateway site will include the reinstatement of native riparian and wetland vegetation and aquatic habitat features and these areas are likely to be occupied by local populations of native frogs after the initial construction period. Populations of frogs are likely to be relatively resilient to short term construction impacts due to their ability to disperse and seek shelter during dry or cool periods and to congregate around suitable breeding habitat when conditions are suitable. The frog species recorded at the site are widespread and common species that are able to persist in fragmented and disturbed environments. Local populations of these species are likely to successfully recolonise areas of suitable habitat on site after the construction period.

There is likely to be impacts on fauna utilising immediately adjacent areas of habitat during construction associated with noise and other disturbances. There are already disruptive human activities in the vicinity of the site, notably heavy traffic on the F3 and Wyong Road. Resident fauna are likely to be adapted to these disturbances. There may be impacts upon smaller, less mobile fauna in the immediate vicinity of construction footprints.

6.2.3 Habitats

The project will have a direct negative effect on habitat for native flora and fauna through vegetation clearing as described above. The clearing of vegetation would remove associated habitat resources such as foraging substrate, foraging resources (fruits, nectar, seed etc), hollow-bearing trees, and woody debris. This clearing will have additional negative effects on the quality of adjoining retained habitats through edge effects and fragmentation and the possible disruption of some fauna movements.

The project will remove up to 36 habitat trees within the disturbance footprint. This is a worse case estimate given the potential for some of the habitat trees recorded on site to be incorporated into future riparian buffer lands and open space within Area 1 of the Gateway Site. Given the extensive areas of alternative habitat surrounding the site, this development would affect a minor proportion of available habitat resources for hollow-dependant fauna in the locality. Many of the hollow-bearing trees to be removed are within areas of derived grassland. These hollows would have less value than those that occur within intact woodland or forest and are considerably less likely to support threatened species.

The proposed development on the Gateway Site would directly disturb water bodies, including a drainage line and adjoining intermittent marshes and freshwater wetlands associated with farm dams. Habitat would be removed within the construction footprint and the form and flow characteristics of the drainage line through the site would be modified. Impacts would be associated with the loss of wetland foraging substrates and shelter, drinking water and aerial foraging habitat for species which feed on amphibious insects. Mobile fauna populations would potentially experience increased energy costs of foraging for the duration of the construction period since they will have to travel to utilise alternative surface water resources. There are alternative surface water resources in the locality, including floodplain marshes and drainage lines to the north and east and farm dams in agricultural land to the west. Temporary surface water features, such as coffer dams and sediment basins, may provide alternative drinking water resources during the proposed construction.

The proposed detention basin in the Gateway Site will include the reinstatement of native riparian and wetland vegetation and aquatic habitat features. This area is likely to provide habitat for a range of invertebrates, frogs, reptiles and wetland birds.

The project is unlikely to contribute to existing fauna movement barriers in the locality in any significant way. The project will remove approximately 5.33 ha of native vegetation much of which comprises already isolated stands or the disturbed edges of larger stands. Fauna movement to the east, west and north is already limited by existing development and within the site by existing cleared land and roads.

The developed site would constitute a partial barrier to movements of migratory or nomadic fauna species such as native birds and bats by increasing the area of non-viable habitat that they need to traverse. Migratory species often rely on ‘stepping stones’ of suitable foraging and roosting habitat during migrations. By removing 5.33 ha of habitat the proposed construction would increase the distance between suitable patches. In a regional context this would probably comprise a minor effect on these more mobile species. Aerial habitat would not be affected and so migratory species are likely to traverse obstacles and gaps in habitat created by permanent project infrastructure. The project does not involve any structures that would pose a significant obstruction or hazard to birds or bats in the context of existing land uses in the locality.

There is the potential for a small area of native and planted vegetation in the north-western corner of Area 3 to be isolated from the proposed E2 conservation zone if additional clearing for future operational requirements for the Shopping Centre is required. This is unlikely to have any significant impact on local fauna movements, given the vegetation in question is bound to the north by the existing Shopping Centre and is effectively a ‘dead end’. More mobile fauna, including threatened species known to occur on the site on occasion such as the Glossy Black Cockatoo and microchiropteran bats would still be able to access this habitat.

The proposed E2 zone in the southeast of Area 1 has been located to enhance current connectivity through the site by linking the proposed E2 zone in Area 3 with more extensive tracts of intact vegetation to the south of the Gateway site (refer Figure 2). The proposed drainage line rehabilitation on the Gateway site also has the potential to improve habitat connectivity by reinstating riparian vegetation and aquatic habitats and providing a potential habitat ‘stepping stone’ that may facilitate the movement of more mobile fauna such as birds and bats through the post-development landscape.

Existing disturbance on site has resulted in clearly visible edge effects in native vegetation on the site such as infestation with exotic species around the margins of woodland patches. The development would create new edges along areas of retained vegetation, which would be exposed to additional edge effects. Increasing edge effects can compromise bushland habitats by encouraging weed growth, changing light and microclimatic conditions as well as potentially increasing nutrient levels. Some fauna, such as bats and predatory birds, may use the newly

created open areas for foraging which would result in increased predation within open areas and along edges by both native and introduced predatory fauna. Measures recommended in Section 7.3.1 should be implemented to minimise the potential for edge effects in retained habitats.

6.3 Indirect and Operational Impacts

6.3.1 Degradation of Surface Waters

Potential sources of impacts to surface water within the study area include:

- Runoff from areas stripped of vegetation;
- Runoff from soil stockpiles;
- Runoff from hardstand areas, including roads, processing areas and site facilities;
- Leakage or spillage of hydrocarbon products from vehicles, wash down areas and workshops; and
- Refuelling bays and fuel, oil and grease storages.

There are a number of sensitive aquatic habitats within close proximity to the development footprint, including drainage lines and intermittent marshes. The site drains directly to Tuggerah Creek and the Tuggerah Lakes which contain significant aquatic habitat. These areas are all sensitive receptors for adverse impacts on water quality potentially arising from the development.

Potential water quality impacts may be associated with runoff from disturbed areas, including vegetation clearing areas, construction lay down areas and access roads if risks are not effectively managed and appropriate mitigation measures implemented. Concentrated and/or altered water movement within the construction footprint could increase the potential for sediment mobilisation and transport. Negative effects on aquatic habitats may include increases in stream sediment load, changes in channel form, changes in stream hydrology and a variety of changes in stream faunal populations and communities. Infrastructure that impinge on the stream channel may also cause increases in sediment input and consequent declines in water quality and stream habitat integrity, leading to declines in abundance of invertebrates and fish (Davies and Nelson, 1994).

Soil protection measures and techniques would be implemented during and following construction. Any localised increases in erosion hazard as a result of construction would be limited to the immediate construction footprint and there would be appropriate control devices and buffers between the disturbance footprint and sensitive receptors.

6.3.2 Sediments, Dust and Runoff

There are sensitive environmental receptors adjacent to the development footprint, including aquatic habitats and intact native vegetation. Potential indirect impacts on terrestrial flora and fauna from construction activities would include dust and vehicle exhaust emissions generated from vehicles and equipment. The CEMP for the proposed works would include measures to reduce the risk and severity of these impacts as far as possible.

6.3.3 Edge Effects

Edge effects refer to the impact of clearing on the surrounding areas of retained vegetation. Negative impacts may include an increase in incursion of weeds, sedimentation or access for predators. Existing disturbance has resulted in edge effects in native vegetation in the study area such as infestation with exotic species around the margins of woodland patches. The

development would create new edges along areas of retained vegetation, which would be exposed to edge effects. Increasing edge effects can compromise bushland areas by encouraging weed growth, changing light and microclimatic conditions as well as potentially increasing nutrient levels. Some fauna, such as bats and predatory birds, may use the newly created open areas for foraging which would result in increased predation within open areas and along edges by both native and introduced predatory fauna. Measures recommended in Section 8 should be implemented to minimise the potential for these impacts.

6.3.4 Pests and Pathogens

Construction activities within the site have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*) and Myrtle Rust (*Uredo rangelii*) through vegetation disturbance. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats.

A 'clean on entry, clean on exit' policy should be implemented during construction activities as outlined in Section 7 to prevent the introduction or spread of these pathogens.

6.3.5 Roads and Access

Collisions with wildlife (such as macropods and arboreal mammals) within the site are possible, particularly during dusk and dawn when macropods are active. The development would represent a relatively minor increase in traffic volumes in the context of very heavy traffic on the F3 and Wyong Road. Therefore the increase in traffic is unlikely to significantly increase the risk of vehicle collisions with fauna utilising habitats in the local area.

6.3.6 Artificial Lighting

The site would experience some artificial lighting 24 hours a day, including street lights, security lighting and potentially after-hours warehousing activities. Night-time security or operational lighting can potentially discourage habitat use where diffuse light penetrates into adjoining areas of vegetation. The foraging regimes of some nocturnal native mammals and birds can be disrupted by lighting and make them vulnerable to predation by cats, dogs and foxes. The eyesight of nocturnal species (such as owls, gliders and possums) is hindered by bright lights, and where they are affected by this, they become more susceptible to predation.

Lighting associated with future development, in particular in areas adjacent to retained natve vegetation, should be located and designed wherever practicable to avoid spill into adjoining areas of native vegetation.

6.4 Positive Impacts

The proposed provision of a new detention basin and riparian buffer areas within the Gateway Site to manage upstream and downstream flows for flood mitigation will include the reinstatement of native riparian and wetland vegetation and aquatic habitat features. Mature trees would be retained and protected through the construction process and integrated within the revegetated landscape where possible. In the medium to long-term, the area of retained and remediated wetland/riparian areas may have superior habitat value for some native biota, such as common frogs, reptiles and wetland birds, when compared to the current situation. However, some native species are likely to be discouraged from using the revegetated habitat by noise or light associated with the surrounding development.

The proposed E2 ecological corridor will protect and conserve areas of high biodiversity value on the site over the long-term and offset impacts associated with the development in Areas 1, 2

and 3. The establishment of the E2 zone along the south-eastern boundary of the Gateway site will enhance connectivity with the E2 zone within Area 3 and link vegetation within the site with more extensive tracts of vegetation to the south. Connectivity within the site would be enhanced through the rehabilitation of the currently degraded section of the proposed E2 corridor west of Tonkiss Street. The E2 corridor will contribute to the long term conservation of threatened biota on a local and regional basis and is discussed further in Section 7.4.

6.5 Duration of Impacts

The development would result in the permanent removal of native vegetation and habitats within the proposed development footprints. There would also be continuous and permanent indirect impacts, such as noise, light, dust and traffic. Long-term impacts on native biota will include the loss of ecological functions and habitat resources that take a long time to develop. These include hollow-bearing habitat trees and feed trees, since trees must reach full sexual maturity to produce large volumes of blossom and fruit.

Portions of the construction footprint within the Gateway Site would be remediated as part of the proposed hydrological works. Reinstatement and revegetation of wetland and riparian areas would partially mitigate the removal of wetland and aquatic habitat within Area 1. There will be medium term impacts on native fauna as local populations of common reptiles, frogs, fish and other aquatic biota reoccupy this habitat.

The development would result in positive longer term impacts through the conservation in perpetuity of the E2 zoned ecological corridor through Areas 1, 2 and 3 as discussed in Section 7.4.

6.6 Key threatening processes

The project will directly contribute to the operation of four Key Threatening Processes (KTPs):

- Clearing of native vegetation;
- Removal of dead wood and dead trees;
- Loss of hollow-bearing trees; and
- Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands.

The extent of clearing of native vegetation is presented in Table 8. Up to approximately 5.33 ha of native vegetation would be removed for future development on the site largely comprising small, isolated patches and the edges of stands of vegetation that extend off site.

The proposal will remove up to 36 habitat trees, including stags and/or hollow-bearing trees out of 53 habitat trees identified on the site during field surveys. This is a worst case estimate given the potential for some of the habitat trees recorded on site to be incorporated into future riparian buffer lands and open space within Area 1 of the Gateway Site.

The proposal will disturb a small amount of fallen dead trees within the construction footprint. In line with the groundcover clearance protocol outlined in Section 7.3.1 ground debris will be salvaged and relocated within retained habitats. The habitat value of the timber will be retained and so this measure would mitigate against the operation of the KTP.

Future development will require alterations to the hydrology of the drainage line through Area 1 of the Gateway site and associated moist grasslands and wetlands on adjoining alluvial flats. The hydrology of this area is already substantially modified by previous disturbance, including contour banking, installation of drains and culverts and dumping of fill. These effects are probably secondary to the effects of clearing, invasion by exotic perennial grasses and ongoing grazing. The proposed construction would impact the extensively degraded aquatic and wetland

habitats. Over the medium to long term, the proposed hydrological works on the site, including a detention basin designed with a vegetated riparian buffer and aquatic habitat features is likely to result in an improvement in aquatic habitat resources to those currently present at the site.

The following KTPs may also be of relevance to the proposal:

- Invasion of native plant communities by exotic perennial grasses
- Infection of native plants by *Phytophthora cinnamomi*
- Introduction and establishment of Exotic Rust Fungi of the order *Pucciniales* pathogenic on plants of the family *Myrtaceae*
- Infection of frogs by amphibian chytrid causing the disease *chytridiomycosis*

Provided the soil and weed management measures outlined in Section 7 are followed, the project should not result in the operation of, or increase the impact of, any of either of these KTPs.

6.7 Impacts on threatened biota listed under the TSC and EPBC Acts

6.7.1 Threatened Flora Species

Melalueca biconvexa

The proposed rezoning and future development of the Gateway Site will not involve the removal of any *M. biconvexa*. Approximatley 37 stems will be retained along with habitat in buffer vegetation along the northern boundary of Area 1 of the Gateway Site. This area of habitat adjoins the road reserve which contains up to an additional 50-100 stems.

Future development within the B3 Commercial Core zone within Area 3 if required would have direct impacts on approximately 17 stems of *Melaleuca biconvexa*. Approximately 284 stems occur within Area 3, comprising 74 stems in vegetation within B3 zoned land in the northwestern portion and 210 stems within the proposed E2 conservation land (see Figure 7). The regional population of *M. biconvexa* consists of many thousands of individuals across a variety of land tenures and include many OEH (2013a) Wildlife Atlas records within a 10 km radius of the site (refer Figure 8). Duncan (2001), in a detailed study of *M. biconvexa* in the Wyong Shire, identified five populations, including 'population 3' within the Tuggerah area. Population 3 comprised ten sub-populations, including a 'medium abundance/immature age stand' south of Wyong Road (east of Area 3 of the Westfield Tuggerah and Gateway Site) and a 'medium abundance/mature age stand' west of the F3 and north of Wyong Road (immediately north of Area 1 of the Gateway Site). The smaller stands of *M. biconvexa* that occur in Areas 1 and 3 of the Westfield Tuggerah and Gateway site were not mapped by Duncan (2001) and are not considered an important population of the species.

The subpopulation in the study area is likely to be somewhat isolated from other identified subpopulations by existing development, including the F3 motorway to the west, drier forest at higher elevations to the south, residential development to the east and Wyong Road to the north. There is the potential for some cross-pollination between local sub-populations, to the north and east of the site, although the dominant mode of reproduction in the Wyong Area is through vegetative means (suckering) (Duncan 2001). The removal of approximately 17 stems of *M. biconvexa* and associated habitat would have a relatively minor effect on the viability and recovery of the species in the broader locality. The subpopulation to the north of Wyong Road will not be impacted by the proposed action. The potential for cross-pollination with *M. biconvexa* retained within a vegetated buffer area along the northern boundary of Area 1 will be maintained.

Based on a preliminary assessment of likely impacts, the proposed rezoning and development of the Westfield Tuggerah and Gateway site, including future development within the indicative footprint within Area 3 if required, is unlikely to constitute a significant impact pursuant to Section 5A of the EPA Act given:

- *M. biconvexa* is relatively abundant in the locality and the region and the stems on site comprise a small, largely isolated sub-population of a much larger local population;
- The removal of 17 stems of the sub-population on site is unlikely to comprise an ecologically significant proportion of the local population and is not considered important to the long-term persistence of the species in the locality; and
- The proposed development would not create any significant additional barriers to the movements of pollinators through the landscape and is unlikely to adversely affect the lifecycle or viability of the local population.

An assessment of significance for *M. biconvexa* pursuant to the EPBC Act MNES significance guidelines was prepared as part of the ecological assessment for the State Significant Site Study for the Tuggerah Town Centre (GHD 2011). The project area for that assessment included additional lands to the east of Gavinlock Road that provide habitat for over 1126 stems of *M. biconvexa* and which do not form part of the site for the current Westfield Tuggerah and Gateway Site project. The assessment concluded that the proposed Tuggerah Town Centre would not have a significant impact on *M. biconvexa*. The assessment of significance was included in a referral to DSEWPaC (now DotE) (GHD, 2011b). DotE determined that the project would not involve a significant impact on *M. biconvexa* and was not a controlled action (EPBC Ref. 2010/5562).

The current project, will remove approximately 17 stems of *M. biconvexa* which is substantially less than the 1140 stems assessed for the previous larger Tuggerah Town Centre project study area. Impacts arising from the project would have a relatively minor effect on the viability and recovery of the species in the broader locality, as the affected population is separated from other populations of the species by disturbed land. Based on the above considerations the proposed rezoning and proposed development on the Westfield Tuggerah and Gateway Site is not likely to have a significant impact on the EPBC Act listed vulnerable species *M. biconvexa*.

The project may make a positive contribution to the long term viability of *M. biconvexa* in the locality through the removal of grazing in areas of known habitat along the northern boundary of Area 1, conservation of stems and known habitat within the dedicated ecological corridor in Area 3. Supplementary planting of the species in revegetation areas (where appropriate to do so) is recommended using transplanted stems, seed and/or cuttings from *M. biconvexa* within the development footprint. Planting specimens may help to maintain the size and viability of the local population as well as retaining genetic material from the individuals to be removed.

Other threatened plants

There is potentially suitable habitat for five threatened plant species at the site which may exist in the soil seed bank, as dormant individuals or potentially colonise the site in the future. These species comprise: the small, rainforest tree *Syzygium paniculatum*; three terrestrial orchids of moist forests on sandy soils: *Rhizanthella slateri*, *Cryptostylis hunteriana* and *Diuris praecox;* and the freshwater aquatic herb *Maundia triglochinoides*.

The project will remove potential habitat for these species at the site within construction footprints. Based on a preliminary assessment of the likely impacts, the current proposal is unlikely to impose a significant adverse impact on these threatened flora species or their habitats given on the following key considerations:

- None of these threatened flora species have previously been recorded at or in the vicinity of the site and there are no specific habitat features or resources at the site that suggest any permanent local populations are present;
- The proposed development would remove limited areas of moderate quality habitat, including:
  - A total of 5.33 ha of native forest which may provide potential habitat for *Szygium paniculatum, Rhizanthella slateri*, *Cryptostylis hunteriana* and *Diuris praecox* as the remainder is severely degraded by grazing and weed infestation. There are no known local populations or specific habitat features or resources to suggest that the habitat to be removed is important for these species;
  - Aquatic habitat for *Maundia triglochinoides* in the drainage line through the Gateway site. This water body is degraded by cattle grazing, trampling, nutrification and exotic plant infestation and is unlikely to be important for any local population of the species;
- The remainder of the disturbance footprint has been degraded by clearing, grazing and weed infestation and would have little value for threatened plants;
- Considering the limited area of habitat within the development footprint and the extent of alternative habitat in the locality, these areas are unlikely to contain an ecologically significant proportion of the local populations of any threatened plants;
- The proposed disturbance footprint will not isolate any areas of habitat from birds and insects or otherwise disrupt the pollination and regeneration cycles of local populations of these species if present; and
- The habitat to be removed or modified is unlikely to be important for connecting local populations or allowing for germination or recruitment.

The proposed E2 conservation corridor would conserve potential habitat for these threatened plants on the site and in the broader locality.

6.7.2 Endangered Ecological Communities

Future development on the site would affect two EECs listed under the TSC Act: Swamp Sclerophyll Forest and River Flat Eucalypt Forest.

Based on a preliminary assessment of the likely impacts, the current proposal is unlikely to impose a significant adverse impact on these EECs based on the following key considerations:

- It would remove a maximum of 2.12 hectares of native vegetation that qualifies as these EECs. This would reduce the extent of these EECs but the vegetation to be removed would have limited value to local occurrences of the communities because:
  - Much of the vegetation to be removed has been modified by historic clearing and ongoing grazing and weed infestation
  - It predominantly occurs as fragmented remnants surrounded by cleared or developed land (in Area 1) or as edges of patches adjacent to existing developments (in Area 3)
- The vegetation to be removed is small in extent compared to that within the wider locality and region: the removal of 1.23 ha of SSF equates to approximately 0.02% of the community mapped within the lower Hunter region (NPWS 2000), the removal of 0.89 ha of RFEF equates to 0.05% of the community mapped within the lower Hunter region (NPWS 2000);
- The small areas of these EECs within the project disturbance footprints are highly unlikely to contain an ecologically significant proportion of any of the species which collectively comprise these EECs; and

- The areas of EEC to be affected are already largely isolated in the landscape by the presence of cleared lands or urban development.

The proposed E2 ecological corridor described in Section 7.4 will further mitigate negative impacts on local populations of these EECs. The proposed E2 corridor along the rear of the Tuggerah Westfield and Gateway site aims to maintain the connectivity of vegetation on the site with more extensive stands of vegetation to the south and in doing so, enhance the likely long-term viability of native vegetation, including the EECs within Area 3.

The site does not contain any EECs listed under the EPBC Act and the proposed rezoning and development of the site will not have any impact on nationally listed EECs.

6.7.3 Threatened Fauna Species

A preliminary assessment of the likely significance of impacts on those threatened fauna species recorded on the site is presented below. The proposed E2 corridor will retain habitats of highest value for these species on site.

Glossy Black-cockatoo

The project would involve the clearing of approximately 3.79 ha of habitat for the Glossy Black-cockatoo within the site, comprising the drier forest types.

Based on a preliminary assessment of likely impacts, the current proposal is unlikely to impose a significant adverse impact on this species given:

- Future development would remove habitat resources, including possible nest trees and feed trees but would affect a minor proportion of resources available in the locality
- The project will not significantly affect connectivity of habitat or movement opportunities for this species.

The proposed E2 conservation corridor will ensure the long-term protection of habitat for the Glossy Black Cockatoo on the site and will contribute to the conservation of suitable habitat for this species in the locality. The establishment of the E2 corridor along the southeastern boundary of the Gateway Site will maintain and enhance vegetation connectivity through the site and with extensive tracts of native vegetation to the south which is likely to promote the longterm viability of habitats for this species retained on the site.

Threatened micro bats

The project will have direct impacts on habitat for threatened microbats such as the Yellow-bellied Sheathtail Bat, Little Bentwing-bat, Eastern Bentwing-bat and Eastern Freetail Bat.

The overall project disturbance footprint comprises 5.33 ha of foraging and roosting habitat in native vegetation, up to 36 potential hollow-bearing roost trees and 34.96 ha of exotic derived grasslands. The proposed construction may displace or disturb some individuals if they are within or near this disturbance footprint, particularly roosting individuals.

Based on a preliminary assessment of likely impacts, the current proposal is unlikely to impose a significant adverse impact on these microchiropteran bat species or their habitats given:

- Proposed development would reduce the extent of native vegetation in the locality but would not isolate any areas of habitat nor sever any important wildlife corridors for these mobile species;
- The resources to be removed or disturbed are associated with fragmented remnant vegetation and are likely to have limited value for local populations in the context of extensive areas of alternative, less-disturbed habitat for these highly mobile species in the locality;

- The project would affect only a small proportion of the habitat available to local populations of the species given the extensive areas of alternative habitat in the vicinity of the site; and
- Local populations are likely to persist in alternative habitat outside the site and in retained vegetation within the site.

The proposed E2 conservation corridor will ensure the long-term protection of habitat for microchiropteran bats on the site and will contribute to the conservation of suitable habitat for these species in the wider locality. The establishment of the E2 corridor along the southeastern boundary of the Gateway Site will enhance vegetation connectivity through the site and with extensive tracts of native vegetation to the south which is likely to promote the longterm viability of habitats retained on the site.

Other Threatened Fauna

The project will remove potential habitat for a further 20 threatened fauna species which may occur within the study area, and that may utilise habitat at the site, at least on occasion or on an opportunistic basis. The proposed E2 corridor will retain habitats of highest value for these species on site. The project is unlikely to impose a significant adverse impact on any other threatened fauna species or their habitats based on the following considerations:

- None of these threatened fauna species have previously been recorded at or in the vicinity of the site and there are no specific habitat features or resources at the site that suggest any permanent local populations are present;
- There is no evidence of important breeding, roosting or sheltering habitat for any of these species at the site;
- The proposal would have a minor effect on migration and dispersal ability as vegetation within the site is already partially disrupted by existing clearing and roads and the small area of habitat that may be fragmented by future development in area 3 if required adjoins existing development and is an effective ‘dead end’;
- The 5.33 ha of native vegetation and 34.96 ha of disturbed vegetation (predominantly exotic grassland) to be removed is likely to make a minor overall contribution to the amount of potential habitat available to these species in the locality and are unlikely to contain an ecologically significant proportion of the local populations of any mobile threatened fauna; and
- Drainage works on site will include a vegetated buffer and designed habitat features and in many respects is likely to provide superior habitat value for aquatic and wetland fauna than the current situation.

The proposed E2 conservation corridor will ensure the long-term protection of habitat for native fauna on the site and will contribute to the conservation of suitable habitat for these species in the wider locality. The E2 corridor along the south-eastern boundary of the Gateway Site will enhance vegetation connectivity through the site and with extensive tracts of native vegetation to the south which is likely to promote the long-term viability of habitats retained on the site.

6.8 Potential Impacts on Migratory Species listed under the EPBC Act

The study area provides habitat for a number of EPBC Act listed migratory species, including waterfowl (*Anatidae* species) and the White-bellied Sea Eagle, Cattle Egret and Masked Lapwing which were observed during field surveys. Native vegetation and wetlands at the site are likely to be used by a range of these migratory species on a periodic basis. This would

potentially include use of seasonal foraging resources by threatened migratory species, including the Regent Honeyeater.

Habitats within the site are limited in extent, as well as being patchy and degraded by grazing and weed infestation. Therefore the habitats present are not considered to constitute critical or important habitat for any listed species under the migratory bird provisions of the EPBC Act.

The proposed construction would remove 5.33 ha of native vegetation and 34.96 ha of highly disturbed vegetation. The construction would reduce the extent of native vegetation in the locality but would not isolate any areas of habitat nor sever any important wildlife corridors. The modified site area would constitute a partial barrier to regional movements of migratory species by increasing the area of non-viable habitat that they need to traverse. Migratory species often rely on 'stepping stones' of suitable foraging and roosting habitat during migrations. By removing 5.33 ha of potential habitat the proposed construction would increase the distance between suitable patches. In a regional context this would probably comprise a minor effect on these more mobile species.

Aerial habitat would not be affected and so migratory species are likely to traverse obstacles and gaps in habitat created by permanent project infrastructure. The project does not involve any structures that would pose a significant obstruction or hazard in the context of existing land uses in the locality.

The proposed construction would result in very minor modification of remnant vegetation outside of the project footprint through noise, light-spill and other secondary effects. This would comprise a minor effect in the context of existing fragmentation and modification of habitat in the locality. The final landform would create a vegetated habitat corridor along the south-eastern boundary of the Gateway Site connecting conserved habitat within Area 3 and extensive tracts of intact vegetation to the south of the site.

The project is also unlikely to create a barrier to migration, increase the risk of injury or mortality or otherwise impact on migratory species. Therefore the proposed Westfield Tuggerah and Gateway Site project is unlikely to impose a significant effect on any of the listed migratory fauna species, which could possibly occur in the study area on occasion.

Based on a preliminary consideration of the criteria contained in the MNES significance guidelines (DotE 2013), the proposal would not substantially modify, destroy or isolate an area of important habitat for a migratory species or seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species. Therefore the proposal is not likely to have a significant impact on migratory species listed under the EPBC Act.

7. Mitigation

7.1 Approach

The proposal would result in direct impacts on native biota and habitats within the indicative development footprints as described in Section 6. There is also the potential for indirect impacts on retained vegetation and habitats with the proposed E2 corridor.

This section presents an overview of recommended mitigation measures to avoid or minimise the potential impacts of the project. The mitigation of adverse effects arising from future development has been presented according to the hierarchy of avoidance, mitigation and offsetting of impacts. The development has been designed to avoid areas of high biodiversity value as far as possible. Mitigation measures would be incorporated into subsequent development designs to minimise impacts on the natural environment surrounding the site, and in particular to reduce potential impacts on threatened species and their habitats in the development footprints and within the retained E2 corridor.

The development would result in unavoidable residual adverse impacts upon some elements of the natural environment. These residual impacts are not expected to impose a significant negative effect on local occurrences of EECs or local populations of native species, including threatened species and their habitats, which occur on the site or in adjoining habitats (see Section 6.7). Biodiversity offsets are proposed to address these residual adverse impacts and are detailed in Section 7.4 below.

7.2 Avoidance of Impacts

7.2.1 Project Location and Scope

The majority of the site falls within land which is extensively modified by historical and ongoing land uses. The proposal has a surface disturbance area of approximately 40.40 ha of which approximately 35.07 ha is derived grassland, or exotic or planted vegetation or disturbed, cleared land. Therefore approximately 86% of the disturbance area has very low habitat value for native biota. Impacts on native flora and fauna are substantially less than would be associated with an undisturbed ‘green field’ site.

Areas of higher quality habitat have been substantially avoided, including the following:

- Intact native vegetation, comprising threatened ecological communities and *M. biconvexa* within land proposed to be rezoned from 3A Business General to E2 Environmental Conservation and continuous with vegetation contained within the existing 7(a) Environmental Protection zone within Area 3 (which will also be rezoned to E2 Environmental Conservation).
- Intact Spotted Gum – Ironbark Forest in the southeast of the Gateway site within land proposed to be rezoned from 10(a) Investigation Precinct and 7(a) Environmental Protection to E2 Environmental Conservation that is continuous with more extensive tracts of intact vegetation within environmental and open space zoned lands to the south of the site.

In addition, a strip of disturbed land between the northern boundary of the Gateway Site that contains approximately 37 stems of *M. biconvexa* will be retained as a vegetated buffer between the proposed mixed use zone and Wyong Road. This will maintain existing connectivity between the population of *M. biconvexa* on the site and that within the road reserve (over 50-100 stems). The stand of Coastal Narabeen Moist Forest in the north-western corner of Area 1 is also likely to be at least partially retained within visual and riparian buffer lands proposed on the Gateway

site. These areas have not been included in the calculation of areas to be retained in the absence of detailed design at this stage of the project.

The development footprint for the Gateway Site (Areas 1 and 2) would not involve the removal of any *M. biconvexa* stems and will only remove EECs in very poor condition. Where impacts on native vegetation and habitats have not been avoided within the Gateway Site or Area 3, they will be offset by the proposed retention and conservation of vegetation as described above. The proposed E2 corridor in particular will consolidate existing environmental protection zones on the site, maintain and enhance vegetation connectivity on and off site and as a result promote the likely long-term viability of these stands of vegetation.

There is also likely to be some scope to retain mature trees, including large hollow-bearing habitat trees within landscaped roadside corridors and open space areas in the Gateway Site. In the absence of detailed design, it was not possible to accurately document the trees to be ultimately retained and removed within the site and so a conservative approach was taken when estimating impacts. It is possible that fewer habitat trees would be removed than the estimate presented in Section 6.2.

7.3 Mitigation of Impacts

7.3.1 Construction Environment Management Plan

A Construction Environmental Management Plan (CEMP) would be required for construction phases of the Westfield Tuggerah and Gateway Site project. The CEMP would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures including the procedures outlined below. The CEMP should be prepared and implemented by the contractor.

The CEMP would be required to address the following as a minimum:

- A soil and water management plan, which would require:
  - Installation of erosion and sediment control measures prior to construction;
  - Regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality;
  - Stockpiles to be restricted to identified construction compounds, in areas of cleared land and exotic grassland and managed to ensure no offsite impacts of dust generation or sedimentation;
  - Immediate removal offsite of excavated fill materials not required for backfilling.
  - Runoff from disturbed and rehabilitated areas will be diverted into sediment ponds and not discharged into the natural system; and
  - Implementation of measures to minimise the generation of dust during construction.
- A vegetation management sub-plan to the CEMP, which should include (but not be limited to) the following:
  - Delineation and protection of exclusion zones around native vegetation to be retained;
  - Delineation and protection of exclusion zones around patches of *M. biconvexa* to be retained in close proximity to construction footprints;
  - Supplementary planting of local flora species in revegetation areas using transplanted stems, seed and/or cuttings from within the development footprint;
  - Communication with construction personnel of the conservation value of surrounding habitats and their responsibilities with regard to protecting these habitats during construction; and

  - Hygiene procedures to prevent the introduction and spread of pathogens such as Phytophthora and Myrtle Rust in areas of native vegetation. These would include exclusion zones around retained areas of native vegetation and/or provision of machine and footwear washdown stations for all equipment and personnel working in areas of native vegetation.
- A weed management sub-plan to the CEMP, including a description of:
  - Type and location of weeds of concern (including noxious weeds) within the subject site;
  - Sensitive receivers (such as native vegetation and waterways) within or adjacent to the site;
  - Measures to prevent the spread of weeds, including hygiene procedures for equipment, footwear and clothing;
  - Proposed weed control methods and targeted areas; and
  - Weed disposal protocols.
- A fauna management sub-plan to the CEMP, including (but not limited to) the following:
  - Marking of hollow-bearing trees to be felled prior to clearing of vegetation. The removal of hollow bearing trees is to be undertaken in accordance with a tree hollow management protocol (to be developed as part of the fauna management sub-plan), and would require the presence of a qualified ecologist or wildlife expert experienced in the rescue of fauna;
  - Development of procedures for the safe capture and relocation or captive rearing of less mobile fauna (such as roosting microbats, nestling birds or any injured fauna) by a trained fauna handler and with assistance from Wildlife Information Rescue and Education Service (WIRES) as required;
  - Deferral of vegetation removal and associated construction activity in areas occupied by more mobile threatened fauna until the fauna has vacated the subject site;
  - Erection of exclusion fencing around vegetation to be retained, delineation of 'no-go' areas and marking fauna habitat features, such as hollow-bearing trees, in close proximity to construction footprints to avoid inadvertent impacts during construction activities;
  - Habitat features (fallen logs and tree hollows) removed from site should be salvaged and relocated within adjacent areas of retained vegetation; and
  - Protocols to prevent the introduction or spread of chytrid fungus should be implemented following OEH Hygiene protocol for the control of disease in frogs (DECCW, 2008c).

7.3.2 Hydrology on Site

Final detailed design of works within the Gateway site to manage upstream and downstream flows for flood mitigation will incorporate inputs from hydrologists, geomorphologists and relevant government departments. The detention basin will be designed with riparian buffers and features to provide habitat for birds, reptiles and amphibians and will compensate for the removal of farm dams within the construction footprint.

7.4 Offsetting of Impacts

The proposed rezoning and future development of the Westfield Tuggerah and Gateway Site, including development within Areas 1 and 2 and potential future development within Area 3 (if required), would result in the following residual impacts on native flora and fauna that cannot be avoided or mitigated:

- Clearing of approximately 5.33 ha of native vegetation and fauna habitats, potentially including up to 36 habitat trees;
- Clearing of approximately 2.12 ha of TSC Act-listed EECs; and
- Removal of approximately 17 *Melaleuca biconvexa* stems.

A biodiversity offset for the project has been identified to compensate for these residual impacts with reference to the *Principles for the Use of Biodiversity Offsets in NSW* (DECC, 2008) and includes the identification of:

- Appropriate offset areas;
- Future management actions to improve biodiversity values; and
- Titling options to ensure legal protection of the offset site and achieve conservation in perpetuity.

7.4.1 The proposed offset

The offset proposed for the Westfield Tuggerah and Gateway site involves the establishment of an E2 zoned ecological corridor along the rear of the site as indicated in Figure 11, and includes:

  - Establishment of an E2 Environmental Conservation zone within Area 3 east of Tonkiss Street through the rezoning of approximately 3.16 ha of native vegetation currently zoned 3(a) Commercial and 7(a) Environmental Protection
  - Establishment of an E2 Environmental Conservation zone within Areas 1 and 2 through the rezoning of approximately 2.11 ha of native vegetation and disturbed lands currently zoned RU6 Transition and 7(a) Environmental Protection; and
  - Rehabilitation of 0.31 ha of cleared land and disturbed vegetation within the proposed E2 corridor west of Tonkiss Street to restore native vegetation, enhance connectivity and thereby improve biodiversity values within the offset site.

The proposed E2 zoned corridor would formally conserve vegetation and habitats with high biodiversity values on the site, increase and consolidate the existing environmental protection area and maintain and enhance connectivity through the site and with more extensive areas of native vegetation to the south of Area 1. A total of approximately 5.1 ha of native vegetation would be formally conserved and managed to enhance existing condition and connectivity to offset the removal of up to 5.30 ha of native vegetation in future development footprints, including the formal conservation of 2.90 ha of EECs to offset the removal of 2.12 ha of EECs (refer Table 10).

This proposed E2 corridor offset has been agreed to, in principal, by OEH and DoPE and its component areas are described in more detail below.

Table 9 Comparison of development footprint and offset site areas

Vegetation Type	Areas 1, 2, 3 Total indicative development area or number of stems	E2 Corridor (offset)		Total E2 Corridor Offset Area
		Existing Zone 7a	Additional contribution	
Native vegetation	5.33 ha	3.35 ha	1.75 ha	5.1 ha
EECs	2.12 ha	2.25 ha	0.65 ha	2.9 ha
Melaleuca biconvexa	17 stems	47 stems	163 stems	210 stems
Native vegetation rehabilitation	-	-	0.31 ha	0.31 ha

The biodiversity values of the component areas of the proposed E2 corridor on Areas 1 and 2 of the Gateway site and Area 3 are described below.

Proposed E2 Corridor within Area 3

Area 3 contains remnant native vegetation, including two EECs, *M. biconvexa* and threatened fauna habitat. It is proposed to formally conserve the southernmost portion of Area 3, within Lot 10 of DP 10625, which is currently zoned 7(a) Environmental Protection and a further 0.63 ha of the native vegetation currently zoned 3(a) Commercial to E2 Environmental Conservation (Figure 3). This would yield a consolidated patch of conserved native forest habitat of approximately 3.15 ha within Area 3. This conservation area would be contiguous with the proposed offset area on the Gateway Site and the opportunity exists to enhance connectivity through rehabilitation of currently disturbed areas within the proposed corridor west of Tonkiss Street (see below).

Vegetation types within the proposed E2 zone within Area 3 are presented in Figure 6. The proposed E2 zone has high biodiversity values, including:

- The presence of EECs, comprising 0.91 ha of intact Swamp Sclerophyll Forest and 1.93 ha of River Flat Eucalypt Forest in good condition;
- Approximately 284 stems of *M. biconvexa*;
- Known foraging habitat for the threatened Glossy Black-cockatoo;
- 10 hollow-bearing habitat trees located within a patch of intact native forest;
- Generally good vegetation condition, with high plant species diversity and minor weed infestation; and
- A reasonably large patch of remnant native vegetation with the opportunity to enhance connectivity with other retained vegetation on site and to the south.

Proposed E2 corridor within Areas 1 and 2 of the Gateway Site

It is proposed to formally conserve a further 2.11 ha of land, incorporating native vegetation and disturbed lands along the southeastern boundary of the Gateway Site (within Areas 1 and 2) through rezoning of land from 10A Investigation Precinct and 7(a) Environmental Protection to an E2 Environmental Conservation zone (Figure 3). This proposed corridor of vegetation would be 50m wide where it adjoins Tonkiss Street to create a similar width corridor to the E2 conservation zone in Area 3 on the other side of the Street.

Vegetation types within the proposed E2 zone in Areas 1 and 2 are presented in Figure 6. The biodiversity values of the corridor include:

- 1.95 ha of Coastal Foothills Spotted Gum-Ironbark Forest;
- Generally good vegetation condition, fauna habitats and minor weed infestation.
- Native vegetation adjoining more extensive tracts of native vegetation within environmental and open space zoned lands to the south of the site.

A portion of the proposed E2 corridor immediately west of Tonkiss Street currently contains a cleared and disturbed area of land supporting a dwelling and associated infrastructure. It is proposed to rehabilitate this portion of the corridor to improve biodiversity values and enhance connectivity with the proposed E2 corridor within Area 3 to the east of Tonkiss Street (see Section 7.4.2).

Table 10 Approximate areas of vegetation types within the proposed offset sites

Vegetation Type	TSC Act Status	Area within existing 7(a) zone	Additional contribution	Total within proposed E2 Corridor (ha)
Gateway Site				
Coastal Foothills Spotted Gum Ironbark Forest	-	0.85	1.09	1.94
Coastal Narabeen Moist Forest	-	-	0.01	0.01
Derived Grassland	-	-	0.01	0.01
Disturbed cleared land	-	-	0.17	0.17
Area 3				
Alluvial Tall Moist Forest	River-flat Eucalypt Forest EEC	1.60	0.34	1.94
Coastal Foothills Spotted Gum Ironbark Forest	-	0.25	0.05	0.30
Swamp Mahogany - Paperbark Forest	Swamp Sclerophyll Forest EEC	0.65	0.26	0.91
Swamp Mahogany - Paperbark Forest (degraded)	Swamp Sclerophyll Forest EEC	-	-	
Total Native Vegetation		**3.35**	**1.75**	**5.10**
Total Area		**3.35**	**1.93**	**5.28**

7.4.2 Management of the Offset

The DECC (2008) offsetting principals require the improvement of condition and biodiversity values at offset sites through management. A Plan of Management would be prepared to provide for the rehabilitation of the disturbed area of the corridor west of Tonkiss Street (see Figure 11).

The condition and biodiversity value of the offset rehabilitation area would be improved through the following measures:

- Maintenance of site boundaries and exclusion of potentially damaging activities;
- Demolition of the dwelling and associated infrastructure in the corridor west of Tonkiss Road, site preparation and rehabilitation through planting;
- Management of weeds;
- Planting of native tube stock of local provenance and representative of local vegetation types;
- Facilitated regeneration of degraded native vegetation types through weed removal and supplementary planting if required;
- Monitoring of planted and intact native vegetation and supplementary planting or targeted management actions as appropriate.

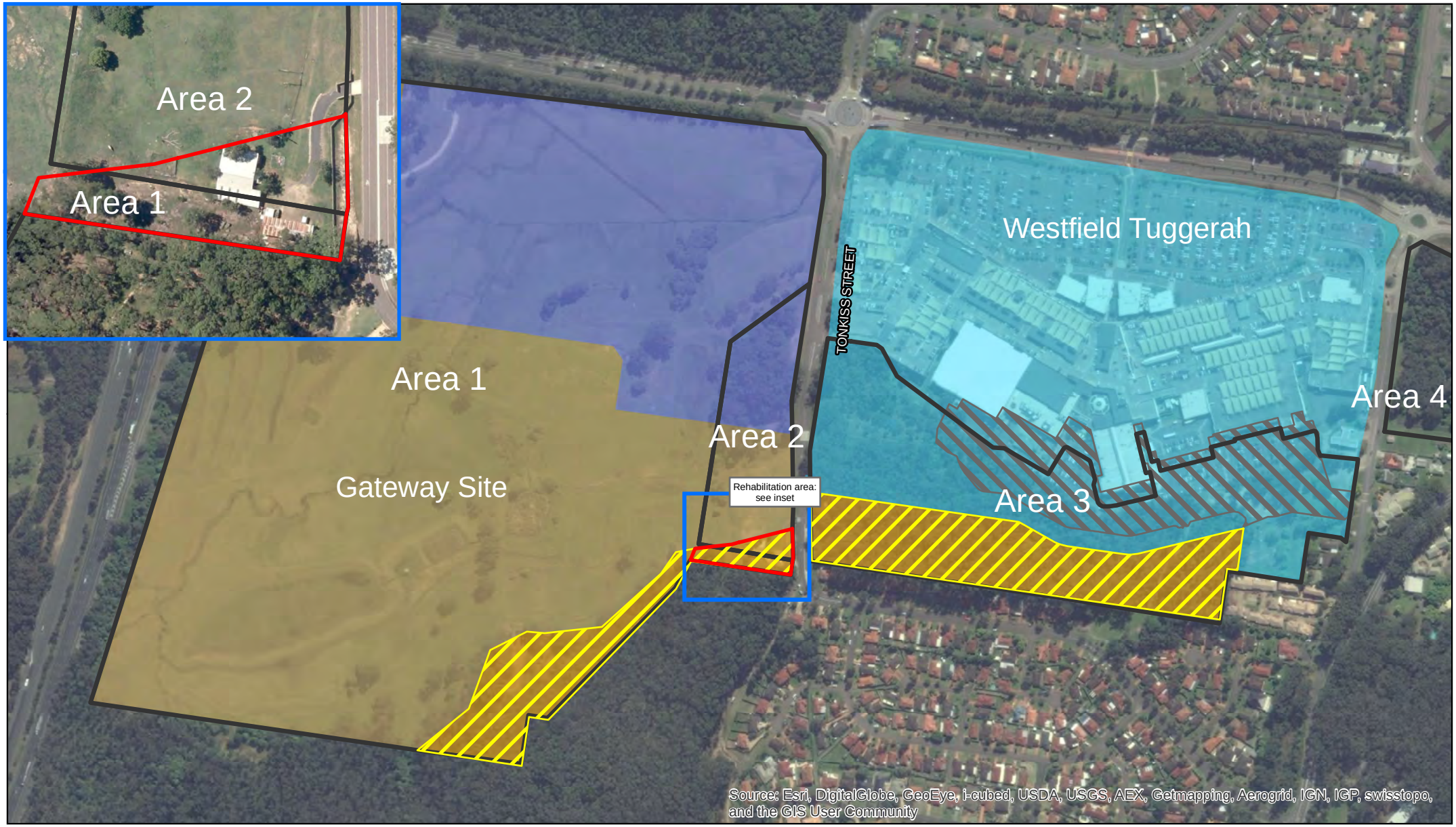
The existing dwelling and any associated infrastructure would be demolished and removed and the area rehabilitated through replanting and weed management to increase the extent and condition of native vegetation, enhance connectivity within the corridor and improve biodiversity values.

A Vegetation Management Plan (VMP) has been prepared to outline the works to be undertaken within the E2 corridor, recommended implementation time frames, rehabilitation and management cost estimates and other associated information. The VMP is attached as Appendix D.

7.4.3 Titling of the Offset

The DECC (2008) offsetting principles state that offset areas must be 'enduring' and they must be enforceable; that is, the offset area must be protected in perpetuity by a planning instrument and/or by changes to the title of the property.

The proposed E2 conservation landuse zone will impose restrictions on the use and development of the ecological corridor consistent with its conservation as an offset site in perpetuity. Under the Wyong LEP 2013, this zone is applied to the most environmentally valuable land in the LGA, including SEPP 14 Coastal Wetlands, SEPP 26 Littoral Rainforests, Endangered Ecological Communities and land subject to conservation agreements or land acquired by Council for conservation purposes. This zoning would identify the corridor within the most environmentally valuable lands within the Wyong LGA and protect its long term retention and contribution to the ecological values of the wider area.



Paper Size A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- The Site
- Approved Westfield expansion (DA 514/2013)
- Proposed E2 corridor
- Rehabilitation area

Proposed rezoning

- B3 Commercial Core
- B4 Mixed Use Precinct
- RU6 Transition
- E2 Environmental Conservation

Westfield Ltd
Westfield Tuggerah and Gateway Site

Job Number	21-23343
Revision	1
Date	17 Jun 2014

Proposed E2 Environmental Conservation corridor and rehabilitation area

Figure 11

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Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com

Data source: ESRI: Aerial, 2013; LPI: DBTB, 2012; Geoscience Australia: 250K Topographic Data Series 3, 2006. Created by: tmorton, fmackay

8. Conclusion

The proposed rezoning of the Westfield Tuggerah and Gateway Site presented for consideration and assessed in this report aims to achieve an appropriate balance between development and conservation, providing for a sound ecological outcome for this significant site in the growth and development of the Wyong LGA.

The proposed rezoning has been formulated with consideration of future development and operational requirements of this commercially significant site, the results of the previous ecological assessments and consultation with the Department of Planning, Wyong Council and the Office of Environment and Heritage during the development of the Wyong LEP 2013.

Key aspects of the proposed rezoning comprise:

- Creation of a B4 mixed use precinct circa. 13 ha, straddling both Area 1 and 2 resulting in the removal of isolated patches of variously degraded vegetation and retention of a vegetated buffer along the northern boundary of the Gateway site containing the threatened plant *Melaleuca biconvexa*;
- Creation of an E2 Environmental Conservation zoned corridor, through the rear of the site to more formally conserve habitats of high biodiversity value on site, consolidate existing environmental protection areas, maintain habitat connectivity and to offset impacts on biodiversity values. Creation of the E2 corridor will involve:
  - Conservation of a large portion of Area 3 through the rezoning of land from 3(a) Commercial and 7(a) Environmental Protection to E2 Environmental Conservation,
  - Conservation of vegetation along the southeastern boundary of Area 1 through rezoning of land from 10(a) Investigation Precinct and 7(a) Environmental Protection to E2 Environmental Conservation. This will retain a corridor of conserved vegetation through the rear of the site and maintain existing connectivity with adjoining environmental and open space zoned lands to the south. Part of this area will be rehabilitated via a Vegetation Management Plan (VMP) to improve vegetation condition and to enhance the connectivity of vegetation through the site;
- Rezoning the remainder of Area 1 to RU6 transition; and
- Provision for a new detention basin within the north-western portion of Area 1 to manage upstream and downstream flows for flood mitigation and designed with riparian buffers and features to provide habitat for birds, reptiles and amphibians.

A preliminary assessment of the likely significance of impacts of the current Westfield Tuggerah and Gateway Site proposal (as described above), has been assessed based on the findings of previous studies completed for earlier phases of the project, and taking into consideration the impacts and benefits associated with the proposed rezoning of the site and future development. The conclusion of these assessments is that the proposed development is not likely to result in a significant negative impact on native biota or their habitats, including threatened biota listed under the TSC Act or EPBC Acts.

The current proposal will result in impacts on the local population of *Melaleuca biconvexa*, which is listed as Vulnerable under the EPBC Act and thus comprises an impact on a matter of national environmental significance. The earlier Tuggerah Town Centre project, which assessed a larger development footprint and impacts on a much larger number of stems of M*. biconvexa*, was referred to the Commonwealth and determined not to be a controlled action (EPBC Ref. 2010/5562). The development footprint for the current project will affect a much smaller number

of stems of *Melaleuca biconvexa* and is unlikely to have a significant impact on this species or any threatened or migratory biota listed under the EPBC Act. On this basis, the current proposal is also unlikely to constitute a controlled action under the EPBC Act.

While the proposal is unlikely to have a significant effect on threatened biota listed under the TSC or EPBC Acts, unavoidable residual impacts will be offset through the establishment of an E2 environmental conservation zoned corridor on the Westfield Tuggerah and Gateway Site. The proposed ecological corridor will formally protect and conserve areas of high biodiversity value on the Westfield Tuggerah and Gateway Site, enhance vegetation connectivity through the site and with extensive tracts of native vegetation within environmental and open space zoned land to the south and promote the long-term viability of the ecological communities and habitats retained on the site. The proposed offset will maintain and improve biodiversity values on the site and contribute to the long term conservation of threatened biota on a local and regional basis.

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Appendices

Appendix A – Species Lists

Flora Species List

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower	U					x
	*Thunbergia alata**	Black-eyed Susan	U					x
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair	P13		x		x	
	Adiantum hispidulum	Rough Maidenhair	P13					x
	Cheilanthes sieberi	Rock Fern	U			x		
	Pellaea falcata	Sickle Fern	U					x
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	U		x			
Amaryllidaceae	*Nerine filifolia**		U					x
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla-lily	U				x	
	Caesia parviflora	Pale Grass-lily	U					x
	Caesia parviflora var. parviflora		U					x
	Caesia parviflora var. vittata		U			x		
Apiaceae	*Centella asiatica*	Indian Pennywort	U		x	x	x	
	*Hydrocotyle bonariensis**		U					x
	Hydrocotyle peduncularis	A Pennywort	U		x			
Apocynaceae	*Araujia sericifera**	Moth Vine	U					x

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
	Marsdenia rostrata	Milk Vine	U		x			
	Marsdenia suaveolens	Scented Marsdenia	U				x	
	Parsonsia straminea	Common Silkpod	U			x	x	
Araceae	*Gymnostachys anceps*	Settler's Twine	U				x	
Araliaceae	*Astrotricha latifolia*		U					x
	Polyscias sambucifolia	Elderberry Panax	U		x	x	x	
Arecaceae	*Livistona australis*	Cabbage Palm	P13				x	
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern	U			x	x	
	*Asparagus asparagoides**	Bridal Creeper	U					x
Asteraceae	*Ageratina adenophora**	Crofton Weed	U		x			
	*Bidens pilosa**	Cobbler's Pegs	U					x
	*Carthamus lanatus**	Saffron Thistle	U		x			
	*Cirsium vulgare**	Spear Thistle	U		x			
	*Conyza bonariensis**	Flaxleaf Fleabane	U		x	x		
	Eclipta prostrata		U					x
	Euchiton involucratus	Star Cudweed	U		x			
	Leptinella longipes		U		x			
	Senecio linearifolius	Fireweed Groundsel	U					x

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
	*Senecio madagascariensis**	Fireweed	U		x			
	*Sonchus oleraceus**	Common Sowthistle	U		x			
	*Taraxacum officinale**	Dandelion	U		x			
	Vernonia cinerea		U				x	
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine	U				x	
Blechnaceae	*Blechnum camfieldii*		U					x
	Blechnum indicum	Swamp Water Fern	U					x
	Doodia aspera	Prickly Rasp Fern	U					x
Cannaceae	*Canna sp**		U					x
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle	U					x
	*Lonicera sp.**		U		x			
Caryophyllaceae	*Stellaria media**	Common Chickweed	U		x			
Casuarinaceae	*Allocasuarina sp.*		U				x	
	Allocasuarina torulosa	Forest Oak	U			x	x	
	Casuarina glauca	Swamp Oak	U		x			
Commelinaceae	*Commelina cyanea*	Native Wandering Jew	U		x	x	x	
	*Tradescantia fluminensis**	Wandering Jew	U					x
Convolvulaceae	*Cuscuta campestris**	Golden Dodder	U				x	

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
	Dichondra repens	Kidney Weed	U		x	x	x	
	Polymeria calycina		U				x	
Crassulaceae	*Crassula sp**		U		x			
Cyperaceae	*Carex appressa*	Tall Sedge	U		x			
	Carex sp.		U			x		
	Caustis pentandra	Thick Twist Rush	P13			x		
	*Cyperus eragrostis**	Umbrella Sedge	U		x			
	*Cyperus papyrus**		U					x
	Cyperus polystachyos		U		x			
	Eleocharis cylindrostachys		U					x
	Gahnia clarkei	Tall Saw-sedge	U		x		x	
	Gahnia radula		U			x		
	Lepidosperma laterale	Variable Sword-sedge	U			x	x	
	Lepidosperma sp.		U			x	x	
	Lepidosperma urophorum		U					x
	Schoenus melanostachys		U				x	
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern	U		x		x	
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	U				x	

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern	U				x	
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower	U				x	
	Hibbertia dentata	Twining Guinea Flower	U				x	
	Hibbertia scandens	Climbing Guinea Flower	U			x	x	
	Hibbertia sp.		U					x
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash	U				x	
Ericaceae	*Epacris pulchella*	Wallum Heath	U				x	
	Leucopogon juniperinus	Prickly Beard-heath	U			x		
	Leucopogon sp.	A Beard-heath	U				x	
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush	U			x	x	
	Glochidion ferdinandi	Cheese Tree	U			x	x	
	Homalanthus populifolius		U					x
Fabaceae (Caesalpinioideae)	*Senna artemisioides**	Silver Cassia	U					x
Fabaceae (Faboideae)	*Aotus ericoides*		U			x	x	
	Castanospermum australe	Black Bean	U					x
	Daviesia ulicifolia	Gorse Bitter Pea	U		x	x		
	*Erythrina sykesii**	Coral Tree	U		x			
	Glycine clandestina	Twining glycine	U				x	

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
	Glycine microphylla	Small-leaf Glycine	U		x	x	x	
	Glycine tabacina	Variable Glycine	U				x	
	Hardenbergia violacea	Purple Coral Pea	U				x	
	Kennedia prostrata	Running Postman	U	x	x	x	x	
	*Medicago sp.**	A Medic	U					x
	*Trifolium subterraneum**	Subterranean Clover	U		x			
Fabaceae (Mimosoideae)	*Acacia elata*	Mountain Cedar Wattle	U					x
	Acacia floribunda	White Sally	U			x		
	Acacia irrorata	Green Wattle	U				x	
	Acacia irrorata subsp. irrorata	Green Wattle	U					x
	Acacia longifolia		U				x	
	Acacia longifolia subsp. sophorae	Coastal Wattle	U					x
	Acacia suaveolens	Sweet Wattle	U				x	
Geraniaceae	*Geranium homeanum*		U		x			
Gleicheniaceae	*Gleichenia dicarpa*	Pouched Coral Fern	U					x
Goodeniaceae	*Goodenia ovata*	Hop Goodenia	U					x
	Goodenia paniculata		U		x			
	Scaevola ramosissima	Purple Fan-flower	U				x	

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort	U				x	
	Gonocarpus teucrioides	Germander Raspwort	U					x
Hypoxidaceae	*Hypoxis hygrometrica*	Golden Weather-grass	U				x	
Iridaceae	*Watsonia meriana**		U					x
Juncaceae	*Juncus cognatus**		U		x			
	Juncus continuus		U		x			
	Juncus planifolius		U		x			
	Juncus sp.	A Rush	U					x
	Juncus subsecundus	Finger Rush	U			x		
	Juncus usitatus		U		x			
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum	U		x		x	
	Mentha satureioides	Native Pennyroyal	U		x			
	Plectranthus parviflorus		U		x			
Lauraceae	*Cassytha glabella*		U				x	
	*Cinnamomum camphora**	Camphor Laurel	U		x	x	x	
Liliaceae	*Lilium formosanum**	Formosan Lily	U					x
Lindsaeaceae	*Lindsaea linearis*	Screw Fern	U				x	
Lobeliaceae	*Pratia purpurascens*	Whiteroot	U			x	x	

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	U		x	x	x	
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	U			x	x	
	Geitonoplesium cymosum	Scrambling Lily	U			x	x	
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne	U		x		x	
Meliaceae	*Melia azedarach*	White Cedar	U		x			
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine	U					x
	Stephania japonica	Snake vine	U				x	
Menyanthaceae	*Villarsia exaltata*	Yellow Marsh Flower	U					x
Monimiaceae	*Wilkiea huegeliana*	Veiny Wilkiea	U					x
Myrtaceae	*Angophora costata*	Sydney Red Gum	U		x		x	
	Angophora floribunda	Rough-barked Apple	U		x	x		
	Backhousia myrtifolia	Grey Myrtle	U				x	
	Callistemon citrinus	Crimson Bottlebrush	U		x			
	Callistemon salignus	Willow Bottlebrush	U					x
	Corymbia gummifera	Red Bloodwood	U		x			
	Corymbia maculata	Spotted Gum	U		x	x	x	
	Eucalyptus acmenoides	White Mahogany	U				x	
	Eucalyptus amplifolia	Cabbage Gum	U		x			

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
	Eucalyptus pilularis	Blackbutt	U		x	x	x	
	Eucalyptus robusta	Swamp Mahogany	U		x		x	
	Eucalyptus saligna	Sydney Blue Gum	U					x
	Eucalyptus sp.		U		x			
	Kunzea ambigua	Tick Bush	P13					x
	Leptospermum continentale	Prickly Teatree	U					x
	Leptospermum polygalifolium	Tantoon	U			x	x	
	Leptospermum trinervium	Slender Tea-tree	U				x	
	Melaleuca biconvexa	Biconvex Paperbark	V	V	x		x	
	Melaleuca decora		U					x
	Melaleuca ericifolia	Swamp Paperbark	U					x
	Melaleuca linariifolia	Flax-leaved Paperbark	U		x		x	
	Melaleuca nodosa		U					x
	Melaleuca quinquenervia	Broad-leaved Paperbark	U				x	
	Melaleuca squamea	Swamp Honey-myrtle	U					x
	Melaleuca styphelioides	Prickly-leaved Tea Tree	U					x
	Rhodamnia rubescens	Scrub Turpentine	U				x	
	Syncarpia glomulifera	Turpentine	U				x	

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant	U			x	x	
Oleaceae	*Ligustrum sinense**	Small-leaved Privet	U					x
	Notelaea longifolia	Large Mock-olive	U					x
	Notelaea ovata		U		x			
	*Olea europaea**	African Olive	U				x	
Onagraceae	*Ludwigia peploides subsp. montevidensis*	Water Primrose	U		x			
Orchidaceae	*Cryptostylis erecta*	Tartan Tongue Orchid	P13				x	
	Cymbidium suave	Snake Orchid	P13				x	
Oxalidaceae	*Oxalis corniculata**	Creeping Oxalis	U			x		
	Oxalis perennans		U		x	x		
Phormiaceae	*Dianella caerulea var. producta*		U				x	
	Dianella revoluta	Blueberry Lily	U			x	x	
Phytolaccaceae	*Phytolacca octandra**	Inkweed	U		x			
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	U			x	x	
	Pittosporum revolutum	Rough Fruit Pittosporum	U				x	
	Pittosporum undulatum	Sweet Pittosporum	U				x	
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues	U		x			
Poaceae	*Andropogon virginicus**	Whisky Grass	U		x			

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
	Austrostipa sp.	A Speargrass	U		x	x		
	*Avena sp**	Oats	U		x			
	*Briza maxima**	Quaking Grass	U		x			
	*Briza minor**	Shivery Grass	U		x			
	Cymbopogon refractus	Barbed Wire Grass	U				x	
	Cynodon dactylon	Common Couch	U		x		x	
	Deyeuxia quadriseta	0	U					x
	Dichelachne micrantha	Shorthair Plumegrass	U			x		
	Echinopogon caespitosus	Bushy Hedgehog-grass	U		x	x	x	
	*Ehrharta erecta**	Panic Veldtgrass	U		x	x		
	*Ehrharta longiflora**	Annual Veldtgrass	U				x	
	*Eleusine indica**	Crowsfoot Grass	U					x
	*Eleusine tristachya**	Goose Grass	U					x
	Enneapogon avenaceus		U					x
	Entolasia marginata	Bordered Panic	U			x	x	
	Entolasia stricta	Wiry Panic	U		x	x	x	
	Eragrostis brownii	Brown's Lovegrass	U			x	x	
	*Holcus lanatus**	Yorkshire Fog	U					x

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
	Imperata cylindrica	Blady Grass	U			x	x	
	Microlaena stipoides	Weeping Grass	U			x	x	
	Oplismenus aemulus		U				x	
	Panicum sp.	Panicum	U					x
	*Paspalum dilatatum**	Paspalum	U		x			
	*Pennisetum clandestinum**	Kikuyu Grass	U		x			
	*Phalaris aquatica**	Phalaris	U					x
	Phragmites australis	Common Reed	U					x
	*Setaria sp.**		U			x		
	*Setaria verticillata**	Whorled Pigeon Grass	U		x			
	*Setaria viridis**	Green Pigeon Grass	U					x
	Sporobolus virginicus		U		x			
	Themeda australis	Kangaroo Grass	U			x	x	
	*Vulpia bromoides**	Squirrel Tail Fesque	U		x			
	Zoysia macrantha	Prickly Couch	U		x			
Polygonaceae	*Acetosa sagittata**	Rambling Dock	U					x
	*Acetosella vulgaris**	Sheep Sorrel	U					x
	Persicaria hydropiper	Water Pepper	U		x			

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
	Persicaria lapathifolia	Pale Knotweed	U		x			
	Persicaria orientalis	Princes Feathers	U					x
	*Persicaria strigosa**		U					x
	*Rumex sp.**	Dock	U		x			
Pontederiaceae	*Eichhornia crassipes**	Water Hyacinth	U		x			
Proteaceae	*Banksia integrifolia*	Coast Banksia	U					x
	Banksia marginata	Silver Banksia	U				x	
	Banksia oblongifolia	Fern-leaved Banksia	U				x	
	Banksia spinulosa	Hairpin Banksia	P13				x	
	Persoonia levis	Broad-leaved Geebung	P13				x	
	Persoonia linearis	Narrow-leaved Geebung	P13			x	x	
Ranunculaceae	*Clematis aristata*	Old Man's Beard	U			x	x	
	Ranunculus inundatus	River Buttercup	U					x
	Ranunculus plebeius		U		x			
Restionaceae	*Baloskion tetraphyllum*		U					x
Rhamnaceae	*Alphitonia excelsa*	Red Ash	U			x	x	
Rosaceae	*Rosa sp.*		U					x
	*Rubus fruticosus sp. agg.**	Blackberry complex	U		x	x		

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
Rubiaceae	*Morinda jasminoides*	Sweet Morinda	U				x	
	Pomax umbellata	Pomax	U		x		x	
Rutaceae	*Phebalium sp.*		U		x		x	
	Zieria smithii	Sandfly Zieria	U				x	
Salicaceae	*Salix babylonica**	Weeping Willow	U		x			
Salviniaceae	*Salvinia molesta**		U					x
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell	U				x	
Selaginellaceae	*Selaginella uliginosa*	Swamp Selaginella	U					x
Smilacaceae	*Smilax australis*	Lawyer Vine	U					x
	Smilax glyciphylla	Sweet Sarsparilla	U				x	
Solanaceae	*Duboisia myoporoides*	Corkwood	U				x	
	*Solanum mauritianum**	Wild Tobacco Bush	U		x		x	
	*Solanum nigrum**	Black-berry Nightshade	U		x			
	*Solanum seaforthianum**	Brazilian Nightshade	U					x
Sphagnaceae	*Sphagnum sp.*	Sphagnum Moss	U		x			
Tropaeolaceae	*Tropaeolum majus**	Nasturtium	U					x
Typhaceae	*Typha orientalis*	Broad-leaved Cumbungi	U		x	x		
Urticaceae	*Urtica incisa*	Stinging Nettle	U		x			

Family	Scientific Name	Common Name	NSW Status	EPBC Status	Area 1	Area 2	Area 3	Opportunistic
Verbenaceae	*Lantana camara**		U		x	x	x	
	*Verbena bonariensis**	Purpletop	U		x			
Violaceae	*Viola hederacea*	Ivy-leaved Violet	U					x
Vitaceae	*Cayratia clematidea*	Slender Grape	U				x	
	Cissus antarctica	Water Vine	U			x	x	
	Cissus hypoglauca	Giant Water Vine	U			x	x	
Xanthorrhoeaceae	*Xanthorrhoea minor subsp. minor*		P13				x	
	Xanthorrhoea sp.		P13			x		
Zingiberaceae	*Hedychium gardnerianum**	Ginger Lily	U					x

U – Unprotected under the NSW NPWS Act

P13 – Protected under the NSW NPWS Act

V – Vulnerable under the NSW TSC Act and/or Commonwealth EPBC Act

Fauna Species list

Scientific Name	Common Name	NSW Status	EPBC Status	Observation Type
FROGS				
Litoria dentata	Bleating Tree Frog	P		Heard
Litoria fallax	Eastern Dwarf Tree Frog	P		Heard
Litoria peronii	Peron's Tree Frog	P		Heard
Crinia signifera	Common Eastern Froglet	P		Heard
Limnodynastes dumerilii	Eastern Banjo Frog	P		Heard
Limnodynastes peronii	Brown-striped Frog	P		Heard
Limnodynastes tasmaniensis	Spotted Grass Frog	P		Heard
Uperoleia fusca	Dusky Toadlet	P		Heard
BIRDS				
Acanthiza nana	Yellow Thornbill	P		Seen
Acanthiza pusilla	Brown Thornbill	P		Seen
Acanthorhynchus tenuirostris	Eastern Spinebill	P		Seen
Accipiter fasciatus	Brown Goshawk	P		Seen
Alisterus scapularis	Australian King-Parrot	P		Seen
Anas castanea	Chestnut Teal	P		Seen
Anas gracilis	Grey Teal	P		Seen
Anas superciliosa	Pacific Black Duck	P		Seen
Anthochaera carunculata	Red Wattlebird	P		Seen
Anthochaera chrysoptera	Little Wattlebird	P		Seen
Ardea pacifica	White-necked Heron	P		Seen
Cacatua galerita	Sulphur-crested Cockatoo	P		Seen
Cacatua sanguinea	Little Corella	P		Seen
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	P		Seen
Calyptorhynchus lathami[†]	**Glossy Black-Cockatoo**	**V**		**Seen**
Chenonetta jubata	Australian Wood Duck	P		Seen
Colluricincla harmonica	Grey Shrike-thrush	P		Seen
Coracina novaehollandiae	Black-faced Cuckoo-shrike	P		Seen
Corvus coronoides	Australian Raven	P		Seen
Corvus mellori	Little Raven	P		Seen
Cracticus nigrogularis	Pied Butcherbird	P		Seen
Cracticus tibicen	Australian Magpie	P		Seen

Scientific Name	Common Name	NSW Status	EPBC Status	Observation Type
Cracticus torquatus	Grey Butcherbird	P		Seen
Dacelo novaeguineae	Laughing Kookaburra	P		Seen
Egretta novaehollandiae	White-faced Heron	P		Seen
Elanus axillaris	Black-shouldered Kite	P		Seen
Entomyzon cyanotis	Blue-faced Honeyeater	P		Seen
Eolophus roseicapillus	Galah	P		Seen
Eopsaltria australis	Eastern Yellow Robin	P		Heard
Eudynamys orientalis	Pacific Koel	P		Seen
Eurystomus orientalis	Dollarbird	P		Seen
Falco cenchroides	Nankeen Kestrel	P		Seen
Gallirallus philippensis	Buff-banded Rail	P		Seen
Geopelia striata	Peaceful Dove	P		Seen
Gerygone albogularis	White-throated Gerygone	P		Heard
Glossopsitta concinna	Musk Lorikeet	P		Seen
Grallina cyanoleuca	Magpie-lark	P		Seen
Haliaeetus leucogaster	White-bellied Sea-Eagle	P		Seen, overfly
Hirundo neoxena	Welcome Swallow	P		Seen
Lichenostomus chrysops	Yellow-faced Honeyeater	P		Seen
Lichenostomus penicillatus	White-plumed Honeyeater	P		Seen
Malurus cyaneus	Superb Fairy-wren	P		Seen
Malurus lamberti	Variegated Fairy-wren	P		Seen
Manorina melanocephala	Noisy Miner	P		Seen
Manorina melanophrys	Bell Miner	P		Seen
Neochmia temporalis	Red-browed Finch	P		Seen
Ocyphaps lophotes	Crested Pigeon	P		Seen
Oriolus sagittatus	Olive-backed Oriole	P		Seen
Pachycephala rufiventris	Rufous Whistler	P		Heard
*Passer domesticus**	House Sparrow	U		Seen
Pelecanus conspicillatus	Australian Pelican	P		Seen
Petrochelidon nigricans	Tree Martin	P		Seen
Philemon corniculatus	Noisy Friarbird	P		Seen
Phylidonyris niger	White-cheeked Honeyeater	P		Seen
Phylidonyris novaehollandiae	New Holland Honeyeater	P		Seen
Platycercus eximius	Eastern Rosella	P		Seen

Scientific Name	Common Name	NSW Status	EPBC Status	Observation Type
Podargus strigoides	Tawny Frogmouth	P		Seen
Psephotus haematonotus	Red-rumped Parrot	P		Seen
Psophodes olivaceus	Eastern Whipbird	P		Seen
Ptilonorhynchus violaceus	Satin Bowerbird	P		Seen
*Pycnonotus jocosus**	Red-whiskered Bulbul	U		Seen
Rhipidura albiscapa	Grey Fantail	P		Seen
Rhipidura leucophrys	Willie Wagtail	P		Seen
Scythrops novaehollandiae	Channel-billed Cuckoo	P		Seen
Sericornis frontalis	White-browed Scrubwren	P		Seen
Smicrornis brevirostris	Weebill	P		Seen
Strepera graculina	Pied Currawong	P		Seen
*Sturnus tristis**	Common Myna	U		Seen
*Sturnus vulgaris**	Common Starling	U		Seen
Todiramphus sanctus	Sacred Kingfisher	P		Seen
Trichoglossus haematodus	Rainbow Lorikeet	P		Seen
*Turdus merula**	Eurasian Blackbird	U		Seen
Vanellus miles	Masked Lapwing	P		Seen
Zosterops lateralis	Silvereye	P		Seen
MAMMALS				
*Bos taurus**	European cattle	U		Seen
*Canis lupus familiaris**	Dog	U		Scat
*Vulpes vulpes**	Fox	U		Scat, Camera trap
*Equus caballus**	Horse	U		Seen
*Felis catus**	Cat	U		Seen
*Oryctolagus cuniculus**	Rabbit	U		Seen
Macropod sp.	unidentified macropod	P		Scat
Wallabia bicolor	Swamp Wallaby	P		Scat
*Rattus rattus**	Black Rat	U		Seen
Isoodon/Perameles sp.	unidentified Bandicoot	P		Diggings
Pseudocheirus peregrinus	Common Ringtail Possum	P		Seen
Pteropus sp.		P		Seen, overfly
Saccolaimus flaviventris	**Yellow-bellied Sheathtail-bat**	**V**		**Anabat D**

Scientific Name	Common Name	NSW Status	EPBC Status	Observation Type
Mormopterus "Species 2"	Undescribed Freetail Bat	P		Trapped, Anabat D
Mormopterus norfolkensis	**Eastern Freetail-bat**	**V**		**Anabat PR**
Tadarida australis	White-striped Freetail-bat	P		Heard, Anabat D
Tachyglossus aculeatus	Short-beaked Echidna	P		Seen
Chalinolobus gouldii	Gould's Wattled Bat	P		Trapped, Anabat D
Chalinolobus morio	Chocolate Wattled Bat	P		Anabat PR
Falsistrellus tasmaniensis	**Eastern False Pipistrelle**	**V**		**Anabat PO**
Miniopterus australis	**Little Bentwing-bat**	**V**		**Anabat D**
Miniopterus orianae oceanensis	**Eastern bentwing Bat**	**V**		**Anabat D**
Myotis macropus	**Southern Myotis**	**V**		**Anabat PO**
Nyctophilus geoffroyi	Lesser Long-eared Bat	P		Trapped
Nyctophilus sp.	Long-eared bat	P		Anabat PO
Scoteanax rueppellii	**Greater Broad-nosed Bat**	**V**		**Anabat PO**
Scotorepens orion	Eastern Broad-nosed Bat	P		Trapped, Anabat PR
Vespadelus darlingtoni	Large Forest Bat	P		Anabat D
Vespadelus regulus	Southern Forest Bat	P		Anabat PR
Vespadelus sp.	Unidentified Vespadelus	P		Anabat
Vombatus ursinus	Common Wombat	P		Seen
REPTILES				
Amphibolurus muricatus	Jacky Lizard	P		Seen
Chelodina longicollis	Eastern Snake-necked Turtle	P		Seen
Eulamprus quoyii	Eastern Water-skink	P		Seen
Lampropholis delicata	Dark-flecked Garden Sunskink	P		Seen
Lampropholis guichenoti	Pale-flecked Garden Sunskink	P		Seen
Tiliqua scincoides	Eastern Blue-tongue	P		Seen
FISH				
*Gambusia holbrookii**	Plague Minnow / Mosquito Fish	U		Seen
Anguilla reinhardtii	Long-finned Eel	U		Seen

U – Unprotected under the NSW NPWS Act
P – Protected under the NSW NPWS Act

V – Vulnerable under the NSW TSC Act
D – Definite call identification
PR – Probable call identification
PO – Possible call identification

Appendix B - Assessment of likely occurrence of threatened biota and likelihood of impact

Threatened biota known or predicted to occur in the locality and their likelihood of occurrence at the site

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
ECOLOGICAL COMMUNITIES					
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC		Occurs on landward side of mangrove stands in intertidal zones along the shores of estuaries and lagoons that are permanently or intermittently open to the sea. Characterised by *Baumea juncea, Juncus kraussii, Sarcocornia quinqueflora, Sporobolus virginicus, Triglochin striata, Isolepis nodosa, Samolus repens, Selliera radicans, Suaeda australis* and *Zoysia macrantha*, with occasional scattered mangroves occurring throughout the saltmarsh. Saltpans and tall reeds may also occur.	Absent.	Nil.
Coastal Upland Swamp in the Sydney Basin Bioregion	EEC		Associated with periodically waterlogged soils on Hawkesbury sandstone plateaus, generally where mean annual rainfall exceeds 950 mm. The vegetation is dominated by sclerophyll shrubs and/or sedges, with dynamic mosaics of structural forms that may include tall scrub, open heath and/or sedgeland. Although typically treeless, Coastal Upland Swamp may include scattered trees. Dominant species include various combinations of *Leptospermum juniperinum, L. grandifolium, Melaleuca squarrosa, Banksia robur* and *Epacris paludosa*, often with a dense layer of *Gleichenia* spp. and/or sedges including *Gahnia sieberiana, Baumea teretifolia, Chorizandra sphaerocephala* and *Empodisma minus*, and the grass *Tetrarrhena turfosa*.	Absent.	Nil.
Freshwater wetlands on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions	EEC		Freshwater Wetlands on Coastal Floodplains occur in coastal areas subject to periodic flooding in which standing fresh water persists for at least part of the year in most years. Typically occurring on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes, it may also occur in backbarrier landforms where floodplains adjoin coastal sandplains, generally below 20 m elevation on level areas. Structure and composition of the community varies spatially and temporally depending on the water regime, though is usually dominated by herbaceous plants and has few woody species	Absent.	Nil.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			(OEH 2013b).		
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	EEC		Occurs in the lower Hunter Valley, growing on Permian sediments on gentle slopes of depressions and drainage flats of the valley floor. Open forest dominated by *Eucalyptus tereticornis* and *E. punctata*, over an open shrub layer commonly including *Breynia oblongifolia, Leucopogon juniperinus, Daviesia ulicifolia* and *Jacksonia scoparia*. Ground cover comprises grasses and herbs.	Absent.	Nil.
Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion	EEC		Kincumber Scribbly Gum Forest is restricted to a small area on the Bouddi Peninsula on the NSW Central Coast south of Kincumber. It occurs in the Gosford LGA. The total remaining area of Kincumber Scribbly Gum Forest to thought to be less than 100 ha within an area of about 4 km^2. Kincumber Scribbly Gum Forest is an open forest with a tree canopy dominated by some combination of *Eucalyptus racemosa* (Scribbly Gum), *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Syncarpia glomulifera* (Turpentine) and *Eucalyptus piperita* (Sydney Peppermint). There is a prominent shrub layer which typically includes *Dodonaea triquetra* (Hopbush), *Platylobium formosum*, *Persoonia levis* (Broad-leaved Geebung), *Breynia oblongifolia* (Coffee Bush), *Leptospermum polygalifolium* (Lemon-scented Tea-tree), and *Lomatia silaifolia* (Crinkle Bush). The groundcover comprises herbs, scramblers, grasses, sedges and ferns, such as *Billardiera scandens* (Appleberry), *Cassytha glabella*, *Dianella caerulea* (Blue Flax Lily), *Entolasia stricta* (Wiry Panic), *Pratia purpurascens* (Whiteroot), *Pteridium esculentum* (Bracken) and *Tetrarrhena juncea* (Wire Grass).	Absent.	Nil.
Littoral Rainforest in the NSW North Coast; Sydney Basin and South East Corner Bioregions	EEC	CEEC	A closed forest, the structure and composition of which is strongly influenced by its proximity to the ocean. Plant species of this community are predominantly rainforest species, with vines potentially comprising a major component of the canopy. The canopy layer is dominated by rainforest species, with scattered emergent individuals of sclerophyll species also occurring in many stands. There is considerable floristic variation between stands with localised variants occurring in some regions. Littoral Rainforest occurs only on the coast and is	Absent.	Nil.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			found in the NSW North Coast Bioregion, Sydney Basin Bioregion and South East Corner Bioregion. It is a very rare community and occurs in many small stands, and comprises less than one percent of total rainforest present in NSW (OEH 2013b).		
Low woodland with heathland on indurated sand at Norah Head	EEC		Known to occur only near Norah Head, east of Wilfred Barrett Drive, within the Wyong Local Government Area, on the Central Coast of NSW. None of this community is represented within a conservation reserve. Low woodland with heathland on indurated sand at Norah Head is a low woodland or heathland with a very open cover of trees up to 3 metres high. Small trees species present include *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Melaleuca sieberi*, *Corymbia gummifera* (Red Bloodwood) and the Endangered *Eucalyptus camfieldii* (Camfield's Stringybark). The dense shrub layer includes *Banksia oblongifolia* (Fern-leaved Banksia), *Hakea dactyloides* (Finger Hakea), *Melaleuca nodosa* (Prickly-leaved Paperbark) and *Allocasuarina distyla*. Common species in the ground layer include *Themeda australis* (Kangaroo Grass), *Leptocarpus tenax*, *Gonocarpus teucrioides* (Raspwort), *Anisopogon avenaceus* (Oat Speargrass) and *Ptilothrix deusta*.	Absent.	Nil.
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	EEC		Occurs along the NSW coast, usually within 2 km of the ocean on a variety of substrates. Variable structure and composition, typically with closed canopy. Generally rainforest species with vines a major component.	Absent.	Nil.
Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	EEC		Quorrobolong Scribbly Gum Woodland is low shrubby woodland with the overstorey dominated by *Eucalyptus racemosa* (Scribbly Gum). Other tree species present include *E. piperita* (Sydney Peppermint), *E. resinifera* (Red Mahogany), *Angophora costata* (Smooth-barked Apple) and *E. punctata* (Grey Gum). There is usually a well-developed shrub layer with common species being *Leptospermum trinervium* (Slender Tea-tree), *Acacia parvipinnula* (Silver-stemmed Wattle), *Persoonia linearis* (Narrow-leaved Geebung) and *Leptospermum polygalifolium* (Tantoon). The ground layer is often sparse and	Absent.	Nil.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			frequently occurring species are *Imperata cylindrica* var. *major* (Blady Grass), *Panicum simile* (Two-colour Panic), *Pratia purpuracens* (Whiteroot), *Lomandra cylindrica* (Needle Mat-rush) and *Dianella revoluta*. Currently known from only a small area between Quorrobolong and Mulbring in the Cessnock local government area, but may also occur elsewhere within the Hunter Valley. The current known extent is about 70 hectares.		
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions	EEC		This community is found on the river flats of the coastal floodplains and is characterised by a tall open canopy layer of eucalypts, up to or exceeding 40 m in height. Though composition varies considerably, characteristic tree species include Forest Red Gum (*Eucalyptus tereticornis*), Cabbage Gum (*E. amplifolia*), Rough-barked Apple (*Angophora floribunda*) and Broad-leaved Apple (*A. subvelutina*). Blue Box (*Eucalyptus baueriana*), bangalay (E*. botryoides*), and south of Sydney, River Peppermint (*E. elata*) may also occur. Swamp Gum (*E. ovata*) occurs on the far south coast, Sydney Blue Gum (E*. saligna*) and Flooded Gum (*E. grandis*) may occur north of Sydney, while *E. benthamii* is restricted to the Hawkesbury floodplain. *Melaleuca decora*, Prickly Leaved tea tree (*M. styphelioides*), Grey Myrtle (*Backhousia myrtifolia*), White Cedar (*Melia azaderach*), River Oak (*Casuarina cunninghamiana*) and Swamp Oak (*C. glauca*) may also occur (OEH 2013b)	Present in area 3.	Removal of 0.61 ha
Swamp oak floodplain forest of the NSW North Coast; Sydney Basin and South East Corner bioregions	EEC		Swamp Oak Floodplain is found on coastal floodplains of NSW. It has a dense to sparse tree layer dominated by Swamp Oak (*Casuarina glauca*). Lilly Pilly (*Acmena smithii*), Cheese Trees (*Glochidion spp*.) and Paperbarks (*Melaleuca spp*.) may be present. Tree diversity decreases with latitude, and *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui. The understorey is characterised by frequent occurrences of vines *Parsonsia straminea, Geitonoplesium cymosum* and *Stephania japonica var. discolor*, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter. Varying salinity levels alter groundcover species (OEH 2013b)	Absent.	Nil.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions	EEC		Swamp Sclerophyll Forest on Coastal Floodplains is characterised by an open to dense tree layer of eucalypts and paperbarks, with trees up to or higher than 25 m. This community includes areas of fern land and tall reed or sedge land, where trees are sparse or absent (OEH 2013b)	**Present** in areas 1 and 3.	**Certain** removal of remnants in area 1 and 3.
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	EEC		Sydney Freshwater Wetlands are a complex of vegetation types largely restricted to freshwater swamps in coastal areas, occurring on sand dunes and low-nutrient sandplains along coastal areas in the Sydney Basin bioregion, varying considerably with fluctuating water levels and seasonal conditions. Characteristic species include sedges and aquatic plants such as Baumea species, *Eleocharis sphacelata, Gahnia* species, *Ludwigia peploides ssp. montevidensis* and *Persicaria* species. Areas of open water may occur where drainage conditions have been altered, with patches of emergent trees and shrubs also occurring. This community group has been extensively cleared and filled, with remaining remnants often small and disturbed (OEH 2013b).	Absent.	Nil.
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC		Themeda australis is the dominant species in the Themeda Grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner bioregion ecological community. *Banksia integrifolia* subsp. *integrifolia*, *Westringia fruticosa* and *Acacia sophorae* occurs as an emergent shrub or as a dense cover where they have recruited over grasslands. Smaller shrubs occur often as prostrate to dwarf forms, most frequently *Pimelea linifolia*, *Hibbertia vestita*, *Pultenaea maritima* and *Westringia fruticosa*. Although a number of woody species are listed as part of the community, these are usually sparsely distributed and may be absent from some stands. Found on a range of substrates in the NSW North Coast, Sydney Basin and South East Corner bioregions. Stands on sandstone are infrequent and small. Larger stands are found on old sand dunes above cliffs, as for example at Cape Banks and Henry Head in Botany Bay National Park.	Absent.	Nil.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion	EEC		A low woodland dominated by trees of *Eucalyptus botryoides* and Angophora floribunda with a diverse understorey of sclerophyllous shrubs species including *Banksia integrifolia*, *Banksia serrata*, *Monotoca elliptica*, *Macrozamia communis*, *Acacia ulicifolia*, *Platysace lanceolata*, *Acacia suaveolens* and *Allocasuarina littoralis*. *Eucalyptus botryoides* is the dominant tree in the zone immediately behind the beach, while Angophora floribunda is dominant in the zone beyond up to 2 km from the beach. The community contains many more species and other references should be consulted to identify these. Largely restricted to coastal sands on the Umina, Woy Woy and Ettalong Sandplain, a beach ridge system within the Gosford local government area.	Absent.	Nil.
FLORA					
Acacia bynoeana	E	V	This semi-prostrate shrub to one metre occurs in heath or dry sclerophyll forest on sandy soils and seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leafed Apple. *A. bynoeana* is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains (OEH 2013b).	Low. This species is easily surveyed and was not recorded during targeted surveys.	Low.
Apatophyllum constablei		E	This species of shrub occurs in dry sclerophyll forest on sandy and skeletal soils on slopes with a north to north-westerly aspect near cliff bases or just above. It grows in association with *Eucalyptus piperita, E. punctata, E. sparsifolia, Banksia serrata, Acacia linifolia, Cleistochloa rigida,* and *Lomandra obliqua*. This species is only known from four sites, three within Wollemi National Park near Gospers Mountain and Coorongooba Creek, and the other about 2 km from Glen Davis. Flowering occurs from August to January (OEH 2013b).	Low. No suitable geomorphology or vegetation associations at the site.	Low.
Asterolasia elegans	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford	Low. No suitable geomorphology.	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			LGA. There are seven known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.		
Biconvex Paperbark *Melaleuca biconvexa*	V	V	This species occurs in damps areas often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. The flowering period for this species is short with flowering taking place over a 3 - 4 week period during September and October. This species is conspicuous and could be easily identified outside the flowering period. *M. biconvexa* populations are threatened by land clearing, too frequent fire, alteration to drainage hydrology, increased pollution, and disturbance by stock (OEH 2013b).	**Present in Areas 1 and 3.**	Impacts avoided in areas 1 and 3.
Black-eyed Susan *Tetratheca juncea*	V	V	This species is known to inhabit low open forest / woodland with a mixed shrub understorey and grass groundcover. It has been recorded in heath and moist forest habitats (OEH 2013b).	Low-medium. Cryptic species potentially overlooked during surveys.	Low-medium.
Caladenia tessellata	E	V	This species of orchid inhabits grassy sclerophyll woodland on clay loam or sandy soils, and low woodland with stony soil. Flowering generally occurs between September and November, however late flowering in September or early October has been recorded in southern populations. This species is known from Sydney (historic records), Wyong, Ulladulla and Braidwood regions in NSW. Kiama and Queanbeyan populations are presumed extinct. Records from the 1930s occur within the Huskisson area. *C. tessellata* occurs on the coast of Victoria from east of Melbourne to almost the NSW border. Threats to this species include clearing associated with urban development, pedestrian activity associated with recreational use along coastal areas, long-term absence of fire, and events leading to local population extinctions (OEH 2013b).	Low-medium. Cryptic species potentially overlooked during surveys. Marginal habitat for the species at the site.	Low.
Camfield's Stringybark *Eucalyptus camfieldii*	V	V	This species is usually a mallee to 4 m tall although it can grow to a straggly tree to 9 m. It occurs on poor coastal country in shallow sandy soils overlying Hawkesbury sandstone often in coastal heath mostly on exposed sandy ridges. Stands usually occur near the boundary of tall coastal heaths and low open	Low. No suitable geomorphology or vegetation associations at the site.	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of Narrow-leaved Stringybark (*E. oblonga*), Brown Stringybark (*E. capitellata*) and Scribbly Gum (*E. haemastoma*) (OEH 2013b)		
Charmhaven Apple *Angophora inopina*	V	V	This species is endemic to the central coast region of NSW and is known to occur in four main vegetation communities: *Eucalyptus haemastoma / Corymbia gummifera / Angophora inopina* woodland / forest; *Hakea teretifolia / Banksia oblongifolia wet heath; Eucalyptus resinifera / Melaleuca sieberi / Angophora inopina sedge / woodland*; and *Eucalyptus capitellata / Corymbia gummifera / Angophora inopina* woodland / forest. Threats include habitat loss and fragmentation, frequent fire, grazing and trampling by livestock, and changes to hydrological process due to urbanisation and industrial development (OEH 2013b).	Low. This species is easily surveyed and was not recorded during targeted surveys. Co-dominant canopy species not present on site.	Low.
Eastern Underground Orchid *Rhizanthella slateri*	V	E	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed. Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. (OEH 2013b)	Low-medium. Cryptic species potentially overlooked during surveys.	Low-medium.
Epacris purpurascens var. *purpurascens*	V		This erect shrub grows from 0.5 to 1.8m and has been recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence. Lifespan is recorded to be 5-20 years, requiring 2-4 years before seed is produced in the wild. The species is killed by fire and re-establishes from the soil seedbank (DECC OEH 2013b).	Low. This species is easily surveyed and was not recorded during targeted surveys.	Low.
Eucalyptus parramattensis	EP		This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in	Low. This species is easily surveyed and was	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
subsp. Parramattensis (Endangered population)			woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (Swamp mahogany), *E. tereticornis* (Forest Red Gum), *E. gummifera* (Sydney Bloodwood) as well as *Melaleuca* (Paperbark) species. The species usually occurs from the Goulburn Valley on the Central West slopes to Hill Top on the Central Coast. The endangered population in the Lake Macquarie and Wyong local government areas is at the north-eastern limit of the species range and is quite separate from other known populations. The majority of the population occurs within Wyong in the Porter's Creek and the Wallarah Creek catchments. (OEH 2013b)	not recorded during targeted surveys.	
Eucalyptus pumila	V	V	This species of Mallee grows to 6 m is known from a single population west of Pokolbin in the Hunter Valley, occurring on a north-west-facing slopes derived from sandstone. Its historic range extended to Wyong and Sandy Hollow, however the species has not been found in these regions for some years. Flowering occurs between April - May, however this species may not flower annually. Threats include too frequent fire, and random natural and human induced events that may lead to the extinction of the small population (OEH 2013b).	Low. No suitable geomorphology or vegetation associations at the site.	Low.
Grevillea parviflora ssp *parviflora*	V	V	The habitat for this species are broad, and are known to occur in areas supporting heath, shrubby woodland and forest on light clay or sandy soils, and often in disturbed areas such as on the fringes of tracks. It has been known to flower over two periods throughout the year, July to December and April to May (OEH 2013b).	Low. This species is easily surveyed and was not recorded during targeted surveys.	Low.
Heath Wrinklewort *Rutidosis heterogama*	V	V	Small perennial herb of the daisy family to 30cm. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides. The species has a scattered distribution coastal location between Wyong and Evans Head and on the New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes. Threats include habitat loss and fragmentation, frequent fire, trampling or picking by visitors, roadside management and risk of local extinction because numbers are low (OEH 2013b).	Low. No suitable geomorphology or vegetation associations at the site.	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Leafless Tongue Orchid *Cryptostylis hunteriana*	V	V	This species is a leafless, saprophytic tongue orchid, which is reliant on a symbiotic relationship with the microrrhizal fungus found in decaying plant matter. Flowering occurs between November and February, producing green, red and black flowers carried on an axillary raceme. Foliage is absent, with the leaves reduced to scales. *C. hunteriana* grows in a range of habitats including swampy heaths on sandy soils, scrubby swamp fringes, through to bare hillsides in tall eucalypt forest. Potential habitat typically occurs in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*Eucalyptus sieberi*), Red Bloodwood and Black She-oak. This species appears to prefer open areas in the understorey and is often found in association with the Large Tongue Orchid (*Cryptostylis subulata*) and the Tartan Tongue Orchid (*Cryptostylis erecta*) (OEH 2013b).	Medium. Cryptic species potentially overlooked during surveys. Suitable habitat for the species in areas 2 and 3.	Medium.
Magenta Lily Pily *Syzygium paniculatum*	E	V	This species is a small to medium rainforest tree, found only in NSW in a narrow linear coast strip from Bulahdelah to Conjola State Forest. It is distinguished from other *Syzygiums* by its large grape-shaped fruit. Threats include fire, loss of habitat through clearing, grazing and trampling by stock, and weed invasion (OEH 2013b).	Low-medium. This species is easily surveyed and was not recorded during targeted surveys. Suitable habitat at the site, so may occur in the soil seed bank or in the future.	Medium. Potential removal of habitat or dormant individuals.
Maundia triglochinoides	V		Perennial with rhizomes about 5mm thick and emergent tufts of leaves arising along their length. The species grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay with low nutrients. It is associated with wetland species e.g. *Triglochin procerum* and flowers during warmer months (November-January). The plant spreads vegetatively, with tufts of leaves arising along rhizome while pollination probably occurs via wind. The diaspore is the seed and root tubers, which are probably dispersed by water. Threatening processes include further loss and fragmentation of habitat, changes in hydrology and water quality and weed invasion (OEH 2013b).	Medium. Cryptic species potentially overlooked during surveys. Suitable habitat for the species in area 1.	Medium.
Narrow-leaved	EP		Normally found on dry open forest with infertile sandy soils on sandstone. The population at Bateau Bay occurs on coastal	Low. No suitable geomorphology or	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Stringybark *Eucalyptus oblonga* (Endangered Population – Bateau Bay)			sands. The species occurs from Gosford to the Appin and Waterfall districts. The disjunct outlier population at Bateau Bay occurs on coastal sands of the Norah Head Soil Landscape. Here it is at the eastern limit of the species' range and is of significant conservation value because it is the only known population of *Eucalyptus oblonga* on coastal sands. Elsewhere the species occurs on sandstone. The population of *Eucalyptus oblonga* at Bateau Bay consists of about 20 trees. (DECC OEH 2013b)	vegetation associations at the site.	
Netted Bottle Brush *Callistemon linearifolius*	V		This species of shrub grows in dry sclerophyll forest on the coast and adjacent ranges of NSW and flowers in spring and summer (OEH 2013b).	Low. This species is easily surveyed and was not recorded during targeted surveys.	Low.
Omeo Stork's-bill *Pelargonium* sp. *striatellum*	E	E	It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Low. There is no suitable habitat within the site.	Low
Pimelea curviflora var. *curviflora*	V	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots. Flowers October to May. Likely to be fire tolerant species capable of resprouting following fire due to the presence of a tap root. Seedlings have been observed following fire (OEH 2013b).	Low. No suitable geomorphology or vegetation associations at the site.	Low.
Prostanthera askania	E	E	An erect, spreading and sometimes scrambling, openly-branched shrub that grows from 1 – 3 metres high. The species is distributed over a very restricted geographic range (<12 km) in the upper reaches of creeks that flow into Tuggerah Lake or Brisbane Water within the Wyong and Gosford local	Low. This species is easily surveyed and was not recorded during targeted surveys. Suitable habitat in area 1	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			government areas (OEH 2013b).	is severely degraded by grazing.	
Prostanthera junonis	E	E	This species of shrub grows to 0.3 m and occurs on both the Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone within open forest/low woodland/open scrub in both disturbed and undisturbed areas. Flowering occurs from October to mid-December. Identification outside this time is very difficult. Its range extends approximately 19 km on the Somersby Plateau in the Gosford and Wyong LGAs (OEH 2013b)	Low. No suitable geomorphology or vegetation associations at the site.	Low.
Rainforest Cassia *Senna acclinis*	E		This species is a shrub to 3 m tall with compound leaves. It can easily be mistaken for introduced Senna species that are environmental weeds. Rainforest Cassia occurs in coastal districts and adjacent tablelands of NSW from Illawarra in NSW to QLD, and grows in or on the edges of subtropical and dry rainforest. Threats include clearing, timber harvesting, weed invasion and accidental removal during weed control activities (OEH 2013b).	Low-medium. This species is easily surveyed and was not recorded during targeted surveys. Suitable habitat at the site, so may occur in the soil seed bank.	Medium. Potential removal of habitat or dormant individuals.
Rough Double Tail *Diuris praecox*	V	V	This species is known to occur on hills and slopes of near-coastal districts in open forests that have a grassy to fairly dense understorey. This species flowers during winter and is only detectable during the flowering season. It has a restricted distribution between Ourimbah to Nelson Bay (OEH 2013b).	Medium. Cryptic species potentially overlooked during surveys. Suitable habitat for the species in areas 2 and 3.	Medium.
Siah's Backbone *Streblus pendulinus*	-	E	Occurs in grassland or grassy woodland. Often found in damp sites in association with kangaroo grass. Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands.	Low. No suitable habitat within the site.	Low.
Spreading Guinea Flower *Hibbertia procumbens*	E		Majority of known populations occur within *Banksia ericifolia–Angophora hispida–Allocasuarina distyla* scrub/heath on skeletal sandy soils. May also be found associated with 'hanging swamp' vegetation communities on sandy deposits. Within NSW, known from several locations only on the Central Coast in the Gosford and Wyong local government areas. These populations are at Bumble Hill near Yarramalong in Wyong LGA; Kulnura, Strickland State Forest, Mangrove	Low-medium. This species is easily surveyed and was not recorded during targeted surveys. Suitable habitat at the site, so may occur in the soil seed bank.	

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			Mountain, Somersby, Calga/Mt White and Peats Ridge in the Gosford LGA; and near Mogo Creek to the west of Mangrove Creek Dam. It has been recorded in four conservation reserves: Yengo, Popran and Brisbane Water National Parks and the non-production Strickland State Forest. Also occurs in Victoria and Tasmania, although investigation is required to verify that the disjunct NSW populations are the same species (OEH 2013b).		
Thelymitra sp. adorata	CE		This species is a hairless terrestrial herb, dying back annually to a tuberous rootstock. It is currently known from a few occurrences in the area bounded by the towns of Wyong, Warnervale and Wyongah on the New South Wales Central Coast, within the Wyong Local Government Area and in the Sydney Basin Bioregion (sensu Thackway and Cresswell 1995). The extent of occurrence is about 5 km^2 (a range of 5 km east-west by about 1 km north-south). Total area of occupancy is confined to two 4 km^2 grids and the recorded populations occupy patches totalling less than 100 m^2 within this area. The geographical distribution is therefore very highly restricted (OEH 2013b)	Low-medium. Cryptic species potentially overlooked during surveys.	Low-medium.
FAUNA					
Antipodean albatross *Diomedea exulansantipodensis*	-	V	The Antipodean Albatross is endemic to New Zealand, however forages widely in open water in the south-west Pacific Ocean, Southern Ocean and the Tasman Sea, notably off the coast of NSW. It is marine, pelagic and aerial. The Antipodean Albatross breeds on the New Zealand islands of Antipodes Island, Campbell Island, Pitt Island and the Auckland Islands.	Low. No suitable habitat at the site.	Low.
Australian Fairy Tern *Sternula nereis nereis*	-	V	Occurs along NSW coast. Inhabit offshore, estuarine or lake islands, wetlands, beaches and spits. Nests on coral shingle on continental islands or coral cays, on sandy islands and beaches inside estuaries and on open sandy beaches.	Low. No suitable habitat at the site.	Low.
Australian Grayling *Prototroctes maraena*	-	V	The Australian Grayling occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range, from Sydney, southwards to the Otway Ranges of Victoria and in Tasmania. The Australian Grayling is diadromous, spending	Low. No suitable habitat at the site.	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones.		
Australasian Bittern *Botaurus poiciloptilus*	V		This species favours permanent freshwater wetlands with tall dense reedbeds particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.) with adjacent shallow, open water for foraging. No breeding population known from the Lower Hunter. It hides during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails. (OEH, 2013b).	Medium. Suitable habitat in freshwater wetlands in area 1.	Medium. Removal of potential habitat.
Barking Owl *Ninox connivens*	V		Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as *Acacia* and *Casuarina* species, or in dense clumps of canopy leaves in large eucalypts. The Barking owl feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits important during breeding. This species lives alone or in a pair with territories ranging from 30 to 200 hectares. Nests are built in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camandulensis*), White Box (*Eucalyptus albens*), Red Box (*Eucalyptus polyanthemos*), and Blakely's Red Gum (*Eucalyptus blakelyi*). Breeding occurs during late winter and early spring (OEH, 2013b).	Medium. Potentially suitable habitat forest at the site.	Medium. Removal of potential habitat.
Black Bittern *Ixobrychus flavicollis*	V		Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. This species may roost by day in trees or within reeds on the ground. Nests are located in branches overhanging water and breeding takes place from December to March (OEH, 2013b).	Medium. Suitable habitat in freshwater wetlands in area 1.	Medium. Removal of potential habitat.
Black-necked Stork *Ephippiorhynchus asiaticus*	E		Primarily inhabits permanent freshwater wetlands but can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. This species breeds during summer, nesting in or near a freshwater	Medium. Suitable habitat in freshwater wetlands and adjacent moist grassland in area 1.	Medium. Removal of potential habitat.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			swamp (OEH, 2013b).		
Black-tailed Godwit *Limosa limosa*	V	M	Primarily a coastal species, usually found in sheltered bays, lagoons and estuaries with large intertidal mudflats and/or sandflats where it is frequently recorded in mixed flocks with Bar-tailed Godwits. Inland, it can be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Individuals have also been recorded in wet fields and sewerage treatment works. This species feeds on a variety of insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles present in soft mud or shallow water. Roosting and loafing occurs on low banks of mud, sand and shell bars (OEH, 2013b).	Low-medium. Marginal habitat in freshwater wetlands and adjacent moist grassland in area 1.	Low. Removal of marginal habitat.
Broad-billed Sandpiper *Limicola falcinellus*	V	M	This species favours sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, salt marshes, and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow fresh-water lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches. This species is an active forager, typically feeding by rapidly and repeatedly jabbing its bill into soft wet mud. Feeding also occurs while wading, often in water so deep that they have to submerge their heads and necks in order to probe the underlying mud. Their diet includes insects, crustaceans, molluscs, worms, and seeds (OEH, 2013b).	Low-medium. Marginal habitat in freshwater wetlands and adjacent moist grassland in area 1.	Low. Removal of marginal habitat.
Broad-headed Snake *Hoplocephalus bungaroides*	V	V	This species is generally black above with yellow spots forming narrow, irregular cross-bands. The average length is around 60 cm, with a maximum of 150 cm. The Broad-headed snake is nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. It feeds mostly on geckos and small skinks, as well as occasionally on frogs and small mammals. Threats include the removal of bushrock from sandstone escarpments, the intentional killing of snakes discovered during bushrock collecting or other outdoor activities, illegal collection of individuals by reptile collectors, removal of large hollow-bearing trees adjacent to sandstone escarpments, and damage	Low. No suitable geomorphology or vegetation associations at the site.	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			to habitat by feral goats (OEH, 2013b).		
Brush-tailed Rock Wallaby *Petrogale penicillata*	E	V	This species of small wallaby occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. In NSW they occur along the whole Eastern section of the State. Threats include habitat loss, degradation and fragmentation, predation by foxes and feral dogs, competition with feral goats for food, and inappropriate fire regimes (OEH, 2013b).	Low. No suitable geomorphology or vegetation associations at the site.	Low.
Bush Stone-curlew *Burhinus grallarius*	E		This species inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights, it feed on insects and small vertebrates, such as frogs, lizards and snakes. Nests are on the ground in a scrape or small bare patch. Threats include predation by foxes and cats, trampling of eggs by cattle, clearance of woodland habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, grazing and frequent fires, and other disturbance in the vicinity of nest sites (OEH, 2013b).	Low. No suitable vegetation associations at the site.	Low.
Comb-crested Jacana *Irediparra gallinacea*	V		This species of bird occurs throughout coastal Australia and well inland in the north from the Kimberley to Sydney. Vagrants occasionally appear further south, possibly in response to unfavourable conditions further north in NSW. Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies. Pairs and family groups forage across floating vegetation, walking with a characteristic bob and flick, or flying low with toes dangling behind. They feed primarily on insects and other invertebrates, as well as some seeds and other vegetation. Breeds in spring and summer in NSW, in a nest of floating vegetation. (OEH, 2013b).	Low-medium. Marginal habitat in freshwater wetlands and adjacent moist grassland in area 1.	Low. Removal of marginal habitat.
Curlew Sandpiper *Calidris ferruginea*	E	M	The Curlew Sandpiper is distributed around most of the coastline of Australia (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-	Low. No suitable habitat at the site.	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Diamond Firetail *Stagonopleura guttata*	V		This species is known to occur in grassy eucalypt woodlands, including Box-Gum Woodlands, and Snow Gum (*Eucalyptus pauciflora*) Woodlands, riparian areas (rivers and creeks), and sometimes in lightly wooded farmland (OEH, 2013b).	Low. No suitable vegetation associations at the site.	Low.
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	V		This species has dark reddish-brown to dark brown fur and is essentially a cave bat, but also utilises man-made habitats such as road culverts, storm-water tunnels and other man-made structures. It is known from a variety of habitats along the east coast including rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grasslands (Churchill 1998, OEH, 2013b). In forested areas, it flies above the canopy to hunt, while in open grassland areas, flight may be within 6 m of the ground. Moths form the major component of their diet and breeding takes place from October to April (Churchill 1998).	**Present.** Definite Anabat recording at the site.	**Certain.** Removal of foraging habitat.
Eastern Bristlebird *Dasyornis brachypterus*	-	E	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Low. No suitable habitat at the site.	Low.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V		This species of bat inhabits moist forest generally with trees larger than 20 m and roosts in eucalypt hollows, underneath bark or in buildings. Diet consists of moths, beetles and other insects, which it collects within or just below the tree canopy. This species hibernates during winter and breeding takes place in late spring (OEH, 2013b).	Medium. Possible Anabat recording at the site.	Removal of potential foraging habitat and diurnal roosts.
Eastern Freetail-bat *Mormopterus norfolkensis*	V		This species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range and roosts primarily in tree hollows but also in man-made structures or under bark. This species is solitary and probably insectivorous (OEH, 2013b)	**Present.** Probable Anabat recording at the site.	**Certain.** Removal of foraging habitat and potential diurnal roosts.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Eastern Pygmy-possum *Cercartetus nanus*	V		This species is a small arboreal marsupial distributed along the coast of southern QLD, NSW, and Victoria, south eastern SA, and is present throughout Tasmania (Bowen and Goldingay 2000). It is generally a solitary species with home ranges of the males around 0.68 ha and females around 0.35 ha. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting sites in drier habitats. The eastern Pygmy-possum's diet consists largely of pollen and nectar from Banksia spp., Eucalyptus spp., Callistemon spp. and insects (Turner and Ward 1995). It nest in hollows in trees but its small size allows it to nest in a variety of places including under the bark of Eucalypts, forks of tea-trees, and in abandoned bird nests (Turner and Ward 1995). It is an agile climber and a very mobile species, and may undergo short-term seasonal migration possibly in response to food availability (Bowen and Goldingay 2000). The majority of births occur in spring to early autumn, but if abundant food supplies are available breeding will continue on the mainland throughout the year (Turner and Ward 1995).	Low-medium. Potentially suitable habitat at the site, primarily within area 3. May be limited by habitat fragmentation and feral predators.	Low.
Eastern Bristlebird *Dasyornis brachypterus*	-	E	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Low. No suitable habitat at the site.	Low
Eastern Osprey *Pandion cristatus*	V	M	Ospreys are found right around the Australian coastline, except for Victoria and Tasmania. Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	Low. No suitable habitat at the site.	Low.
Flame Robin	V		In NSW, the Flame Robin breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that	Low. Minimal suitable	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Petroica phoenicea			there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys.	habitat at the site.	
Flesh-footed Shearwater *Ardenna carneipes*	V	M	The Flesh-footed Shearwater is a trans-equatorial migrant. The species is widely distributed across the southern Indian and south-western Pacific Oceans during the breeding season with colonies located off the coast of Eyre Peninsula in South Australia, on Lord Howe Island (DSEWPaC, 2013a). Mainly occurs in the subtropics over continental shelves and slopes and occasionally inshore waters. Pairs breed on islands in burrows on sloping ground in coastal forest, scrubland, shrubland or grassland (DSEWPaC, 2013a).	Low. No suitable habitat at the site.	Low.
Gang-gang Cockatoo *Callocephalon fimbriatum*	V		This species is nomadic, spending summer in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests and winter at lower altitudes in drier more open eucalypt forest and woodlands, particularly in coastal areas. This species nests in hollow-bearing trees close to water with breeding taking place between October and January. Breeding usually occurs in tall mature sclerophyll forests that have a dense understorey, and occasionally in coastal forests (OEH, 2013b).	Medium. Suitable habitat in forest at the site.	Removal of potential foraging habitat and roost trees.
Giant Barred Frog *Mixophyes iteratus*	E	E	This species occurs on the coast and ranges from south eastern QLD to the Hawkesbury River in NSW, particularly in Coffs Harbour - Dorrigo area. They forage and live amongst deep, damp leaf litter in rainforest, moist eucalypt forest and nearby dry eucalypt forest. They breed in shallow, flowing rocky streams from late spring to summer, and feed primarily on large insects and spiders (OEH, 2013b).	Low. Potentially suitable vegetation associations but habitat is fragmented and isolated from core breeding habitat.	Low.
Giant Burrowing Frog *Helioporus australiasicus*	V	V	This species of frog ranges from south eastern NSW through to Victoria and appears to exist as two distinct populations: The Northern population occurs on sandy soils supporting heath, woodland or open forest and has a marked preference for sandstone ridge top habitats and broader upland valleys along	Low. Potentially suitable vegetation associations. Not recorded despite GHD (2007a) targeted surveys.	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			slow flowing to intermittent creek lines. It requires creeks and watercourses for breeding but spends drier months buried under deep leaf litter or sandy loose soil within vegetated areas. This species has been found occurring at considerable distance from suitable riparian breeding or other moist habitats, indicating an ability to move about freely. This species calls mainly in spring and autumn with calling bouts after rains in late summer (Anstis 2002), although may be sampled at any time of the year providing it is raining (Recsei 1996). Breeding takes place from August to march. It feeds on ground-dwelling invertebrates such as beetles, ants, and spiders (OEH, 2013b).		
Giant Dragonfly *Petalura australis*	E		The Giant Dragonfly is the second largest dragonfly in Australia and one of the largest dragonflies in the world. The Giant Dragonfly is found along the east coast of NSW from the Victorian border to northern NSW. It is not found west of the Great Dividing Range. There are known occurrences in the Blue Mountains and Southern Highlands, in the Clarence River catchment, and on a few coastal swamps from north of Grafton to Nadgee. They live in permanent swamps and bogs with some free water and open vegetation (OEH, 2013b).	Medium. Suitable habitat in freshwater wetlands in area 1.	Medium. Removal of potential habitat.
Gibson's albatross *Diomedea exulans gibsoni*	-	V	There are no breeding colonies of Gibson's Albatross in Australian territory. This albatross visits Australian waters while foraging and during the non-breeding season. In Australian territory, Gibson's Albatross has been recorded foraging between Coffs Harbour, NSW, and Wilson's Promontory, Victoria. Gibson's Albatross is marine, pelagic and aerial.	Low. No suitable habitat at the site.	Low.
Glossy Black Cockatoo *Calyptorhynchus lathami*	V	E (SA population only)	This species is highly specialised, feeding almost exclusively on the seeds extracted from the wooden cones of Allocasuarina species including Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*Allocasuarina torulosa*) or Drooping She-oak (*Allocasuarina verticilliata*). It is uncommon although widespread throughout suitable forest and woodland habitats, from central QLD to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW. This species needs suitable hollows in living and dead trees for nesting and breeds between March and August (OEH, 2013b).	**Present** in areas 1 and 3.	**Certain.** Removal of potential feed and nesting trees in areas 1 and 2.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Golden-tipped Bat *Kerivoula papuensis*	V		The Golden-tipped Bat has dark brown, curly fur with bright golden tips. The distinctively coloured fur extends along the wings, legs and tail. It has a short, pointed, over-hanging muzzle and pointy, funnel-shaped ears. Found in rainforest and adjacent sclerophyll forest. Roost in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests located in rainforest gullies on small first- and second-order streams. The Golden-tipped Bat will fly up to two km from roosts to forage in rainforest and sclerophyll forest on upper-slopes. It is a specialist feeder on small web-building spiders (OEH, 2013b).	Medium. Suitable habitat in forest at the site.	Removal of potential foraging habitat.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V		This species is a large and robust bat that feed on slow-flying prey such as large moths and beetles. It hunts from above rows of trees lining creeks and the edges of woodland in otherwise cleared paddocks, roosting in hollow tree trunks and branches as well as the roofs of old buildings (Churchill 1998). It inhabits a variety of habitats ranging from moist and dry eucalypt forest and rainforest to tall wet forest, however tends to prefers moist gullies in mature coastal forest or rainforest from the Atherton Tablelands in north QLD, along the coastal regions to southern NSW. The species is only found at low altitudes (below 500 m) (Churchill 1998). Reproduction takes place in January at maternal roosting sites. Suspected threats include clearing and fragmentation of forests in coastal and lowland areas, and the effects of logging activities including direct mortality and reduction of suitable hollows (OEH, 2013b).	Medium. Possible Anabat recording at the site.	Removal of potential foraging habitat and diurnal roosts.
Greater sand-plover *Charadrius leschenaultii*	V		This species is almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. It roosts during high tide on sandy beaches and rocky shores; begins foraging activity on wet ground at low tide, usually away from the edge of the water (OEH, 2013b).	Low-medium. Marginal habitat in freshwater wetlands and adjacent moist grassland in area 1.	Low. Removal of marginal habitat.
Great Knot *Calidris tenuirostris*	V	-	Recorded at scattered sites along the coast of NSW north to about Narooma. Inhabits sheltered coastal habitats such as inlets, bays, harbours, estuaries and lagoons.	Low. No suitable habitat at the site.	Low.
Green and Golden Bell Frog	E	V	This species inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. It prefers	Low. Suitable habitat in freshwater wetlands in	Low. Removal of potential habitat but local

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Litoria aurea			sites containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. They are active by day and breed during the summer months. Plague Minnow (*Gambusia holbrooki*) is a key threatening process as they feed on green and Golden Bell Frog eggs and tadpoles. (OEH, 2013b).	area 1. No recent records despite URS (2007a) targeted surveys.	population very unlikely to occur.
Green-thighed Frog *Litoria brevipalmata*	V		Distribution of this species of frog encompasses isolated localities along the coast and ranges from the NSW central coast to south-east Queensland. Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. The species is thought to forage in leaf-litter (OEH, 2013b).	Low. Suitable habitat in moist forest in areas 1, 2 and 3. No recent records despite URS (2007a) targeted surveys.	Low. Removal of potential habitat but local population unlikely to occur.
Grey-crowned Babbler (eastern subspecies) *Pomatostomus temporalis subsp temporalis*	V		This species inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. It lives in family groups that consist of up to fifteen individuals. All members of the family group remain close to each other when foraging, feeding on invertebrates, either on the trunks and branches of eucalypts and other woodland trees, or on the ground digging and probing amongst litter and tussock grasses. Territories range from 1 to 50 hectares (usually around 10 hectares), and are defended all year round (OEH, 2013b).	Low. No suitable dry grassy woodland or forest habitat at the site.	Low.
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	This species roosts in camps generally located within 20 km of a regular food source and are commonly found in gullies, close to water and in vegetation with a dense canopy. This species is known to forage in areas supporting subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps on the nectar and pollen of native trees, in particular eucalypts, melaleucas and banksias. Grey-headed Flying-fox show a regular pattern of seasonal movement with much of the population moving to northern NSW and QLD during May and June where they exploit the winter flowering trees such as Swamp Mahogany, Forest red gum and Paperbark (NSW Scientific Committee 2004). This species will also forage in urban gardens and cultivated fruit crops (OEH, 2013b).	High. Very likely to forage at the site. No roost camps recorded during surveys.	High. Removal of foraging habitat.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Koala *Phascolarctos cinereus*	V	V	The Koala is protected under SEPP 44, which aims to conserve habitat within its current distribution. The Koala has a fragmented distribution throughout eastern Australia. It is limited to areas of preferred feed trees in eucalypt woodlands and forests. Along the coastal fringe these areas are becoming more fragmented and isolated due to urbanisation. The size of their home range varies depending on the quality of habitat, ranging from less than 2 ha to several hundred hectares in size. Females breed at two years of age and produce one young per year (OEH, 2013b).	Medium. Feed trees in forest at the site. May be limited by fragmentation and feral predators.	Removal of potential foraging habitat.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	This species is distributed between south-eastern QLD to NSW from the coast to the western slopes of the divide. This species roosts in caves and mines and has been most commonly recorded from dry sclerophyll forests and woodlands. *C. dwyeri* is an insectivorous species that flies relatively slowly over the canopy or along creek beds (Churchill 1998) (OEH, 2013b).	Medium. Potentially suitable foraging habitat at the site.	Removal of potential foraging habitat.
Lesser Sand-plover *Charadrius mongolus*	V	M	Primarily a coastal species, favouring mudflats, harbours and lagoons (OEH, 2013b).	Low-medium. Marginal habitat in freshwater wetlands and adjacent moist grassland in area 1.	Low. Removal of marginal habitat.
Little Bentwing-bat *Miniopterus australis*	V		This species of bat inhabits moist eucalypt forest, rainforest or dense coastal Banksia scrub. This species primarily roosts in caves, tunnels and sometimes tree hollows. Breeding for this species occurs during winter at maternal roost sites (OEH, 2013b).	**Certain.** Definite Anabat recording.	**Certain.** Removal of foraging habitat and potential diurnal roosts.
Little Eagle *Hieraaetus morphnoides*	V	-	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	Low. Marginal foraging habitat at the site. No nests recorded.	Low.
Little Lorikeet *Glossopsitta*	V		This species occurs in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant	Medium. Potentially suitable foraging habitat at the site.	Removal of potential foraging habitat.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
pusilla			woodland patches and roadside vegetation on the western slopes. Generally thought to be nomadic. The distribution of the Little Lorikeet extends from just north of Cairns, around the east coast of Australia, to Adelaide. In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri (OEH, 2013b).		
Little Tern *Sterna albifrons*	E	M	Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria, and is almost exclusively coastal, preferring sheltered environments, however also occurs several kilometres from the sea in harbours, rivers, and inlets. It breeds through spring and summer, nesting in small, scattered colonies on low dunes or sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands. The nest is a scrape in the sand, which may be lined with shell grit, seaweed or small pebbles. Their diet consists of small fish, crustaceans, insects, annelids and molluscs sourced from shallow water in channels and estuaries, and in the surf on beaches (OEH, 2013b).	Low-medium. Marginal habitat in freshwater wetlands and adjacent moist grassland in area 1.	Low. Removal of marginal habitat.
Littlejohn's Treefrog *Litoria littlejohni*	V	V	Littlejohn's Tree Frog has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. It occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops, hunting either in shrubs or on the ground. Breeding is triggered by heavy rain and can occur from late winter to autumn, but is most likely to occur in spring when conditions are favourable. Males call from low vegetation close to slow flowing pools and eggs are laid in loose gelatinous masses attached to small submerged twigs. Eggs and tadpoles are mostly found in slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools (OEH, 2013b)	Low. No suitable geomorphology at the site.	Nil.
Long-nosed	V	V	Moist forest types from montane wet sclerophyll forests with	Low-medium. Suitable	Removal of potential

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Potoroo *Potorous tridactylus tridactylus*			dense understorey between 150 m to over 1000m altitude. Its diet consists primarily of underground fruiting fungi as well as some invertebrates and fruits, requiring year-round moist soils to persist. Small conical pits are dug in the ground as it searches for food. It shelters in crude nests made under dense vegetation during the day, coming out to feed at night. Breeding occurs throughout the year (OEH, 2013b).	habitat in forest at the site. May be limited by fragmentation and feral predators.	foraging habitat, local population unlikely to occur.
Masked Owl *Tyto novaehollandiae*	V		This species occurs in dry eucalypt woodlands at altitudes from sea level to 1100 m and roosts and breeds in hollows and sometime caves in moist eucalypt forested gullies. It hunts along the edges of forests and roadsides and has a home range covering between 500 ha and 1000 ha. Prey for this species are principally terrestrial mammals but arboreal species may also be taken. Masked Owls are sparsely distributed from southern QLD to SA and WA. It has also been recorded on the Nullarbor plain. The southern subspecies occupies a home range of 5 to 10 square km. (OEH, 2013b).	Medium. Potentially suitable foraging habitat at the site.	Removal of potential foraging habitat.
New Holland Mouse *Pseudomys novaehollandiae*	-	V	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).	Low. No suitable habitat at the site.	Low.
Osprey *Pandion haliaetus*	V	M	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea. (OEH, 2013b).	Low-medium. Marginal foraging habitat drainage lines in area 1 and potential roosting habitat in forest across the site.	Low. Removal of marginal habitat.
Painted Honeyeater *Grantiella picta*	V		This species of small bird feeds primarily on the fruits of mistletoes growing on woodland eucalypts and acacias. Its preferred diet consists of the mistletoe genus *Amyema*; however it is also known to eat insects and Mistletoe nectar. This species is nomadic, occurring at low densities throughout	Medium. Potentially suitable foraging habitat at the site.	Removal of potential foraging habitat.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			its range. Most breeding occurs on the inland slopes of the Great Dividing Range in NSW, and this is where the greatest densities of this species are found. (OEH, 2013b).		
Painted Snipe *Rostratula benghalensis*	E	V, M	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. This cryptic species nests on the ground amongst tall reed-like vegetation near water. It emerges from the dense growth at dusk to feed on mudflats and the water's edge taking insects, worm and seeds. This species prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (OEH, 2013b).	Low-medium. Marginal habitat in freshwater wetlands and adjacent moist grassland in area 1.	Low. Removal of marginal habitat.
Pale-headed Snake *Hoplocephalus bitorquatus*	V		The Pale-Headed Snake has a patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah. It is found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest, favouring streamside areas, particularly in drier habitats. It will shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. The main prey is tree frogs although lizards and small mammals are also taken (OEH, 2013b).	Medium. Potentially suitable habitat at the site.	Removal of potential habitat.
Parma Wallaby *Macropus parma*	V		This species' range is now confined to the coast and ranges of central and northern NSW. Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest. The species typically feeds at night on grasses and herbs in more open eucalypt forest and the edges of nearby grassy areas and shelter in dense cover during the day (OEH, 2013b).	Low-medium. Suitable habitat in forest at the site. May be limited by fragmentation and feral predators.	Removal of potential foraging habitat, local population unlikely to occur.
Pied Oystercatcher *Haematopus longirostris*	E	-	In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Nests mostly on coastal or estuarine beaches; occasionally saltmarsh or grassy areas.	Low. No suitable habitat at the site.	Low.
Powerful Owl	V		This species is a nocturnal, solitary and sedentary species.	Medium. Potentially	Removal of potential

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Ninox strenua			They occur in a number of vegetation types ranging from woodland and open sclerophyll forest to tall open wet forest and rainforest. However, this species does prefer large tracts of vegetation. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old with breeding taking place from late summer to late autumn. Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400 - 1,450 ha. It forages within open and closed woodlands as well as open areas (OEH, 2013b).	suitable roosting and foraging habitat at the site.	roosting and foraging habitat.
Red-crowned Toadlet *Pseudophryne australis*	V		This species occurs in open forest, mostly on Hawkesbury and Narrabeen Sandstones. It inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or capping, sheltering under rocks and amongst masses of dense vegetation or thick pile of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters, and eggs are laid in moist leaf litter, from where they are washed by heavy rain. This species will disperse outside the breeding period, when they are found under rocks and logs on sandstone ridges and forage amongst leaf litter (OEH, 2013b).	Low. No suitable geomorphology at the site.	Nil.
Red Goshawk *Erythrotriorchis radiatus*	CE	V	Typically occurs in coastal and subcoastal areas, with 90% of recent records in NSW confined to the Northern Rivers and Northern Tablelands regions, north of the Clarence River. Formerly occurred south to Port Stephens. Prefer woodlands and forests with a mosaic of vegetation types that are open enough for fast manoeuvring flight, avoiding very open or very dense habitats. In NSW inhabits mixed subtropical rainforest, Melaleuca swamp forest and open eucalypt forest along coastal rivers. Nests built within 1km of a permanent freshwater body in a large, tall tree (>20m) within a remnant stand. Home ranges large (120-200km2).	Low. Minimal suitable habitat at the site.	Low.
Regent Honeyeater *Xanthomyza*	E	E. M	This species is a semi-nomadic species that inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak where there are significantly large numbers of mature trees, high canopy cover and	Medium. Potentially suitable foraging habitat at the site.	Removal of potential foraging habitat.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
phrygia			abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast (OEH, 2013b).		
Rosenberg's Goanna *Varanus rosenbergi*	V		This species is found in heath, open forest, and woodland, and is associated with termites, the mounds of which this species nests in. Termite mounds are a critical habitat component for this species. Rosenberg's Goanna feeds on carrion, birds, eggs, reptiles, and small mammals. It will shelter in hollow logs, rock crevices and in burrows, which they dig for themselves, or they may use other species' burrows such as rabbit warrens (OEH, 2013b).	Low-medium. Suitable habitat in forest at the site. May be limited by fragmentation and feral predators.	Removal of potential foraging habitat, local population unlikely to occur.
Sooty Owl *Tyto tenebricosa*	V		Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals. Nests in very large tree-hollows (OEH, 2013b).	Medium. Potentially suitable roosting and foraging habitat at the site.	Removal of potential roosting and foraging habitat.
Sooty Oystercatcher *Haematopus fuliginosus*	V		This species of large wader favours rocky headlands, rock shelves, exposed reefs with rock pools, beaches and muddy estuaries, where it forages on exposed rock or coral at low tide for limpets and mussels. Breeding occurs in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories. The nest is a shallow scrape on the ground, or small mound of pebbles, shells, or seaweed (OEH, 2013b).	Low-medium. Marginal habitat in freshwater wetlands and adjacent moist grassland in area 1.	Low. Removal of marginal habitat.
Southern Brown Bandicoot *Isoodon obesulus obesulus*	E	E	Inhabits scrubby vegetation, including heath, shrubland, and heathy forest and woodland. It is often associated with well-drained soils and dry heathland communities. Feeds on invertebrates and earthworms as well as underground fungi. Individuals are usually solitary, with home ranges from 2 - 20 ha. This species is generally found to be more abundant in areas following post-fire regeneration due to increases in vegetation diversity and insect availability (OEH, 2013b).	Low-medium. Suitable habitat in forest at the site. May be limited by fragmentation and feral predators. Confirmed records would be at the northern extent of the species range.	Low. Removal of broadly suitable foraging habitat but local population is unlikely to occur.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Southern Myotis *Myotis macropus*	V		Primarily a coastal species that forages over streams and watercourses feeding on fish and insects which it catches by raking its feet across the water surface, it will occur inland along large river systems. Breeding takes place during November or December, roosting in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage (OEH, 2013b).	Medium. Possible anabat recording.	Removal of potential foraging and roosting habitat.
Speckled Warbler *Pyrroholaemus sagittatus*	V		This species of small wren occurs in a range of Eucalyptus dominated communities that have a grassy understorey with a sparse shrub layer and open canopy, often in gullies or on rocky ridges. The species requires large, relatively undisturbed remnants in order to persist in an area. Its diet consists mainly of seeds and insects (OEH, 2013b).	Low. No suitable grassy, open forest at the site.	**Low.**
Spotted-tailed Quoll *Dasyurus maculatus*	V	V	This species of carnivorous marsupial is largely nocturnal but opportunistically hunts prey during the day. It inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are found in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, which are usually traversed along densely vegetated creek lines (OEH, 2013b).	Medium. Potentially suitable habitat at the site.	Removal of potential habitat.
Square-tailed Kite *Lophoictinia isura*	V		Although this species shows a preference for timbered watercourses, they have been found in a variety of habitats including woodlands and open forests. It appears to occupy large hunting grounds and breeds from July - February with nests generally located along of near watercourses. It is a solitary bird, and a specialised predator, taking small passerines, especially honeyeaters and their eggs and nestlings as well as large insects in the tree canopy. It generally hunts low over open forest, woodlands and mallee communities, heaths, and other low scrubby habitats that are rich in passerines. This species prefers a structurally diverse landscape with a broad range of habitats and appears to utilise a large range greater than 100 km^2 (OEH, 2013b).	Medium. Potentially suitable habitat at the site.	Removal of potential habitat.
Squirrel Glider	V		This species of glider is widely though sparsely distributed	Medium. Recent possible	

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Petaurus norfolcensis			throughout eastern Australia. In NSW it inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. This species prefers a diversity of food supplies including acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein, and requires an abundant supply of tree-hollows for nesting and shelter (OEH, 2013b).	record (GHD 2009)	
Stephen's Banded Snake *Hoplocephalus stephensi*	V		Prefers rainforest, moist eucalypt forests and rocky areas. It shelters between loose bark, in tree trunks or hollow tree limbs, amongst vines, and in rock crevices. A nocturnal species, this snake mainly preys on frogs, lizards, birds and small mammals (OEH, 2013b).	Medium. Potentially suitable habitat at the site.	Removal of potential habitat.
Stuttering Barred Frog *Mixophyes balbus*	E	V	This species is a large muscular frog that occurs along the east coast of Australia. They are found in rainforest and wet, tall, open forest. When not breeding, adults live in deep leaf litter and thick understorey vegetation on the forest floor. This species feeds on insects and smaller frogs, breeding in streams during summer after heavy rain (OEH, 2013b).	Low. Potentially suitable vegetation associations but habitat is fragmented and isolated from core breeding habitat.	Low.
Superb Fruit-dove *Ptilinopus superbus*	V	M	A small pigeon that inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Breeding takes place from September to January. The nest is a structure of fine interlocked forked twigs, giving a stronger structure than its flimsy appearance would suggest, and is usually 5-30 metres up in rainforest and rainforest edge tree and shrub species (OEH, 2013b).	Medium. Potentially suitable habitat at the site.	Removal of potential habitat.
Swift Parrot *Lathamus discolor*	E	E	The Swift Parrot breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E.*	Medium. Potentially suitable habitat at the site.	Removal of potential habitat.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
			albens. Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis* and Swift Parrots will return to some foraging sites on a cyclic basis depending on food availability. Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum *E. globulus*. (OEH, 2013b).		
Terek Sandpiper *Xenus cinereus*	V	M	This species has been recorded on lagoons, creeks and estuaries throughout Australia, however tends to favours mud banks and sandbanks located near mangroves, but can also occur on rocky pools and reefs. Primarily a coastal species, this species is occasionally spotted around brackish pools up to 10 km inland. *X. cinereus* roosts communally amongst mangroves of dead trees, often with other wader species, breaking into smaller flocks or solitary birds when feeding. Diet consists of a variety of worms, crustaceans, small shellfish, and the adult and larvae forms of various beetles, water-bugs, and flies (OEH, 2013b).	Low-medium. Marginal habitat in freshwater wetlands and adjacent moist grassland in area 1.	Low. Removal of marginal habitat.
Tristan albatross *Diomedea exulans exulans*	-	E	The Tristan Albatross occurs in a single population which breeds on Inaccessible Island and Gough Island in the Atlantic Ocean. There is currently only one definitive record of the Tristan Albatross from Australian waters. A bird banded as a chick on Gough Island was recaptured four years later off Wollongong (NSW) (DSEWPaC 2013b). The Tristan Albatross is a marine, pelagic seabird. It forages in open water in the Atlantic Ocean near the Cape of Good Hope, South Africa. It sleeps and rests on ocean waters when not breeding (DSEWPaC 2013b).	Low. Minimal wetland habitat at the site.	Low.
Wallum Froglet *Crinia tinnula*	V		This species of amphibian inhabits acid paperbark swamps and sedge swamps along the northern and central coast regions of NSW. This species can be heard calling at any time throughout the year following rain but calls are more frequent during the breeding season that takes place during winter. Males call from tussocks or at the water's edge (OEH, 2013b).	Low-medium. Not recorded in area 1 despite URS (2007a) targeted surveys.	Low within area 1.
Wandering		V	The Wandering Albatross breeds on Macquarie Island. It feeds	Low. No habitat at the	Low.

Species	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring	Likelihood of Impacts
Albatross *Diomedea exulans* (Sensu lato)			in Australian portions of the Southern Ocean. In the Australasian region, it occurs inshore, offshore and in pelagic waters. Spends majority of the time flying over the southern oceans.	site.	
Wompoo Fruit-dove *Ptilinopus magnificus*	V		This species is a large and dramatically beautiful rainforest pigeon, almost twice the size of other coloured fruit-doves. It occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests, feeding on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit; some of its feed trees rely on species such as this to distribute their seeds. The Wompoo fruit-dove is most often seen in mature forests, but also found in remnant and regenerating rainforest (OEH, 2013b).	Medium. Potentially suitable habitat at the site.	Removal of potential habitat.
Yellow-Bellied Glider *Petaurus australis*	V		This species of large arboreal mammal occurs in a variety of forest types though prefers tall mature eucalypt forest with high rainfall and rich soils, along the east coast to the western slopes of the Great Divide. This species relies on hollow-bearing trees for shelter and nesting. In southern NSW its preferred habitat at low altitudes is moist gullies and creek flats in mature coastal forests. Plant and insect exudates provide the bulk of this gliders diet including nectar, sap, honeydew and manna, whilst protein is obtained from arthropods and some pollen. The Yellow-bellied Gilder incises tree trunks and branches to obtain phloem sap, often leaving a distinctive 'V'-shaped scar. Tree selection and usage is complex and a large number of tree species are used as sap trees throughout the range of this glider (OEH, 2013b).	Medium. Potentially suitable habitat at the site.	Removal of potential habitat.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V		This species of insectivorous bat forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. This species roosts in tree hollows and buildings and in areas where trees are scarce or absent, and has been known to utilise mammal burrows. Breeding takes place between December and mid-March (OEH, 2013b).	**Present.** Definite Anabat recording at the site.	**Certain.** Removal of foraging and potential roosting habitat.

Appendix C - EPBC Protected Matters Search

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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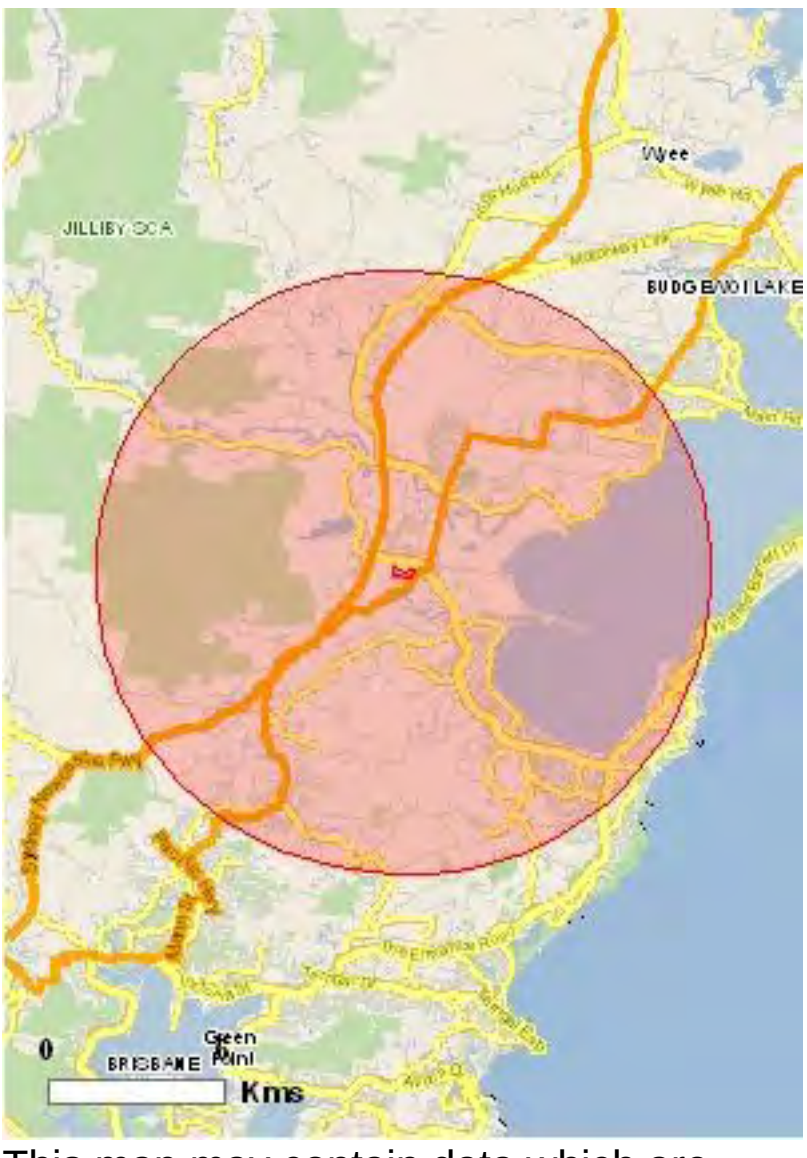
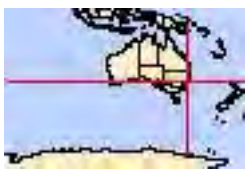


This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	51
Listed Migratory Species:	46

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	4
Commonwealth Heritage Places:	None
Listed Marine Species:	50
Whales and Other Cetaceans:	1
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	5
State and Territory Reserves:	5
Regional Forest Agreements:	1
Invasive Species:	51
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Dasyornis brachypterus		
Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans antipodensis		
Antipodean Albatross [82269]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans exulans		
Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans gibsoni		
Gibson's Albatross [82271]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Erythrotriorchis radiatus		
Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Sternula nereis nereis		
Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Fish		
Epinephelus daemelii		
Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Macquaria australasica		
Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena		
Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus		
Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea		
Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Litoria littlejohni		
Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus		
Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mixophyes iteratus		
Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acacia bynoeana		
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Angophora inopina Charmhaven Apple [64832]	Vulnerable	Species or species habitat likely to occur within area
Asterolasia elegans [56780]	Endangered	Species or species habitat may occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Diuris praecox Newcastle Doubletail [55086]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus camfieldii Camfield's Stringybark [15460]	Vulnerable	Species or species habitat likely to occur within area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat known to occur within area
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill [84065]	Endangered	Species or species habitat likely to occur within area
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat may occur within area
Prostanthera askania Tranquility Mintbush [64958]	Endangered	Species or species habitat likely to occur within area
Prostanthera junonis Somersby Mintbush [64960]	Endangered	Species or species habitat likely to occur within area
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat likely to occur within area
Streblus pendulinus Siah's Backbone, Sia's Backbone, Isaac Wood [21618]	Endangered	Species or species habitat likely to occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area
Tetratheca glandulosa Glandular Pink-bell [2350]	Vulnerable	Species or species habitat may occur within area
Tetratheca juncea Black-eyed Susan [21407]	Vulnerable	Species or species habitat known to occur within area
Reptiles		

Name	Status	Type of Presence
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Hoplocephalus bungaroides		
Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena		
Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni		
Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Sterna albifrons		
Little Tern [813]		Breeding likely to occur within area
Migratory Marine Species		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Lamna nasus		
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat known to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus		
Spectacled Monarch [610]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Xanthomyza phrygia		
Regent Honeyeater [430]	Endangered*	Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Foraging, feeding or related behaviour known to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat likely to occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba		
Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus		
Red Knot, Knot [855]		Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence
		to occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]		Foraging, feeding or related behaviour known to occur within area
[Calidris ruficollis](#) Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
[Calidris tenuirostris](#) Great Knot [862]		Foraging, feeding or related behaviour known to occur within area
[Charadrius bicinctus](#) Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
[Charadrius mongolus](#) Lesser Sand Plover, Mongolian Plover [879]		Foraging, feeding or related behaviour known to occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour known to occur within area
[Heteroscelus brevipes](#) Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Foraging, feeding or related behaviour known to occur within area
[Limosa limosa](#) Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
[Numenius madagascariensis](#) Eastern Curlew [847]		Foraging, feeding or related behaviour known to occur within area
[Numenius minutus](#) Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
[Numenius phaeopus](#) Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
[Pluvialis fulva](#) Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
[Pluvialis squatarola](#) Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
[Rostratula benghalensis (sensu lato)](#) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
[Tringa stagnatilis](#) Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area
[Xenus cinereus](#) Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian & Overseas Telecommunications Corporation
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Director of War Service Homes

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]		Foraging, feeding or related behaviour known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Foraging, feeding or related behaviour known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Foraging, feeding or related behaviour known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris Great Knot [862]		Foraging, feeding or related behaviour known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Foraging, feeding or related behaviour known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Foraging, feeding or related behaviour known to occur within area
Limosa limosa Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew [847]		Foraging, feeding or related behaviour known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Breeding likely to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour known to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Historic		
Gosford Hills Landscape Conservation Area	NSW	Indicative Place
The Entrance Carousel	NSW	Indicative Place
Alison Homestead	NSW	Registered
Felton Mathews Tree	NSW	Registered
Old Maitland Road Section	NSW	Registered

State and Territory Reserves [Resource Information]

Name	State
Jilliby	NSW
Tuggerah	NSW
Tuggerah	NSW
Wambina	NSW
Wyrrabalong	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Bufo marinus Cane Toad [1772]		Species or species habitat likely to occur within area
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Tuggerah Lake	NSW
Wyong Racecourse Swamp	NSW

Coordinates

-33.308383 151.408825,-33.308421 151.408825,-33.309944 151.412118,-33.309088 151.415126,-33.311353 151.414384,-33.310572 151.408673,-33.308383 151.408825

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix D – VMP for E2 Corridor Rehabilitation Area

Westfield Group

Westfield Tuggerah and Gateway Site
E2 Corridor Rehabilitation Area
Vegetation Management Plan

June 2014

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 Overview and background

Following the recent gazettal of the Wyong LEP 2013, the NSW Department of Planning and Infrastructure (DoPI) is undertaking a rezoning of the land within the Tuggerah Town Centre, identified as a “deferred matter” and known as the Westfield Tuggerah and Gateway site. GHD has prepared an ecological assessment of the Westfield Tuggerah and Gateway site in support of the rezoning planning study (see GHD, 2014). The ecological assessment has identified an environmental corridor with high biodiversity values along the southern boundary of the Westfield Tuggerah and Gateway Site that is proposed to be zoned E2 Environmental Conservation to maintain and improve existing biodiversity values (GHD, 2014).

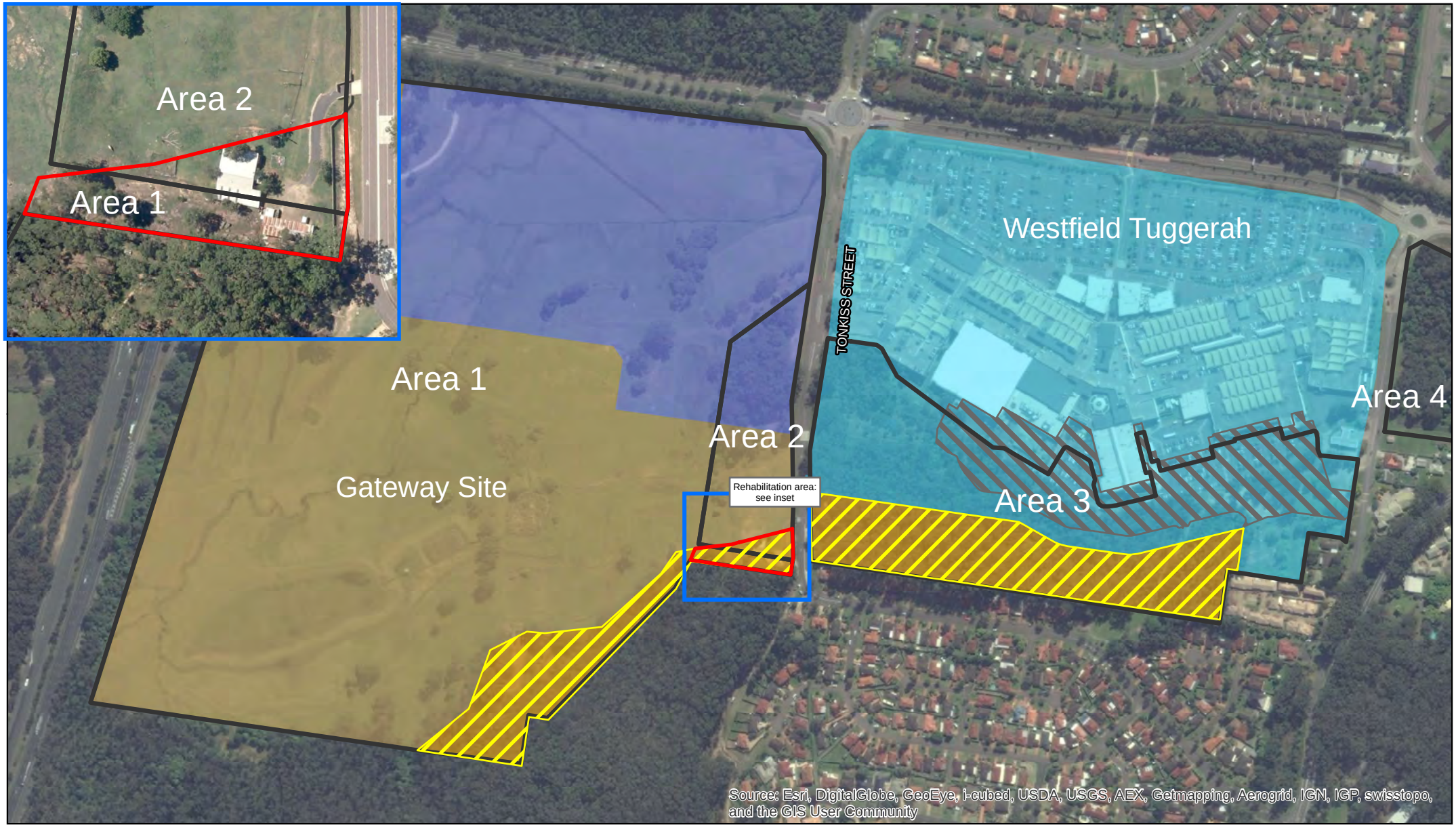
GHD Pty Ltd (GHD) has been engaged by the Westfield Group to prepare a Vegetation Management Plan (VMP) for the rehabilitation of an area of land within the proposed E2 corridor adjacent to Tonkiss Street (see Figure 1), The aim of the VMP is to detail a management framework to restore native vegetation on this land, enhance connectivity within the corridor and improve biodiversity values.

1.2 Proposal description

The proposed rehabilitation area (hereafter referred to as the rehabilitation site) is an area of land approximately 0.31 ha in size, immediately to the west of Tonkiss Street within the proposed environmental corridor (see Figure 1). The rehabilitation site is almost devoid of native vegetation and supports a house and associated outbuildings and cleared areas. As such, it forms an identified gap in native vegetation within the proposed environmental corridor. The overall aim of revegetation activities described in this VMP is to restore native vegetation cover on the rehabilitation site, thus enhancing connectivity between vegetation either side of Tonkiss Street for native fauna and ecological processes such as seed fall and pollination, and thereby increasing the ecological value of the proposed corridor.

Revegetation activities would require four main steps, as described in this report. These are:

- Sourcing and/or collecting seed for the propagation of plants of appropriate provenance
- Site preparation, including removal of existing buildings, ‘spot spraying’ and soil preparation
- Planting
- Ongoing management and weed control.



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- The Site
- Approved Westfield expansion (DA 514/2013)
- Proposed E2 corridor
- Rehabilitation area

Proposed rezoning

- B3 Commercial Core
- B4 Mixed Use Precinct
- RU6 Transition
- E2 Environmental Conservation

Westfield Ltd
Westfield Tuggerah and Gateway Site

Job Number	21-23343
Revision	1
Date	17 Jun 2014

Proposed E2 Environmental Conservation corridor and rehabilitation area

Figure 1

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Data source: ESRI: Aerial, 2013; LPI: DBTB, 2012; Geoscience Australia: 250K Topographic Data Series 3, 2006. Created by: tmorton, fmackay

1.3 Scope and limitations

This report: has been prepared by GHD for the Westfield Group and *may only be used and relied on by the Westfield Group for the purpose agreed between GHD and the Westfield Group as set out in section 1of this report.*

GHD otherwise disclaims responsibility to any person other than the Westfield Group arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

Cost estimates provided are based on GHD's knowledge of industry rates and previous project experience. They are provided for estimating purposes only. Final project costs would be determined by tendering contractors.

2. Relevant legislation

The VMP has been prepared with reference to the following environmental planning and assessment legislation, as relevant.

2.1 NSW Environmental Planning and Assessment Act 1979

As noted above, following the recent gazettal of the Wyong LEP 2013 under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), the NSW Department of Planning and Infrastructure (DoPI) is undertaking a rezoning of the Westfield Tuggerah and Gateway site identified as a "deferred matter" in the LEP. As part of this rezoning, it is proposed to maintain a vegetated corridor with high biodiversity values (to be zoned E2 Environmental Conservation) along the southern boundary of the Westfield Tuggerah and Gateway site to maintain and improve existing biodiversity values (GHD, 2014). The VMP has been prepared for an identified rehabilitation area within this corridor (see Figure 1), and provides a framework to restore native vegetation and enhance connectivity of vegetation within the corridor on either side of Tonkiss Street.

2.2 NSW Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act* 1995 (TSC Act) includes schedules that list threatened species, populations and ecological communities and key threatening processes. The objectives of the TSC Act are to:

- Conserve biological diversity and promote ecologically sustainable development, to prevent the extinction and promote the recovery of threatened species, populations and ecological communities.
- To protect the critical habitat of those threatened species, populations and ecological communities that are endangered.
- To eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities.
- To ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed.
- To encourage the conservation of threatened species, populations and ecological communities by the adoption of measures involving co-operative management.

Two endangered ecological communities (EECs), one threatened plant and four threatened fauna species listed under the TSC Act have been recorded on the Westfield Tuggerah and Gateway site (GHD, 2014). A range of additional threatened flora and fauna species have the potential to occur given the presence of suitable habitat. The proposed rehabilitation site does not contain any EECs or habitat of value for threatened species. The vegetation restoration activities will therefore not adversely affect any threatened biota or habitat for threatened biota and a Section 132C licence is not required.

The proposed rehabilitation activities aim to restore native vegetation on the rehabilitation site and enhance habitat connectivity within the E2 corridor providing habitat and resources for threatened species over the medium to long-term.

2.3 NSW Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) regulates the clearing of native vegetation on all land in NSW except for land listed in Schedule 1 of the Act. Excluded land under Schedule 1 of the Act includes National Parks and other conservation areas, State forests and reserves, and urban areas.

The proposed rehabilitation activities would not require clearance of any native vegetation.

2.4 NSW Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* (NW Act), provides for the declaration of noxious weeds by the Minister of Agriculture. Noxious weeds may be considered noxious on a National, State, Regional or Local scale. All private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land under Part 3 Division 1 of the NW Act.

This VMP considers the landowner's obligations to control weeds listed as noxious and/or environmental in the LGA. During revegetation activities, site owners are legally obliged to 'fully and continuously suppress and destroy' any noxious weed colonisation.

Four listed noxious weeds were recorded during the ecology assessment of the Tuggerah Westfield and Gateway sites (GHD, 2014). Weed control methodologies outlined in this plan should be implemented upon initiation of clearing works to remove noxious weeds from the rehabilitation site if present and/or to decrease the chances of site infestation by invasive noxious weed species.

2.5 Commonwealth Environmental Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) makes it an offence for a person to undertake an action that has the potential to significantly impact on a matter of 'national environmental significance' without first obtaining a permit from the Commonwealth Minister for Environment and Heritage. Matters of national environmental significance include: declared World Heritage areas; National Heritage places, declared Ramsar wetlands; listed threatened species and ecological communities; listed migratory species; nuclear actions; the Great Barrier Reef Marine Park; the environment of Commonwealth marine areas and a water resource in relation to coal seam gas and large mining developments.

One threatened plant species listed under the EPBC Act has been recorded on the Westfield Tuggerah and Gateway site (GHD, 2014). A range of additional threatened flora and fauna species have the potential to occur given the presence of suitable habitat (GHD, 2014). The proposed rehabilitation site does not contain any habitat of value for listed threatened or migratory species. The vegetation restoration activities will therefore not adversely affect any threatened biota or habitat for threatened biota listed under the TSC Act.

The proposed rehabilitation activities aim to restore native vegetation on the rehabilitation site and enhance habitat connectivity within the E2 corridor providing habitat and resources for threatened species over the medium to long-term.

No other MNES are of relevance to the Westfield Tuggerah and Gateway site and the proposed rehabilitation activities will not adversely impact any other MNES listed under the EPBC Act.

3. Site description

The information presented below has been taken from the Ecological Assessment for the Westfield Tuggerah and Gateway Site (GHD, 2014).

3.1 Locality and adjacent land use

The proposed rehabilitation site is located within the Westfield Tuggerah and Gateway Site within the Wyong local government area, which is currently subject to a rezoning application (Figure 1). Lands subject to rezoning comprise the following:

- The Tuggerah Gateway Site (Areas 1 and 2), which is bordered by the F3 Motorway to the west, Wyong Road to the north, Tonkiss Street to the east and native vegetation within lands zoned for open space and environmental management and conservation to the south
- Area 3, which is bordered by Tonkiss Street to the west and south, the existing Westfield Tuggerah to the north, and residences and Gavenlock Road to the east.

The rehabilitation site comprises part of a proposed vegetated corridor (proposed to be zoned E2 Environmental Conservation) along the southern boundary of the Westfield Tuggerah and Gateway site. It is located within Areas 1 and 2 of the Gateway site, west of and adjacent to Tonkiss Street within land formerly zoned as 10(a) Investigation Precinct under Wyong LEP 1991. The site is bordered to the north and west by cleared, predominately exotic pasture associated with the Tuggerah Gateway site, to the east by Tonkiss Street and to the south by intact native vegetation. It contains at least two buildings and associated hardstand areas and supports cleared exotic grassland, with limited canopy trees remaining.

3.2 Climate

Weather statistics have been taken from the nearest weather station to the site (Gosford) (BOM, 2010). The area experiences a mean maximum annual temperature of 23.0^{o} Celsius and a mean minimum annual temperature of 11.0^{o} C. The average annual rainfall is 1,316.4 mm at Gosford.

3.3 Geology, soils and geomorphology

The rehabilitation site is situated on a slight rise, and the ground slopes away towards the south, north and east. The topography immediately adjacent to the rehabilitation site has been modified by the construction of Tonkiss Street, and there is a shallow cutting where the land would have originally sloped down towards Area 3.

The rehabilitation site is mapped as occurring on outcropping Narrabeen Group Sandstone with yellow earth soils, associated with the Erina Soil Landscapes Series (Murphy, 1993). Soil depth in these map units varies with slope position, from 50cm on crests and near outcropping sandstone to 150cm on foot slopes (Murphy, 1993).

To the north and east, the majority of the Tuggerah Westfield and Gateway site consists of broad, alluvial flats of the Wyong Soil Landscapes Series (Murphy, 1993). These are composed of Quaternary alluvial sediments that form deep (>200 cm) and poorly drained Yellow and Brown Podzolic soils (Murphy, 1993). The landform in the central-eastern portion of Area 1 has been shaped by infrastructure associated with a former abattoir. There are also substantial areas of dumped fill on site, including in particular a substantial mound in the north-eastern corner of Area 1. This mound has substantially changed the hydrology of this portion of the area which would have originally been a poorly drained swampy area.

Soils on the proposed rehabilitation site have been variously disturbed through clearing and previous and current land uses and it is highly unlikely that the natural soil profile remains on the majority of the site.

3.4 Hydrology

There are no waterways or dams within the rehabilitation site. As described above, the rehabilitation site is situated on a rise and is higher than the rest of the Tuggerah Gateway Site, and surface water would run off north towards periodically inundated grassland areas within the Gateway Site or into native vegetation to the south.

The Tuggerah Gateway site is dissected by small drainage lines with associated topographic features, including levees and intermittent marshes. Local drainage has been substantially modified by previous earthworks, paving and drain construction. Drainage lines flow from the southwest corner of Area 1, northwards and from the western boundary east. These channels join in the northern portion of Area 1 and flow eastwards to a stormwater drain which drains to Tuggerah Lake. Three dams exist within Area 1 of the Tuggerah Gateway Site to the west of the proposed rehabilitation site.

4. Vegetation within and surrounding the site

4.1 Vegetation

The rehabilitation site is predominantly cleared of native vegetation and supports exotic, grassland with cleared and hardstand areas associated with the existing buildings. There are scattered canopy trees, including several palms which appear to be planted. The site also contains the disturbed edge of Coastal Foothills Spotted Gum Ironbark Forest vegetation that extends within the proposed corridor to the south through Area 1 and off site within open space zoned lands to the south (Figure 2). The rehabilitation site is bordered by areas of derived predominantly exotic grassland within Area 2 to the north and Area 1 to the west (Figure 2). Spotted Gum Ironbark Forest vegetation also occurs east of Tonkiss Street in the proposed E2 corridor within Area 3.It is likely that the whole rehabilitation site and land to the north would have originally supported this vegetation community.

The following descriptions of the vegetation types surrounding the proposed rehabilitation area are taken from GHD (2014).

Spotted Gum Ironbark Forest

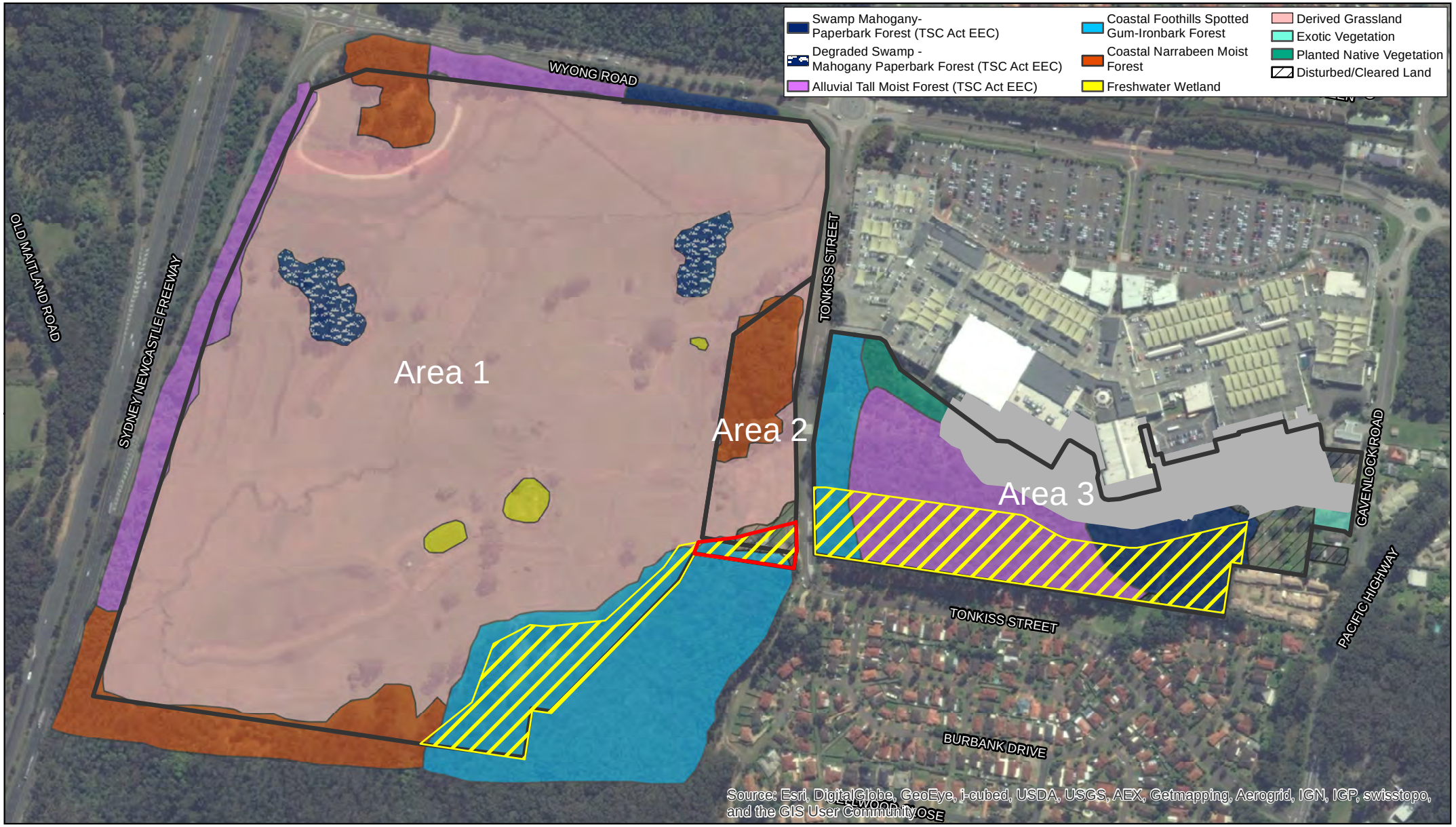
Spotted Gum Ironbark Forest (LHCRREMS MU 15) is present in the south-eastern corner of Area 1 and western edge of Area 3 of the Westfield Tuggerah and Gateway site. It is associated with clay soils on moderately steep mid and upper slopes. It features a canopy of Spotted Gum (*Corymbia maculata*) and *Allocasuarina torulosa*. The composition of the shrub-small tree and groundcover strata varied significantly with the extent of grazing pressure. In areas where stock have been excluded, there was a sparse native shrub layer, including Gorse Bitter Pea (*Daviesia ulicifolia)* and Prickly Moses (*Acacia ulicifolia*), and a diverse groundcover of native grasses and herbs. Within Area 3, the shrub layer has been disturbed and the groundcover has relatively low diversity of native grasses and herbs. Common species include *Imperata cylindrica* (Blady Grass), *Pratia purpurascens* (Whiteroot), *Pteridium esculentum* (Bracken) and *Cymbopogon refractus* (Barbwire Grass).

Exotic species present within this community are *Lantana camara* (Lantana), *Bidens pilosa* (Cobblers Pegs), *Setaria* sp. (Pigeon Grass), *Conyza bonariensis* (Purpletop), *Sida rhombifolia* (Paddy's Lucerne), *Pennisetum clandestinum* (Kikuyu) and *Plantago lanceolata* (Plantain).

Derived grassland

Areas of derived grassland feature improved pasture, herbaceous environmental weeds, exotic sedges and grasses, and native herbs, sedges and grasses. These areas are probably derived from historic clearing of forest and treed wetlands. Vegetation structure is highly variable, including localised dense patches of Lantana, native and exotic sedges or herbaceous environmental weeds. The groundcover is the tallest continuous vegetation strata. It is dominated by Kikuyu with a sparse, patchy cover of native forbs, including *Dichondra repens* and *Vittadenia cuneata* and exotic herbs, including Dandelion (*Taraxacum officianale*) and Sowthistle (*Sonchus oleraceus*).

There are occasional isolated remnant trees, including *Eucalyptus pilularis*, *E. amplifolia* subsp *amplifolia*, *E. robusta*, *Angophora floribunda*, *A. costata*, *Syncarpia glomulifera* and *Melaleuca linariifolia*. There is very little regrowth of these remnant canopy species due to ongoing grazing or human activities.



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Legend

- The Site
- Approved Westfield expansion (DA 514/2013)
- Rehabilitation area
- Proposed E2 corridor

Westfield Ltd
Westfield Tuggerah and Gateway Site

Job Number 21-23343
Revision 1
Date 17 Jun 2014

Vegetation Types

Figure 2

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Data source: ESRI, Aeril, 2013; LPI: DBTB, 2012.. Created by: tmorton, fmackay

4.2 Habitat

The rehabilitation site contains mostly exotic grassland and cleared land surrounding existing buildings and does not support habitat of likely importance for native fauna or in particular for threatened flora and fauna species.

Stands of adjoining native vegetation to the south and to the east across Tonkiss Street (refer Figure 2) are intact, in moderate to good condition and contain mature trees forming a canopy with a forest or open forest structure (Specht, 1980). Where cattle have been excluded, there is a well-developed and structurally diverse lower vegetation strata. Based on the structural and floristic attributes, these areas of forest would be expected to provide habitat for a range of vertebrate fauna, in particular native birds, mammals and reptiles that have been recorded on the Westfield Tuggerah and Gateway Site (GHD, 2014).

Key habitat features within forest vegetation in adjoining or adjacent areas of the proposed E2 corridor which would provide shelter and foraging resources for a variety of native fauna, include:

- Myrtaceous trees and shrubs, including preferred feed tree species for birds and arboreal mammals and areas with a midstorey of *Allocasuarina* spp., which provides foraging resources for granivorous birds, including the threatened Glossy Black-cockatoo.
- Patches of shrubby understorey, which provides shelter and foraging habitat for a range of small woodland birds and terrestrial and arboreal mammals.
- Hollow-bearing trees with a range of hollow sizes and positions, which provide potential roost sites for several native birds, arboreal and terrestrial mammals and microbats. The Red-rumped Parrot and Galah, have been observed nesting in Area 3 and a number of microbats bats have been recorded foraging in the area during the ecological investigations on the site (GHD, 2014).
- Reasonable amounts of standing and fallen dead timber which would provide shelter and foraging habitat for a range of native reptiles, and foraging substrate for native insectivorous birds and mammals.

4.3 Noxious weeds

The Tuggerah Westfield and Gateway site contains four species declared as noxious weeds in Wyong LGA (GHD, 2014; see Table 1). These noxious species generally occurred at low numbers in disturbed areas and are not necessarily found in the rehabilitation site. Details have been included in this VMP to outline which species may be present and the treatments recommended for control if required.

Table 1 Declared noxious weeds of the Wyong LGA recorded from the Tuggerah Westfield and Gateway sites (GHD 2014).

Scientific Name	Common Name	Control category
Rubus fruticosus spp. agg.	Blackberry	4
Lantana camara	Lantana	5
Oxalis corniculata	Creeping Oxalis	5
Ageratina adenophora	Crofton Weed	4

For Category 4: 'the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority'. For Category 5: 'the requirements in the NW Act for a notifiable weed must be complied with'.

5. Rehabilitation direction and restoration program

5.1 Rehabilitation direction

5.1.1 Site opportunities and constraints

The rehabilitation site represents an opportunity to enhance connectivity of native vegetation retained within the proposed E2 corridor on the Westfield Tuggerah and Gateway site and extensive areas of native vegetation to the south of Area 1. The entirety of the rehabilitation site would be replanted with species representative of Coastal Foothills Spotted Gum – Ironbark Forest and then maintained as part of the vegetated E2 corridor identified in Figure 1.

Constraints include the presence of noxious weeds (such as those listed in Section 4.3), existing buildings and hardstand areas, surrounding land uses, weed invasion and edge effects and future adjoining development within Areas 1 and 2 to the north of the rehabilitation site.

5.1.2 Project tasks and objectives

This VMP has been prepared to assist Westfield with determining a management framework to reinstate native vegetation on the site, in order to enhance habitat connectivity within the proposed environmental corridor and improve biodiversity values.

The VMP addresses the following issues:

- Site assessment and determination of constraints (eg. flora and fauna, habitat and corridor values, hydrology, drainage, topography, weeds, etc).
- Definition of project tasks (description of all tasks necessary to implement the plan).
- Preparation of a plant species list
- Details on site preparation (site works, weed control, soil amelioration).
- Description of planting program and methodology.
- Description of maintenance program.
- Description of monitoring and review process.

5.1.3 Description of key terms

The following key terms are used in the description of the proposed restoration program.

- *Regeneration* - Refers to natural regeneration of the vegetation community.
- *Bush regeneration* -Refers to techniques used to assist and promote natural regeneration without utilising plant material propagated in nurseries.
- *Revegetation* - Refers to the planting of tube stock or similar grown from local provenance seed to re-establish vegetation.
- *Restoration* - Refers to a combination of activities and management techniques to restore native vegetation.
- *Practical completion* -Refers to the completion of installation of revegetation activities.
- *Establishment* - Refers to the minimum 24 month maintenance program applied to revegetation work to ensure plant establishment.
- *Final Completion* - Refers to the successful completion of the entire restoration program.

5.2 Restoration program

The following information provides a detailed description of all activities required to implement the VMP.

The intent of the program is to remove existing buildings and infrastructure and revegetate the entirety of the site with canopy, shrub and groundcover species representative of Coastal Foothills Spotted Gum – Ironbark Forest.

5.2.1 Seed collection and propagation

Native seed and tubestock of species used for revegetation activities should be:

- representative of Coastal Foothills Spotted Gum – Ironbark Forest (see Appendix A for a list of recommended species)
- of local provenance (preferably from within 5 km)

To allow for enough lead time for the propagation of species of local provenance, seed collection should start as soon as the proposed E2 zoning is confirmed. Experienced and qualified bush regeneration staff would perform seed collection activities. All seed collection, management, cleaning and storage should be in accordance with the Florabank Guidelines and Code of Practice (prepared by Greening Australia and now accepted as industry best practice – available from http://www.florabank.org.au/default.asp?V_DOC_ID=755).

A search of existing local nurseries or professional revegetation organisations such as Greening Australia for available plant stock may be required to help maintain program timeframes. Plant propagation refers to the germinating of collected seed and the 'growing on' of plants in enviro cells, hiko trays or forestry tubes. A suitably qualified and experienced native plant production nursery should manage this activity.

5.2.2 Site preparation

Preparation of the rehabilitation site prior to planting would require the following activities.

Removal of infrastructure and fencing

As a first step, existing buildings would be demolished and all hard rubbish or litter removed from the site. Any gravel/ concrete surfaces would also be removed.

Fencing exists between the rehabilitation site and adjacent remnant vegetation to the south. Wire strands should be removed from these fences to allow connectivity between the revegetation site and native vegetation to the south. If necessary, fences may be constructed between the rehabilitation site and any development activities within the Gateway site to the north to minimise disturbance from construction activities. It is assumed any permits or approvals required to facilitate the demolition would be the responsibility of the implementing contractor.

Soil management

It is anticipated that de-compaction of soils will be limited to the driveway but may possibly be required at building sites or other hardstand or compacted areas to prepare the soil for seedlings. De-compaction creates a better environment for seedling growth by increasing water filtration and aeration and by softening the soil, allowing seedling roots to penetrate. An assessment of possible contaminants may be required after demolition works and soil de-compaction has been completed.

Soil in these areas should be subjected to light 'ripping'. In some areas, particularly under existing buildings, imported topsoil may be required. Any topsoil should be sourced from a reputable supplier and guaranteed free of weeds or pathogens.

Soil de-compaction should be undertaken after the first round of weed control (see below) to minimise the spread of weed propagules. During any soil disturbance, appropriate erosion and sediment controls should be implemented to prevent any impacts on adjoining areas.

Weed control

It is recommended that noxious and woody weed species be removed prior to revegetation activities via a targeted weed removal program. Weed control activities will be limited to the small area of degraded vegetation associated with the southern boundary of the rehabilitation site. Weed species to be targeted include noxious weeds such as those listed in Section 4.3 and any other noxious or woody weeds encountered by the contractor.

Appendix B provides a summary of the most appropriate weed treatments. Control of these plants usually requires several treatments and is most effective during summer. This program requires specialised equipment and chemicals and will be managed by appropriately trained and experienced staff. In accordance with Wyong Council guidelines, the minimum qualifications and experience required for the bush regeneration contractor are a TAFE Certificate 2 in Conservation and Land Management and three years demonstrated experience (for site supervisor) and a TAFE Certificate 2 in Conservation and Land Management and one year demonstrated experience (for other personnel). In addition, the site supervisor is to be eligible for full professional membership of the Australian Association of Bush Regenerators (AABR). The contractor will have obtained necessary licences to use and operate chemical spray units in native bushland areas.

Often the eradication of weeds requires the combination of a few techniques to remove the diverse types of weed species present within any one given area. It may be necessary to implement any one of the following techniques displayed in Table 2, at the discretion of the revegetation contractor.

Table 2 Weed removal techniques

Control Method	Advantages	Disadvantages	Example application
Manual removal	Selective, reduces off-target damage to native flora, effective for small areas	Labour intensive, can be costly, may cause soil disturbance	Seedlings, saplings and small infestations in areas of native vegetation
Chemical spray	Can be selective if operated by a qualified bushland regenerator, doesn't disturb soil, appropriate for both large and small infestations	Can cause damage to native flora, potential impacts on broader environment, requires technical proficiency to operate	Suitable for most non-woody and young woody weeds in areas of native vegetation.
Cut and paint/ drill and fill	Selective, minimal risk to surrounding native vegetation	Only applies to woody species	Mature woody weed species (i.e trees)
Mulch/ smothering	Inhibits weed growth, compliments site rehabilitation	Also inhibits native plant growth, can be costly and labour intensive	In vegetated areas.

5.2.3 Planting

Following any necessary weed control activities, spot spraying of introduced pasture grasses to prepare for hand plantings is recommended. This approach removes competition immediately surrounding newly installed plants without exposing areas of bare soil. In addition, the retention of introduced pastures between plantings also helps reduce weed establishment. Introduced pastures will be progressively reduced through time via shading (as canopies establish) and supplementary weed control activities.

Native tree and shrub species (species and provenance as described in Section 5.2.1) should then be planted throughout the rehabilitation site to re-establish native vegetation cover. Appropriate flora species and planting densities for each community are listed in Appendix A.

Timing of Planting

In general, spring or autumn are the optimal seasons for planting, as summer temperatures can be too high for young plants to establish successfully and winter frosts can impede survival rates.

Installation of Native Tube Stock

Most plants would be planted as hiko or enviro cells, at appropriate densities for overstorey, midstorey and understorey species (see Appendix A), giving a density of approximately 3,000 stems per hectare. All planted trees and shrubs should be suitably guarded to prevent herbivory and weed competition, and to provide optimum growing conditions. Guards would comprise a plastic tree guard and three bamboo or hardwood stakes.

Plants would be installed by hand into a hole that is at least 25% larger than the container from which the plant came. The edges of the hole should be suitably ‘roughened’ prior to plant installation so as to promote lateral root growth. The soil is then backfilled and firmly set into place by hand or foot. Plants should be watered in and receive follow-up watering as described in Section 5.2.4, below.

Hand broadcasting of some species of treated native grass seed may also be used to add further diversity and supplement hand plantings. Given the proximity of the rehabilitation site to retained areas of native vegetation, it is anticipated that there would be seed fall from adjacent vegetation which may also add natural regeneration and increase species diversity on site, particularly native groundcovers.

Replacement Planting

Replacement planting with native tube stock may be required during the course of the rehabilitation program if survival targets are not met (see section 5.2.4, below). This should occur in conjunction with follow up weed control and maintenance activities.

5.2.4 Management

Follow up maintenance activities will be required in order to control the reinvasion of exotic species. Maintenance activities will include such things as watering, herbicide spraying and general maintenance. The aim of the maintenance program is to ensure a survival rate of 80% is achieved at the conclusion of the five-year program.

Eight general maintenance visits are requested in the first two years and then nine over the next three years (ie a total of 17 visits recommended over the five years). These maintenance visits would involve the following activities as required.

General Maintenance

General maintenance activities will include repairing damaged tree guards, monitoring survival rates, installing replacement plants where required, weeding inside the tree guards and continued follow-up spot spraying.

Watering

All plants will be 'watered in' on installation, with each plant receiving a minimum five litres. All plantings will then receive a further three applications of water during the first 8 weeks, if required, to assist plant establishment. Should weather conditions remain dry for an extended period of time follow-up watering may be required. If so, discussion between client and contractor may be necessary to cover the cost of additional watering.

Maintenance Spraying

To ensure the success of the revegetation activities it is essential to control weed infestation. Weeds compete with the newly installed plants for nutrients and water thereby limiting their survival and growth rates. Spraying of Round-up® and Biactive herbicides will occur where necessary using 'back packs'. Suitably qualified contractors will carry out all spraying.

5.3 Monitoring and reporting

In order to accurately evaluate the success of the rehabilitation program, it is recommended that a monitoring and evaluation program is put into place. A report at practical completion and then six-monthly summary reports throughout the maintenance period would be suitable.

The monitoring and evaluation program should address the following issues:

- Plant growth, percentage cover and survival rates;
- Plant losses through herbivory, disease, vandalism, storm damage or other factors;
- Weed regrowth and control measures;
- Plant replacement;
- Guard repair and weeding inside guards; and
- Maintenance watering regime.

Given the small size of the site, GHD recommends that the above issues be monitored and evaluated through the set-up of two representative 5 x 5 m quadrats at the practical completion stage, of which one should be located in previously hardstand/ compacted areas and one in the derived grassland areas (if there is a large enough area of this vegetation type within the rehabilitation site). The quadrats should be clearly pegged so they can be easily located and monitored throughout the 60-month monitoring period using a field sheet similar to that in Appendix C.

It is also desirable to keep an accurate photo-record of the progress of the restoration works by setting up an appropriate number of representative fixed photo-points across the rehabilitation site. Photos should be taken by digital camera and recorded in the project file by date and discrete photo-point number. Photo-point locations should be clearly marked on site and mapped by a surveyor or by GPS.

All of the above monitoring and evaluation information is to be presented in clear and concise annual monitoring reports that will be prepared by the implementing contractor. The reports should be presented to Westfield and relevant regulatory authorities as appropriate.

The annual monitoring reports should also contain recommendations by the restoration contractor to the client in regard to issues affecting the ongoing success of the rehabilitation

works, and the possible need for additional activities that may be required outside the normal maintenance program.

5.4 Time frames and responsibilities

Time frames for key tasks and responsibilities for implementation area outlined in Table 3 below.

Table 3 Time frames and parties responsible for management activities

Task	Description	Timing	Responsibility
Conservation Agreement	Formalise adoption of this VMP through an appropriate mechanism	Release of the occupation certificate for the first development on the site.	Council and Westfield
Seed collection	Collection, cleaning and propagation of seed	Immediately upon adoption of the VMP.	Westfield and contractor
Site preparation – buildings and fencing	Removal of buildings, internal fencing and hard rubbish	As soon as possible upon adoption of the VMP.	Westfield
Site preparation – weed control	Targeted control of noxious and woody weeds in both zones	As soon as possible after removal of buildings and fencing. Most effective during summer/ warmer months.	Westfield and contractor
Site preparation – soil management	De-compaction of soil in hardstand and building areas	After first round of targeted weed control.	Westfield and contractor
Revegetation activities	Spot spraying and planting of endemic native flora	Approximately 1 year after demolition activities.	Westfield and contractor
Maintenance	Maintenance of Zone 1 plantings (watering, weeding, replacement of guards etc)	17 sessions over 5 years	Westfield and contractor
Monitoring	Annual summary reports	Per annum over length of the restoration program.	Westfield and contractor

6. Costings

Table 4 lists actions described in the preceding sections along with indicative costings for each task. It should be noted that the cost estimates presented in this section are typically developed based on extrapolation of recent similar project pricing, industry unit rates and GHD experience. The accuracy of these estimates is not expected to be better than about ± 25%. The final price would be agreed with the successful contractor.

Table 4 Tasks and indicative costings

Task	Description	Cost Estimate
1.	Demolition of dwellings and other infrastructure and de-compaction of soils	Not included in this VMP
2.	Preparation spraying (one day – team of 3 or 4)	$ 1,350
3.	Installation of plants – 1,200 @ $5.50 each (price includes) • Plant supply (hiko cells) • Hand installation • Installation of 'bags and stakes'	$ 6,600
4.	General maintenance sessions (17 over five years – team of 2) @ $970 per session	$16,490
5.	Project Management and reporting (two days per year @ $480 per day)	$ 4,800
Total		$29,240

7. References

DPI (2014). *Noxious weed declarations for Wyong Shire Council.* Online http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed Accessed 12/06/2014.

GHD (2014). *Westfield Tuggerah and Gateway Site Project: Ecological Assessment*. Prepared for Westfield Group, June 2014.

NPWS (2000) *Vegetation Survey, Classification and Mapping Lower Hunter and Central Coast Region* (LHCCREMS). National Parks and Wildlife Service, NSW.

Murphy, DA, 1993, *Soil Landscapes of the Wyong 1:100,000 Sheet*, Department of Land and Water Conservation, Sydney, NSW.

Appendices

Appendix A – Recommended species for revegetation

Suggested species for revegetation works

Scientific Name	Common Name	Recommended Density	Recorded in locality (GHD 2014)*	LHCCREMS community description (NPWS 2000)
Overstorey				
Corymbia maculata	Spotted Gum	1 per 10m^2	Species characteristic of community	Dominant species
Eucalyptus siderophloia	Grey Ironbark	1 per 10m^2	-	Co-dominant species
Eucalyptus paniculata	Grey Ironbark	1 per 10m^2	-	Co-dominant species
Eucalyptus fibrosa	Red Ironbark	1 per 10m^2	-	Co-dominant species
Upper mid- and midstorey				
Allocasuarina torulosa	Forest Oak	1 per 5m^2	Species characteristic of community	Y
Melaleuca nodosa		1 per 5m^2	Y	Y
Polyscias sambucifolius	Elderberry Panax	1 per 5m^2	Y	Y
Acacia ulicifolia	Prickly Moses	1 per 5m^2	Species characteristic of community	-
Persoonia linearis	Narrow-leaved Geebung	1 per 5m^2	Y	Y
Breynia oblongifolia	Coffee Bush	1 per 5m^2	Y	Y
Understorey				
Themeda australis	Kangaroo Grass	Broadcast seed if required	Y	Y
Microlaena stipoides var. *stipoides*	Weeping Grass	Broadcast seed if required	Y	Y
Cymbopogon refractus	Barbwire Grass	Broadcast seed if required	Species characteristic of community	-
Imperata cylindrica	Blady Grass	Broadcast seed if required	Species characteristic of community	Y
Entolasia stricta	Wiry Panic	Broadcast seed if required	Y	Y
Dianella caerulea	Blue Flax-lily	2 per 5m^2	Y	Y
Lomandra longifolia	Spiny-headed Mat-rush	2 per 5m^2	Y	Y

*Species characteristic of community refers to species listed in the description of Coastal Foothills Spotted Gum – Ironbark Forest within the Tuggerah Westfield and Gateway sites as per GHD (2014). 'Y' indicates species recorded within the Tuggerah Westfield and Gateway sites but not necessarily known from within this community.

Appendix B – Weed control methods

Note: Not all weeds listed in the below table are currently found on the rehabilitation site. The information regarding their treatment will assist those involved in future management of the site should infestation occur.

Recommended Weed control techniques

Common Name	Scientific Name	Status	Removal Techniques
African love grass	*Eragrostis curvula*	Environmental Weed	Slash or mow before it sets seed along roads and in highly disturbed areas. Spot spray with diluted 1:100 Roundup. Hand-remove isolated plants.
Asparagus fern	*Asparagus aethiopicus*	Environmental Weed	Hand remove, ensure that entire rhizome removed
Blackberry	*Rubus fruiticosus* agg. Spp.	Noxious Weed	Cut and paint crown/lignotuber with undiluted Roundup or Garlon and diesel immediately for isolated plants. Slash large populations and spray re-growth with selective herbicide Garlon, Grazon or Brushoff at flowering/fruiting stage.
Boneseed	*Chrysanthemoides monilifera*	Environmental Weed	Spray actively growing plants, spray to wet all foliage. Spray Roundup at a ratio of 1:100.
Bridal Creeper	*Asparagus asparagoides*	Noxious Weed	Hand remove (i.e. by crowning with a knife) isolated plants after removing and bagging fruit. Spray large populations with Brushoff at flowering stage.
Broom	*Spp.*	Environmental Weed	Spray with Garlon 600 Herbicide.
Camphor Laurel	*Cinnamomum camphora*	Environmental Weed	Cut and paint base of trunk or drill/chisel trunk (>10cm diameter) and inject with undiluted Roundup immediately. Hand-remove seedlings.
Cobblers peg	*Bidens pilosa*	Environmental Weed	Spot spray with diluted 1:100 Roundup. Best done before it sets seed. Hand-remove isolated plants.
Crofton weed	*Ageratina adenophora*	Noxious Weed	Hand-remove or spray with 1:100 Roundup.
Dodder	*Cuscata sp.*	Environmental Weed	Hand-remove.
Fireweed	*Senencio madagascariensis*	Environmental Weed	Spot spray with diluted 1:100 Roundup. Best done before it sets seed. Hand remove isolated plants.
Fleabane	*Conyza spp.*	Environmental Weed	Spot spray with diluted 1:100 Roundup. Best done before it sets seed. Hand-remove isolated plants.
Green cestrum	*Cestrum parqui*	Noxious Weed	Stem scrape and paint with Garlon and diesel (i.e. both sides of stem) immediately at flowering stage. Remove and bag fruit.
Inkweed	*Phytolacca octandra*	Environmental Weed	Hand remove or cut and paint base with undiluted Roundup after removing and bagging fruit.
Japanese Honeysuckle	*Lonicera japonica*	Environmental Weed	Cut and paint large stems with undiluted Roundup immediately. Treatment of re-growth may be necessary stems often reshoot. Hand remove seedlings.
Kikuyu	*Pennisetum clandestinum*	Environmental Weed	Spot spray with diluted 1:100 Roundup.
Lantana	*Lantana camara*	Noxious Weed	Cut and paint base of trunks with undiluted

Common Name	Scientific Name	Status	Removal Techniques
			Roundup immediately. Slash Lantana stems into 2x2 metre piles. Treatment of re-growth may be necessary as layering stems may re-shoot. Hand-remove seedlings.
Large leaf privet	*Ligustrum lucidum*	Environmental Weed	Cut and paint base of trunk or drill/chisel trunk (>10cm diameter) and inject with undiluted Roundup immediately before fruiting stage. Hand remove or spot spray seedlings with 1:100 Roundup.
Madeira winter cherry	*Solanum pseudocapsicum*	Environmental Weed	Stem scrape and paint with Garlon and diesel (i.e. both sides of stem) immediately at flowering stage. Remove and bag fruit.
Moth plant	*Arauja sericifolia*	Environmental Weed	Hand remove or cut and paint base of stems with undiluted Roundup after removing and bagging fruit.
Mother of millions	*Kalanchoe tubiflora*	Environmental Weed	Remove by hand, bag all plant material and dispose of in appropriate manner.
Paddy's lucerne	*Sida rhombifolia*	Environmental Weed	Hand-remove or cut and paint base with undiluted Roundup. Slash large populations and spray re-growth with 1:100 Roundup.
Pampas grass	*Cortaderia spp.*	Noxious Weed	Spot spray with diluted 1:70 Roundup after removing and bagging fruit/flowering stems.
Paspalum	*Paspalum dilatatum*	Environmental Weed	Spot spray with diluted 1:100 Roundup.
Prickly pear	*Opuntia spp.*	Noxious Weed	Mattock/hand remove all parts of plant.
Rambling Dock	*Acetosa saggitata*	Environmental Weed	Hand remove
Salvinia	*Salvinia molesta*	Noxious Weed	Hand-remove small infestations, ensuring all fragments are collected. Dispose at an appropriate waste facility.
Scotch thistle	*Onopordum acanthium*	Environmental Weed	Spot spray with diluted 1:100 Roundup. Best done before it sets seed. Hand remove isolated plants.
Silky oak	*Grevillea robusta*	Environmental Weed	Cut and paint base of trunk or drill/chisel trunk (>10cm diameter) and inject with undiluted Roundup immediately. Hand-remove seedlings.
Small leaf privet	*Ligustrum sinense*	Environmental Weed	Cut and paint base of trunk or drill/chisel trunk (>10cm diameter) and inject with undiluted Roundup immediately before fruiting stage. Hand remove or spot spray seedlings with 1:100 Roundup. Treatment of re-growth may be necessary as the plant has the ability to sucker from roots.
Sowthistle	*Sonchus oleraceus*	Environmental Weed	Spot spray with diluted 1:100 Roundup. Best done before it sets seed. Hand-remove isolated plants.
Verbena	*Verbena spp.*	Environmental Weed	Spot spray with diluted 1:100 Roundup. Best done before it sets seed.
Wandering Jew	*Tradescantia fluminensis*	Environmental Weed	Spot spray with 1:50 Roundup or Starane. It is photo-inhibited so should be treated on overcast days after rain. Rake and hand remove all stem fragments in small populations amongst native species.

Appendix C – Monitoring report template

Vegetation Management Plan Monitoring Field Sheet

Project: _____ Date: _____

Quadrat: _____ Recorder: _____

Measure	Observation				Comments/Actions Required	Responsibility	Completion Date
Plant Growth (cm):							
Trees	0-5	5-20	20-50	50+			
Understorey	0-5	5-10	10-30	30+			
Ground cover	0-5	5-10	10-20	20+			
Percentage Cover (%):							
Trees	0-10	10-50	50-85	85+			
Understorey	0-10	10-50	50-85	85+			
Ground cover	0-10	10-50	50-85	85+			
Survival Rates (%):							
Trees	0-10	10-50	50-85	85+			
Understorey	0-10	10-50	50-85	85+			
Ground cover	0-10	10-50	50-85	85+			
Plant replacement required/Ha							
Trees	0-5	5-20	20-50	50+			
Understorey	0-5	5-20	20-50	50+			
Ground cover	0-5	5-50	50-100	100+			
Weed regrowth (% cover)	0-10	10-50	50-85	85+			
Condition of Tree Guards	Poor	Ok	Good				
Watering required	Yes	Some	No				
Photographs:							
Number							
Location							
Direction							

Comments:

_____

_____

_____

Site Plan

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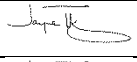
0	R. Hamer D Williams	J. Tipping		J. Tipping		17/06/14
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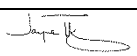
2	R. Hamer D Williams	J. Tipping		J. Tipping		19/06/14

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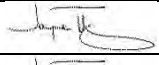
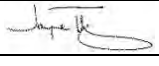
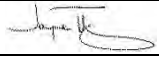
1	GHD	J Tipping		J Tipping		17/06/14
2	GHD	J Tipping		J Tipping		18/06/14

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