Coastal Developments (NSW) Pty Ltd

Fullerton Cove Sand Quarry Rezoning Application

Flora and Fauna Assessment

May 2017

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1. Introduction

1.1 Background

Coastal Development Pty Ltd has engaged GHD Pty Ltd (GHD) to prepare a flora and fauna assessment for inclusion in a Planning Proposal to support a rezoning application of the Fullerton Cove Sand Quarry to rural residential land (approximately 4,000 m^2). The study area is located in Fullerton Cove with access off Coxs Lane, within the Port Stephens Local Government Area (LGA).

Coastal Sand and Quarry Products (a subsidiary of Coastal Development Pty Limited) currently own and operate the Fullerton Cove Sand Quarry (the quarry). Operations at the quarry are currently undertaken in accordance with Project Approval PA 07_0145 which was granted by the NSW Minister for Planning on 18 July 2009 and modified on 17 November 2010. The approved extraction area covers the existing quarry and some adjacent areas of native vegetation. Three conservation areas were established as biodiversity offset as part of the existing approval. There are also additional areas of native vegetation present within and adjacent to the approved areas (see Figure 1-1).

This flora and fauna assessment has been prepared to evaluate the conservation significance of biodiversity in the study area and to identify the likely impact of the proposed rural residential rezoning on biodiversity values. In particular, the assessment considers the likely significance of impacts on threatened species, populations and communities (and their habitats) listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), *Fisheries Management Act 1994* (FM Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

GHD completed a Flora and Fauna Assessment (GHD, 2015) for the Fullerton Cove Sand Quarry as part of a previous project. However, this assessment was not submitted due to a change in scope for the project. The findings presented in this report have been derived from the previous assessment and field surveys completed by GHD (2015).

1.2 Study area description

The study area is situated on the corner of Cox's Lane and Nelson Bay Road Fullerton Cove, approximately 11 km north of Newcastle NSW (Figure 1-1).

The study area is currently operated as a sand quarry and covers approximately 26 ha comprising Lot 3 DP 11519, Lot 1 DP 794575, Lot 1910 DP 55701, Lot 1 DP 1006307, Lot 201 DP 39968, Lot 991 DP 627179 and Lot 1 DP 1142113.

The predominant soil type is fine grained sand of the Tomago Sandbeds. The study area is located in the Hunter River catchment approximately 5 km north east of the Hunter River.

The study area is highly disturbed and consists of cleared land and bushland, with majority of the site having been cleared for the extraction of heavy mineral sands including Rutile and Zircon. The remainder of the site consists of remnant and revegetated bushland including 2.47 ha of conservation area that was established as biodiversity offset land as part of the existing quarry approval. The conservation area on site includes an area of Freshwater Wetland and Paperbark Swamp Forest, which are classified as threatened ecological communities under the TSC Act and also an area of Smooth-barked Apple – Red Bloodwood Open Forest. Environmental and exotic weeds are present throughout the study area. Surrounding land uses include rural residential properties and small businesses.

1.3 Definitions

For the purpose of this report the following definitions apply:

- The 'Proposal' refers to the proposed rural residential rezoning application.
- The 'study area' encompasses the entire quarry site, comprising Lot 3 DP 11519, Lot 1 DP 794575, Lot 1910 DP 55701, Lot 1 DP 1006307, Lot 201 DP 39968, Lot 991 DP 627179 and Lot 1 DP 1142113.
- The 'locality' is the area within a 10 km radius of the study area.

1.4 Scope

The aim of this flora and fauna assessment is to:

- Evaluate the conservation significance of the biodiversity values identified for the study area, including identification of the known or likely occurrence of threatened biota listed under the TSC Act or Matters of National Environmental Significance (MNES) listed under the EPBC Act.
- Describe and map flora and fauna constraints and opportunities with respect to the proposed future use of the study area.
- Provide a preliminary assessment of the potential for direct and indirect impacts on biodiversity values and the potential for proposed future use of the study area to have a significant impact on threatened biota and MNES.
- Recommend mitigation measures that could be incorporated into future development plans to avoid or minimise impacts on threatened biota and MNES (as relevant)
- Assess the likelihood of the requirement for further survey, assessment and approvals under the NSW *Environmental Planning and Assessment Act* 1979 (EP&A Act) or EPBC Act (as relevant).

1.5 Limitations

This report has been prepared by GHD for Coastal Developments and may only be used and relied on by Coastal Developments and Port Stephens Council for the purpose agreed between GHD and Coastal Developments.

GHD otherwise disclaims responsibility to any person other than Coastal Developments 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.

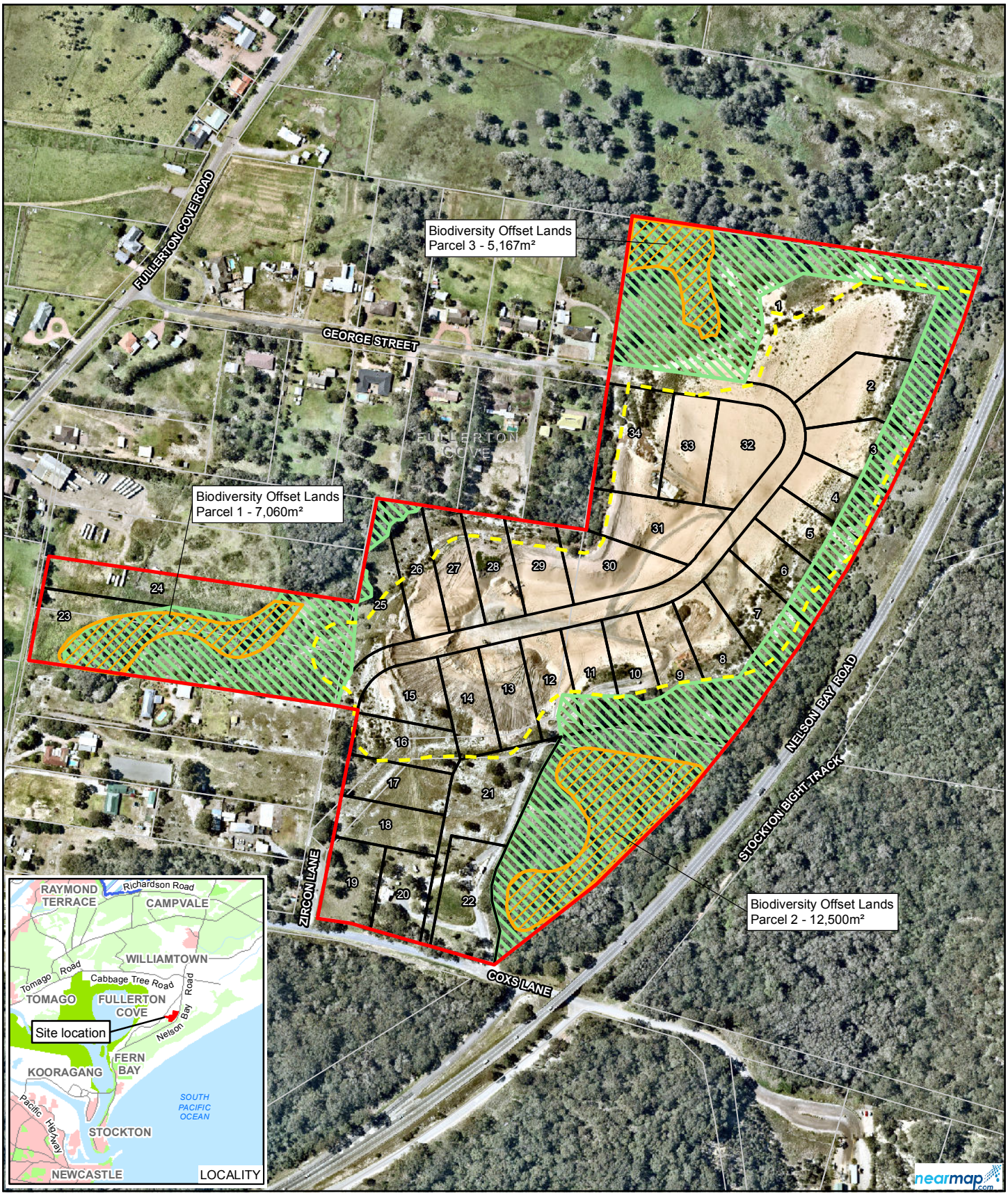
The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Coastal Developments and others (including government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The survey conducted for this report was not designed to detect all species present in the study area, rather to provide an overall 'snapshot' assessment of the biodiversity values in the study area and identify potential constraints and opportunities for future development. Given the duration and timing of the field survey it is likely that some species that utilise the study area (permanently, seasonally or transiently) were not detected, albeit targeted surveys were conducted for this report. Habitat assessments, the results of previous surveys and database results were utilised to determine the likelihood of threatened and migratory species occurring in the study area.

Conditions in the study area (including the presence of threatened vegetation and threatened species and their habitat/s) may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the study area conditions. GHD is also not responsible for updating this report if the study area conditions change.



LEGEND

- Cadastre
- Site boundary
- Approved excavation area
- Lot boundary
- Proposed E2 Environmental Conservation zone
- Existing biodiversity offset lands

Paper Size A4

0 20 40 80 120 160

Metres

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

N

GHD

Pulver Cooper and Blackley
Fullerton Cove Sand Quarry
Rezoning Application - Flora and Fauna Assessment

Job Number 22-18230
Revision 1
Date 25 May 2017

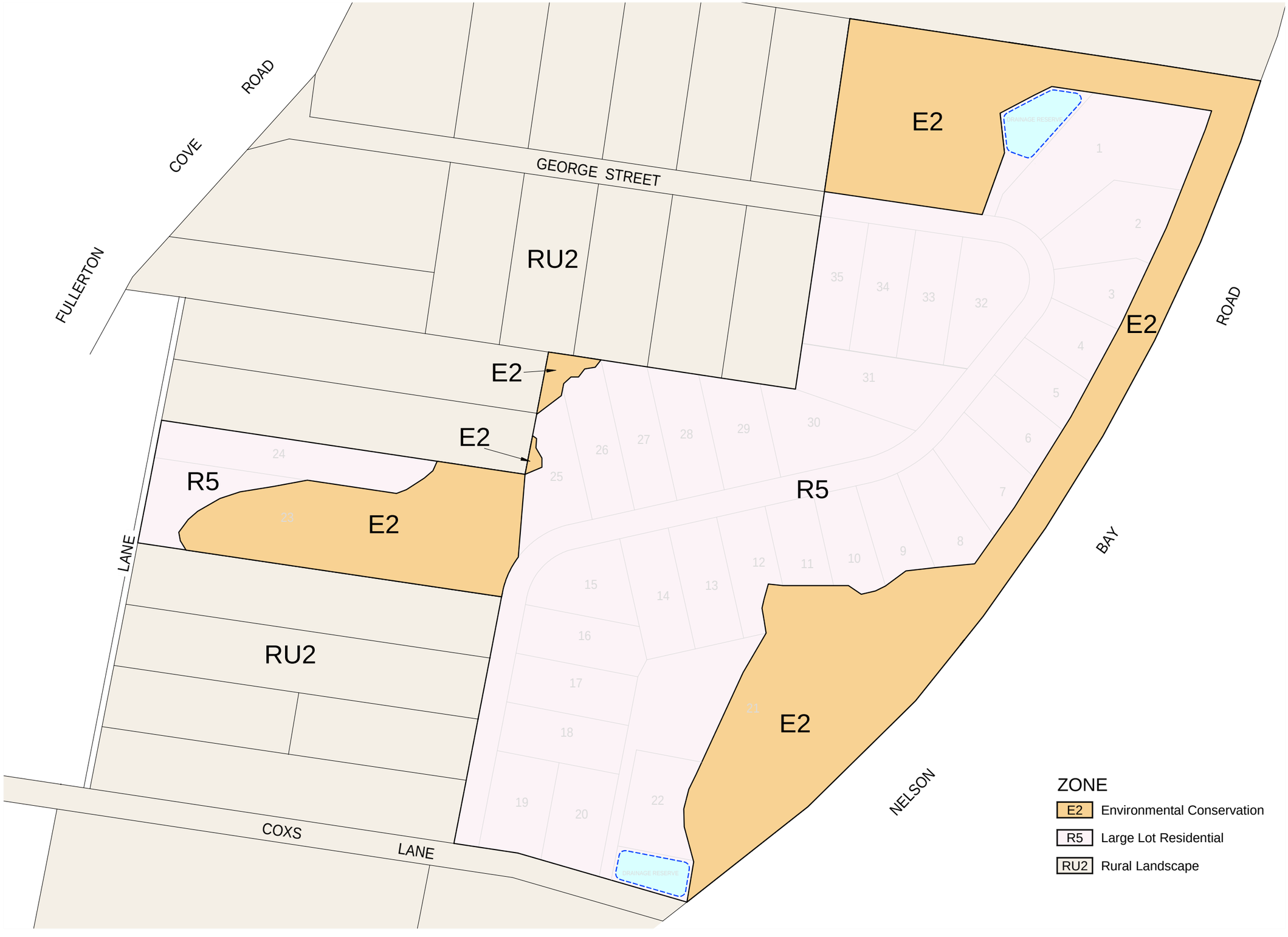
The proposal

Figure 1-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18001\GIS\Maps\Deliverables\2218230\FloraFauna_Assessment\2218230_FFA001_TheProposal_1.mxd

Data source: Geoscience Australia: 250k Topographic Data Series 3, 2006; LPI: DTDB / DCDB, 2012.; Nearmap: Aerial Imagery, extracted 20190109. Created by: fmackay, tmorton



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07/07	N/A				
COMPUTER FILE NUMBER:	DESIGNED:	25/05/2017	ADDED DRAINAGE RESERVES & ADDED LOT 35	DKH	E
ID 119177 (PDF)	MAC	10/04/2017	AMENDED ZONING AREAS	DKH	D
SHEET NUMBER:	DRAWN:	10/01/2017	AMENDED PROPOSED BOUNDARIES TO TRUE MGA	DKH	C
1	DKH	16/12/2016	AMENDED ZONING AREAS	DKH	B
DATUM:	SCALE:	05/09/2016	INITIAL ISSUE	DKH	A
N/A	1:1500 A1	DATE	DESCRIPTION	DRAWN	REVISION
CONTOUR INTERVAL:	CHECKED:				
N/A	MD				

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PLAN:
PROPOSED ZONING PLAN
COXS LANE
FULLERTON COVE
LGA:PORT STEPHENS

CLIENT:
COASTAL DEVELOPMENTS (NSW) PTY LTD

30 15 0 30 60 90
Horizontal Scale 1:1500 (A1)
1:3000 (A3)

Plot Date: 26/05/2017 Cad File: 07_07 – Subdivision Plan (Proposed Zoning Plan) (ID 119171)

Figure 1-2 Indicative subdivision plan

2. Methodology

2.1 Desktop review

A desktop assessment was undertaken to identify threatened species, populations and ecological communities listed under the TSC Act and FM Act (i.e. threatened 'biota') and MNES listed under the EPBC Act that could be expected to occur in the locality (i.e. within a 10 km radius of the study area), based on previous records, known distribution ranges, and habitats present. Biodiversity databases and literature pertaining to the study area and locality included:

- Flora and Fauna Assessment for the Fullerton Cove Sand Quarry - Modification of Project Approval 07_0145 (GHD, 2015).
- Flora and Fauna Assessment conducted for the Fullerton Cove Extractive Industry (Orogen 2008).
- The NSW Vegetation Information System Database (OEH 2015b)
- The Commonwealth Department of the Environment (DotE) Protected Matters Search Tool (PMST) for relevant MNES listed under the EPBC Act (July 2016, buffered at 10 km) (DotE 2015).
- The NSW Office of Environment and Heritage (OEH) Wildlife Atlas database (licensed) for records of threatened species, populations and endangered ecological communities listed under the TSC Act that have been recorded within the locality (within a 10 km radius of the study area) (OEH, 2016).
- OEH threatened biota profiles for descriptions of the distribution and habitat requirements of threatened biota (OEH, 2016a). This resource was used to identify the suite of threatened biota that could potentially be affected by the Proposal and to inform habitat assessments.
- Department of Primary Industries (DPI) Threatened and Protected Species Records Viewer for threatened species listed under the FM Act previously recorded within the Greater Taree local government area (LGA) (DPI 2016).
- Review of the species and community profiles in the Species Profile and Threats (SPRAT) and Threatened Species Profile databases (DotE 2016a).
- Port Stephens Council Comprehensive Koala Plan of Management (KPoM) (Port Stephens Council, 2002).
- Review of relevant threatened species recovery plans.
- Department of Primary Industries (DPI) Noxious Weeds Declarations for information regarding noxious weeds (DPI 2016a).

Following collation of database records and species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the broad habitats known or anticipated to occur within the study area. The likelihood of threatened and migratory biota occurring in the study area was assessed based on presence of records from the locality, species distribution and habitat preferences, and quality of potential habitat present in the study area. The results of the database searches are presented in Section 3.1 and Appendix C.

2.2 Site inspection

Following the desktop review, a field assessment was completed to assess the potential for the Proposal to impact on endangered ecological communities, threatened species, populations and their habitats and MNES and to assist in identifying the most appropriate impact mitigation and environmental management measures to avoid or minimise the potential for significant adverse impacts.

The habitat resources present within the study area (determined during the site inspection) were compared with the known habitat associations/requirements of the threatened and migratory biota highlighted by the desktop review. This was used to determine the likelihood of each threatened ecological community, endangered population and threatened or migratory species occurring within the study area.

Field surveys were conducted by two ecologists on 15 September 2015 within the study area, as shown on Figure 1-1.

Methods utilised during the assessment are described below.

2.2.1 Flora survey

The primary objectives of flora surveys undertaken were to:

- Map and describe the vegetation types occurring within the study area with reference to the NSW Vegetation Information System Database (OEH 2015b).
- Undertake targeted survey for threatened flora species listed under the TSC Act or EPBC Act within the study area using the 'random meander' technique (Cropper 1993), in accordance with the OEH Threatened Species Survey and Assessment: Guidelines for developments and activities (DEC 2004).
- Compile a flora list of those species occurring within the vegetation types, identifying any threatened species.
- Identify the presence of any threatened ecological communities or populations listed under either the TSC or EPBC Acts.
- Identify potential constraints associated with vegetation and flora species within the study area and provide recommendations to assist in minimising impacts on vegetation and threatened flora species.

Flora quadrats

Flora survey techniques included collecting quantitative data describing the condition of vegetation in terms of floristics, structure and habitats. Survey effort included three 20 m x 20 m quadrats positioned to define native vegetation communities in the study area. Within each quadrat all vascular plants (i.e. not mosses, lichens or fungi) observed were recorded on pro-forma field data sheets. Each species list was accompanied by a biophysical description, including vegetation structure, soils, geology and geomorphology, habitat and fire and disturbance history.

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. Plant identifications were made according to nomenclature in Harden (1992, 1993, 2000 and 2002).

Targeted threatened flora surveys

Targeted surveys were undertaken for threatened flora species identified during the desktop review which could potentially occur within the study area given known distributions, previous records in the locality and habitat requirements for each species. In accordance with the survey guidelines specified in the OEH Threatened Species Survey and Assessment: Guidelines for developments and activities (DEC 2004), random meander transects were undertaken according to the methods of Cropper (1993). These transects focused in areas potentially suitable habitat.

Opportunistic observations

Opportunistic and incidental observations of flora species which had not been previously recorded during quadrat surveys or targeted threatened species surveys were recorded during field surveys.

Vegetation mapping

Native vegetation within the study area was mapped based on dominant flora species present within each structural layer (i.e. canopy, shrub and ground layers). Structural vegetation communities were described according to the NSW Vegetation Information System Database (OEH 2015b).

Field ecologists mapped vegetation polygons with a hand-held GPS unit loaded with aerial photography. On the basis of air photo interpretation, and field habitat assessment, the study area was divided into stratification units i.e. functionally similar units for the purposes of environmental assessment according to the OEH guidelines (DEC 2004). Vegetation within the study area was assessed against identification criteria for State and Commonwealth listed threatened ecological communities (critically endangered ecological communities (CEECs), endangered ecological communities (EECs) and vulnerable ecological communities (VECs)). Vegetation and habitats were compared with descriptions provided in published threatened species profiles and management plans (OEH 2015a) and (DotE 2015b).

2.2.2 Fauna survey

Fauna habitat assessment

Fauna habitat assessments were conducted within the study area 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.

Habitat quality was based on the availability of breeding, nesting, feeding and roosting resources available.

Habitat assessment meanders were completed over eight person hours during which the following information was recorded (where relevant):

- Specific food trees and evidence of foraging
- Dominant plant species
- Level of disturbance
- Connectivity of vegetation
- Evidence of activity such as feeding scars, scats, scratches and diggings
- Trees with bird nests or other potential fauna roosts
- Presence of rocky outcrops or caves, tunnels, culverts or bridges
- Presence of burrows, dens and warrens

- Locations of hollow-bearing trees and logs which provide refuge, nest and den sites for a range of threatened fauna species
- Koala food trees and evidence of scratches or scats
- Tracks or animal remains
- Leaf litter and fallen timber suitable for reptile habitat
- Presence of potential habitat for frog species

The fauna habitat assessments have been utilised to prepare the likelihood of occurrence assessments for threatened species identified as potentially occurring in the study area during the desktop assessment.

Diurnal bird surveys

Surveys of diurnal birds were undertaken within the study area, focussing on those habitats of potential relevance for threatened species. Stationary surveys were conducted at two locations within the study area. This comprised recording all birds seen or heard over a 20 min period. Opportunistic observations or calls were recorded throughout the duration of all surveys in the study area.

Trees were also scanned for nests, whitewash 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 the study area focussing on drainage lines, wetlands and areas with suitable habitat. Drainage lines and 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 individuals was undertaken.

Microchiropteran Bats

Searches for potential habitat for threatened microchiropteran bats such as hollows and decorticating bark were undertaken during random meanders, however it was beyond the scope of this assessment to complete more detailed surveys for microchiropteran bats such as nocturnal surveys, Anabat ultrasonic call detection or trapping.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys, which included observations for scats, tracks, burrows or other traces of faun activity.

2.2.3 Likelihood of occurrence of threatened species

The likelihood of occurrence assessment undertaken during the desktop review phase was refined following the field surveys and verification of the extent and quality of the habitats present. The results of this assessment are provided in Appendix C.

2.3 Survey conditions

The field survey was undertaken in early-spring (15 September 2015). This is generally considered a suitable time of year for ecological surveys in the Port Stephens area. Weather was generally fine with the temperature ranging from 9°C to 28°C during the day of the survey (BOM 2015). Light wind (NW 24 km/hr) experienced during the bird surveys did not hamper the detection of bird species. There was very little rain leading up to the field survey and conditions during the survey period were generally not favourable for the detection of amphibian species.

Bureau of Meteorology (BOM) records for survey date are outlined in below. These records were taken at Williamtown weather station located approximately 5 km from the study area.

3. Results

3.1 Database search results

3.1.1 Threatened ecological communities

The desktop assessment indicated 22 threatened ecological communities (TECs) known or predicted to occur within 10 km of the study area. Two of these TECs occur in the study area (see Section 3.3.3). The remaining TECs do not occur within the study area.

Appendix C).

3.1.2 Endangered populations

One endangered population (coastal Emu population) has been previously recorded within 10 km of the study area. This population is not likely to occur in the study area due to lack of suitable habitat (see Appendix C).

3.1.3 Threatened flora

The Atlas of NSW Wildlife database identified seven threatened flora species listed under the TSC Act previously recorded in the locality. The PMST search identified nine threatened flora species listed under the EPBC Act as potentially occurring in the locality.

Threatened flora species known or considered likely to occur, based on habitat present, are discussed in more detail in Section 3.4.2.

3.1.4 Threatened fauna

A search of the Atlas of NSW Wildlife database identified 36 threatened fauna species (21 birds, one amphibian, and 14 mammal species) listed under the TSC Act as having been previously recorded in the locality (see Appendix D). The PMST search identified 23 threatened fauna species listed under the EPBC Act as potentially occurring in the locality, including 14 bird species, seven mammal species and two frog species (see Appendix C).

Threatened fauna species known or considered likely to occur in the study area, based on habitats observed, are discussed in more detail in Section 0.

3.1.5 Migratory species

The PMST search identified 39 migratory fauna species listed under the EPBC Act as potentially occurring in the locality. The majority of these were migratory waders not considered to occur in the study area.

3.1.6 Threatened aquatic species

A search of the DPI Threatened and Protected Species Records Viewer for records of threatened and protected aquatic species listed under the FM Act and EPBC Act within the Port Stephens LGA did not reveal any records within or in proximity to the study area.

3.1.7 Other ecological matters of national environmental significance

In addition to the threatened biota discussed in the sections above, the PMST search identified the Hunter Estuary Wetlands (listed as a Wetland of International Importance) as occurring in the locality of the study area. This wetland is located about 1 km to the west of the study area and is unlikely to be impacted by the proposed rezoning.

3.2 Literature review

An earlier ecological assessment of the study area undertaken as a component of the Environmental Assessment for proposed sand extraction activities (Orogen 2008) reported the following ecological values within the study area:

- Two threatened ecological communities listed under the TSC Act:
  - Freshwater Wetlands on Coastal Floodplains
  - Swamp Sclerophyll Forest on Coastal Floodplains
- Seventy-four (74) fauna species, comprising 40 bird, 23 mammal, seven reptile and four amphibian species. Seven of those species recorded are listed as vulnerable under the TSC Act. These species are:
  - Powerful Owl (*Ninox strenua*)
  - Masked Owl (*Tyto novaehollandiae*)
  - Grey-headed Flying-fox (*Pteropus poliocephalus*)
  - Eastern Freetail-bat (*Mormopterus norfolkensis*)
  - Little Bentwing-bat (*Miniopterus australis)*
  - Southern Myotis (*Myotis macropus*)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*)

  The Grey-headed Flying-fox, is also listed as Vulnerable under the EPBC Act.
- Important habitat features such as foraging habitat for threatened amphibians and bats, and also a number of hollow-bearing trees.

A review of the Port Stephens Comprehensive Koala Plan of Management (CKPoM) (Port Stephens Council 2002) was conducted. This included a review of the Koala habitat mapping and requirements for rezoning proposals.

3.3 Field survey results

This sections summaries the results of the Flora and Fauna Assessment of the quarry completed by GHD (2015).

3.3.1 Flora species

A flora species list for the study area has been compiled from the results of the flora survey and opportunistic observations made during random meander surveys. A total of 74 flora species were recorded during the field surveys, of which 38 are native. A list of plant species recorded during the field survey is presented in Appendix A. No threatened flora species were recorded.

3.3.2 Noxious and environmental weeds

The *Noxious Weeds Act 1993* provides for the declaration of noxious weeds throughout NSW. Landowners and occupiers must control noxious weeds according to the control category specified in the Act.

The study area contains numerous exotic flora species, of which three are declared as noxious weeds in the Port Stephens LGA (DPI 2015a) (refer to Table 3-1). *Chrysanthemoides monilifera* subsp*. Rotundata* (Bitou Bush), *Rubus fruiticosus species aggregate* (Blackberry) and *Senecio madagascariensis* (Fireweed) occur as scattered patches and isolated individuals throughout the study area, particularly in the disturbed area between the Freshwater Wetland and the quarry.

The study area also contains high levels of exotic grasses and environmental weeds associated with disturbed margins of native vegetation, including *Stenotaphrum secundatum* (Buffalo Grass), *Eragrostis curvula* (African Lovegrass), *Lantana camara* (Lantana), *Holcus lanatus* (Yorkshire Fog), *Melinis repens* (Red Natal Grass) and *Acetosella vulgaris* (Sheep Sorrel).

Table 3-1 Noxious weeds recorded in the study area

Weed species	Class	Restriction level
Blackberry (*Rubus fruiticosus species aggregate)*	4	Locally Controlled Weed - *The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.*
Fireweed (*Senecio madagascariensis*)	4	Locally Controlled Weed - *The plant must not be sold, propagated or knowingly distributed.*
Bitou bush (*Chrysanthemoides monilifera* subsp*. rotundata*)	4	Locally Controlled Weed - *The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread.*

3.3.3 Vegetation types

The majority of the study area consists of disturbed lands associated with historical quarrying activities. Vegetation in the study area includes remnant and revegetated areas along the eastern boundary of the study area, in the north-western extent of the study area and also within the western extent of the study area.

Vegetation types mapped within the study area are shown on Figure 3-1 and are described below.

Table 3-2 Vegetation communities in the study area

Vegetation type	TSC Act status	FM Act status	EPBC Act status
Smooth barked Apple (*Angophora costata*) – Red Bloodwood (*Corymbia gummifera*) Woodland/Open Forest	Not listed	Not listed	Not listed
Coastal Tea-tree (*Leptospermum laevigatum*) - Old-man Banksia (*Banksia serrata*) Shrubland	Not listed	Not listed	Not listed
Broad-leaved Paperbark (*Melaleuca quinquenervia*) - Swamp Mahogany (*Eucalyptus robusta*) Swamp Forest	EEC – Swamp Sclerophyll Forest on Coastal Floodplains	Not listed	Not listed
Broad-Leaved Paperbark (*Melaleuca quinquenervia*) Swamp Forest	EEC - Swamp Sclerophyll Forest on Coastal Floodplains	Not listed	Not listed
Freshwater Wetlands	EEC – Freshwater Wetlands on Coastal Floodplains	Not listed	Not listed

Vegetation type	TSC Act status	FM Act status	EPBC Act status
Exotic grassland	Not listed	Not listed	Not listed
Disturbed land	Not listed	Not listed	Not listed

Smooth barked Apple (Angophora costata) – Red Bloodwood (Corymbia gummifera) Woodland/Open Forest

This vegetation type occurs in the south-eastern portion of the study area associated with low sand dune formations. The vegetation displays differential regrowth with scattered older mature eucalypts. The canopy is dominated by *Corymbia gummifera* (Red Bloodwood) and *Angophora costata* (Smoothed-barked Apple) to 20 m with occasional *Eucalyptus pilularis* (Blackbutt). The midstorey consists of a sparse layer of shrubs, including *Banksia serrata* (Old-man Banksia), *Monotoca elliptica* (Tree Broom-heath) and *Acacia longifolia* ssp. *longifolia* (Sydney Golden Wattle). The groundcover is dominated by ferns, low shrubs, grasses and graminoids, including *Pteridium esculentum* (Braken Fern), *Lomandra longifolia* ssp. *longifolia* (Spiny Mat-rush), *Pomax umbellata, Gonocarpus teucrioides* (Raspwort) and *Dianella caerulea* (Blue Flax-lily).

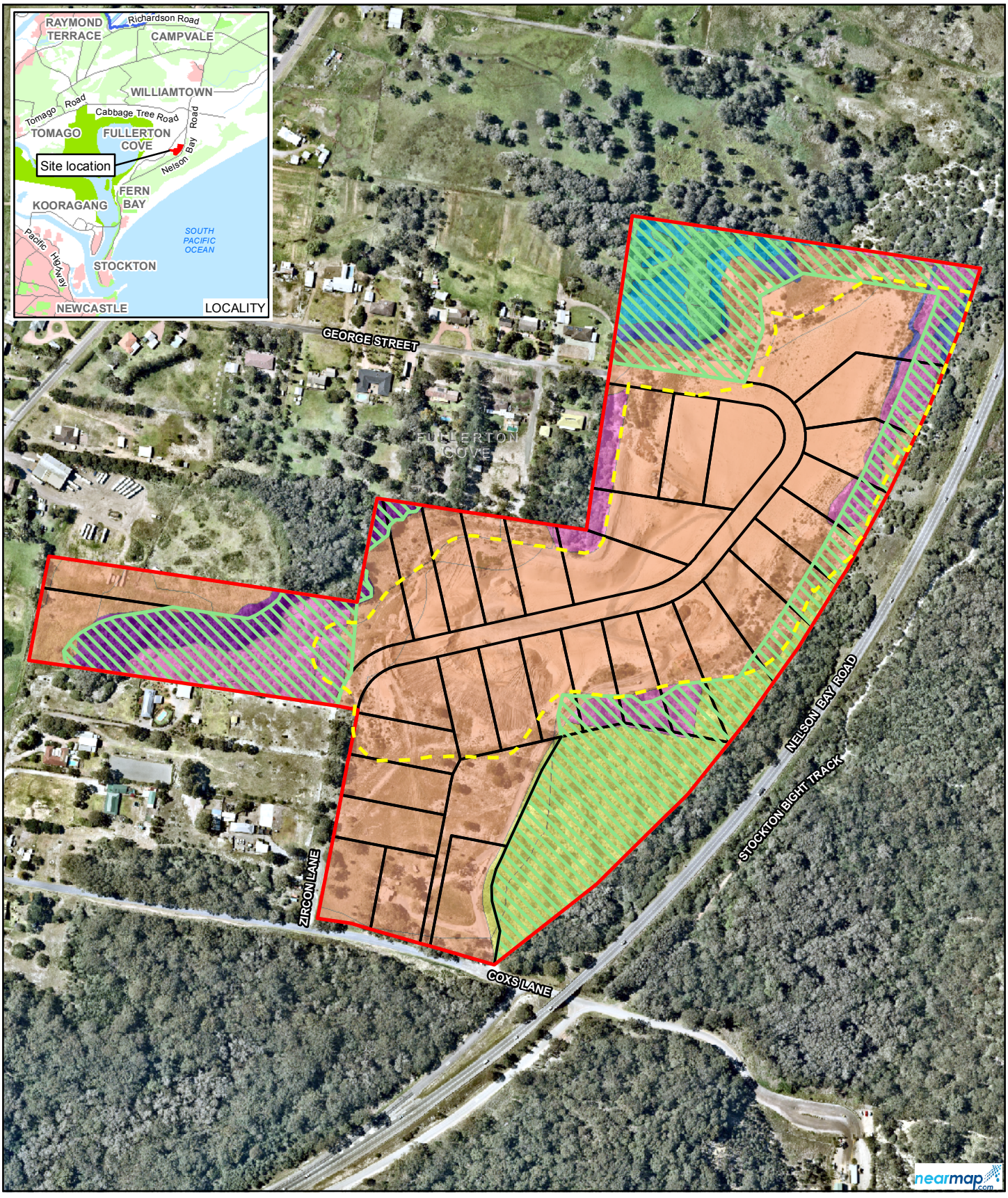
The extent of this vegetation type within the study area is shown in Figure 3-1.

Coastal Tea-tree (Leptospermum laevigatum)-Old-man Banksia (Banksia serrata) Shrubland

This vegetation community occurs on low sand dunes in various locations around the study area, including areas subject to historic quarrying activities. It appears that portions of this vegetation type have been subject to rehabilitation works associated with offsetting measures proposed within the original environmental approvals for the study area. The shrubland to 15 m tall consists of a monoculture of *Leptospermum laevigatum* (Coastal Tea-tree) with occasional *Banksia serrata* (Old-man Banksia) and *Acacia longifolia* var. *sophorae* (Coastal Wattle). The understorey is very sparse due to the dense covering of leaf litter. Species present include scattered *Pomax umbellata, Dianella cerulea* (Blue Flax-lily), *Calochilus robertsonii* (Purplish Beard Orchid), *Hibbertia fasciculata*, *Astroloma pinifolium* (Pine Heath), *Kennedia rubicunda* (Dusky Coral Pea) and *Monotoca elliptica* (Tree Broom-heath).

Vegetation edges have been invaded by exotic species, including *Eragrostis curvula* (African Lovegrass), *Lantana camara* (Lantana), *Acetosella vulgare* (Sheep Sorrel) and *Carpobrotus* spp. (Pigface). Scattered individuals of the noxious weed *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) are present along vegetation edges.

This vegetation type is not commensurate with any threatened ecological communities listed under the TSC or EPBC Acts.



LEGEND

- Site boundary
- Lot boundary
- Proposed E2 Environmental Conservation zone
- Approved excavation area
- Broad-leaved Paperbark Swamp Forest (EEC)
- Coastal Tea-tree-Old-man Banksia Shrubland
- Disturbed lands
- Exotic grassland
- Freshwater wetland (EEC)
- Smooth barked Apple – Red Bloodwood Woodland
- Broad-leaved Paperbark - Swamp Mahogony - Swamp Forest (EEC)

Paper Size A4

0 20 40 80 120 160

Metres

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

N

GHD

Pulver Cooper and Blackley
Fullerton Cove Sand Quarry
Rezoning Application - Flora and Fauna Assessment

Job Number 22-18230
Revision 1
Date 31 May 2017

Vegetation communities within the Proposal site

Figure 3-1

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Data source: Geoscience Australia: 250k Topographic Data Series 3, 2006; LPI: DTDB / DCDB, 2012.; Nearmap: Aerial Imagery, extracted 20170109. Created by: fmackay, tmorton

Plate 3-1 Coastal Tea-tree - Old-man Banksia Shrubland in the east of the proposal site

Broad-leaved Paperbark (Melaleuca quinquenervia) - Swamp Mahogany (Eucalyptus robusta) Swamp Forest

This vegetation type occurs in low lying depressions in the western portion of the study area. The canopy is dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Eucalyptus robusta* (Swamp Mahogany) and the occasional *Eucalyptus resinifera* (Red Mahogany) to 20 m. The midstorey consists of a sparse cover of A*cacia irrorata* (Green Wattle)*, Acacia longifolia* ssp. *longifolia* (Sydney Golden Wattle)*, Homalanthus populifolius* (Bleeding Heart) and *Leptospermum juniperinum* (Prickly Tea-tree). Groundcover consists of *Baumea articulata* (Jointed Twig-rush)*, Baumea rubiginosa* (Soft Twig Rush)*, Blechnum indicum* (Swamp Water Fern)*, Gahnia clarkei* (Saw Sedge)*, Pteridium esculentum* (Braken Fern)*, Parsonsia straminea* (Monkey Rope) and *Entolasia marginata* (Bordered Panic)*.*

Broad-leaved Paperbark (*Melaleuca quinquenervia*) - Swamp Mahogany (*Eucalyptus robusta*) Swamp Forest within the study area is commensurate with the Endangered Ecological Community (EEC) Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions listed under the TSC Act. This vegetation type is also considered a GDE, due to its reliance upon groundwater for wetland and swamp habitat.

Freshwater Wetlands

Freshwater Wetland occurs in the north-west of the study area in areas that are either permanently waterlogged or inundated for extended periods. This vegetation transitions into a patch of adjoining Broad-Leaved Paperbark Swamp Forest. This vegetation type is dominated by sedges and rushes, including *Baumea rubiginosa, Eleocharis gracilis, Juncus usitatus*, *Ranunculus inundatus (*River Buttercup*)*, *Isolepis inundatus* and *Philydrum lanuginosum* (Frogsmouth). There is also a high cover abundance of exotic species and invasive natives present throughout this community, including *Hydrocotyle bonariensis* (Beach Pennywort), *Cynodon dactylon* (Couch Grass), *Carpobrotus* spp. (Pigface) *Persicaria chinensis* (Chinese Knotweed), *Paspalum urvillei* (Vasey Grass) and *Holcus lanatus* (Yorkshire Fog).

Freshwater Wetland within the study area is commensurate with the Endangered Ecological Community (EEC), Freshwater Wetland on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions listed under the TSC Act. This vegetation type is also considered a GDE, due to its reliance upon groundwater for swamp and wetland habitat.

Plate 3-2 Freshwater wetland in the north-western portion of the proposal site

Broad-Leaved Paperbark (Melaleuca quinquenervia) Swamp Forest

This vegetation type occurs in the north-west of the study area, adjacent to an area of freshwater wetland. It is dominated almost exclusively by *Melaleuca quinquenervia* (Broad-leaved Paperbark) to 20 m tall over an understorey dominated by sedges and rushes. Common species within the understorey include *Baumea rubiginosa, Eleocharis gracilis, Isolepis inundata*, *Philydrum lanuginosum (*Frogsmouth), *Fimbristylis* spp. and *Triglochin procera* (Water Ribbons).

The community occurs in a low lying area which is subject to inundation from groundwater for extended periods. In this context this vegetation type meets the definition of a ground water dependent ecosystem.

The edges of this vegetation type have been invaded by exotic herbs and grasses such as *Stenotaphrum secundatum* (Buffalo Grass), *Holcus lanatus* (Yorkshire Fog), *Briza maxima* (Quaking Grass), *Hydrocotyle bonariensis* (Beach Pennywort), *Acetosella vulgare* (Sheep Sorrel) and *Persicaria chinensis* (Chinese Knotweed).

Broad-leaved Paperbark Swamp Forest within the study area is commensurate with the Endangered Ecological Community (EEC) Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions listed under the TSC Act.

Plate 3-3 Broad-leaved Paperbark Swamp Forest in north-west of proposal site

Exotic grassland

Areas of exotic grassland occur along the margins of the Freshwater Wetland and Coastal Tea-tree communities which have been subject to disturbance and edge effects. This vegetation dominated by exotic grasses and herbs as well as small number of invasive native species. Common species within this vegetation type include *Stenotaphrum secundatum* (Buffalo Grass), *Holcus lanatus* (Yorkshire Fog), *Briza maxima* (Quaking Grass), *Hydrocotyle bonariensis* (Beach Pennywort), *Acetosella vulgare* (Sheep Sorrel), *Hebenstretia dentata, Facelis retusa* (Annual Trampweed), *Eragrostis curvula* (African Lovegrass), *Sporobolus africanus* (Parramatta Grass) and *Melinis repens* (Red Natal Grass), *Acacia longifolia* var. sophorae (Coastal Wattle) and *Cynodon dactylon* (Couch Grass).

Exotic grassland is shown in Plate 3-4 and the extent of this vegetation is shown in Figure 3-1.

Plate 3-4 Exotic grassland fringing freshwater wetland in west of study area

Disturbed land

The majority of the study area consisted of disturbed lands associated with the sand extraction area. This area is largely devoid of vegetation, with sporadic regenerating *Acacia longifolia* var. *sophorae* (Coastal Wattle). The extent of disturbed land in the study area is shown in Figure 3-1.

3.3.4 Fauna species

Nineteen fauna species were recorded within the study area, constituting a low diversity of common birds, reptiles and amphibians. Species recorded within the study area during the survey include:

- Two amphibians: the Common Eastern Froglet (*Crinia signifera*) and Eastern Dwarf Froglet (*Litoria fallax*)
- Forest birds, including the Grey Fantail (*Rhipidura albiscapa*), Eastern Spinebill (*Acanthorhynchus tenuirostris*), White-cheecked Honeyeater (*Phylidonyris niger*) and Spotted Pardalote (*Pardalotus punctatus*)
- Three reptiles: Goanna (*Varanus* sp.), Jacky Lizard (*Amphibolurus muricatus*) and Sunskink (*Lampropholis* sp.)

Scats and tracks of two feral species, the European Rabbit and Fox, were observed in the study area. The study area did not appear to have a significant infestation of European Rabbits as scats were minimal and no burrows were detected. Fox tracks and scats were observed in numerous locations throughout the study area along with the skeletal remains and feathers of several birds.

A full list of fauna species recorded is provided in Appendix B.

3.3.5 Fauna habitat types

The study area contains five broad fauna habitat types:

- Woodland
- Shrubland
- Freshwater Wetland/Swamp Forest
- Disturbed land and exotic grassland

These habitat types are described below with particular reference to the threatened fauna species that occur or could potentially occur at the study area.

Woodland

Smooth-barked Apple – Red Bloodwood Open Woodland/Forest habitat occurs in a relatively undisturbed state in the southeastern corner of the study area. This area contains a canopy of myrtaceous trees and a moderately diverse shrub layer that provides potential foraging habitat for a range of woodland species, including birds, arboreal mammals and bats. Some hollow-bearing trees are present which would provide nesting and denning habitat for these species. 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 (OEH 2014) 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.

A number of threatened microchiropteran bat species have been recorded within this area, including the Eastern Freetail-bat (*Mormopterus norfolkensis*), Little Bentwing-bat (*Miniopterus australis),* and Southern Myotis (*Myotis macropus*). Evidence of Powerful Owl (*Ninox strenua*) feeding was also recorded within the area.

Shrubland

This habitat type consists of Coastal Tea-tree- Old-man Banksia Shrubland along portions of the boundary of the study area. Portions are moderately disturbed and contain regenerating plants and revegetated areas. This habitat type is characterised by an upper stratum dominated by *Leptospermum laevigatum* with occasional *Banksia serrata*. This vegetation exhibits a dense cover of leaf litter, with very few understorey species. No fallen logs or tree hollows were observed during the field surveys.

This area provides potential foraging habitat for nectarivorous species such as birds, arboreal mammals, and the threatened Grey-headed Flying-fox (*Pteropus poliocephalus*), and insectivorous species, including microchiropteran bats and birds.

No tree hollows are present in this area.

Freshwater Wetland/Paperbark Swamp Forest

Freshwater wetland occurs in moderate to good condition in the north-western corner of the study area. The freshwater wetland is characterised by a cover of low reeds and sedges that extend out from the patch of paperbark swamp forest recorded in the study area. The eastern edge of this habitat is degraded due to weed infestation and disturbance from previous quarrying activities. The area is likely to provide habitat for a range of wetland dependant species such as birds, amphibians, reptiles and microbats. Swamp Forest is also identified as preferred Koala habitat in the CKPoM (Port Stephens Council 2002) (refer to section 3.3.6).

Exotic grassland

This habitat type includes areas that have been previously cleared during historic quarrying activities. These areas are dominated by exotic grasses and weeds and provide little habitat for native fauna. These areas may provide movement corridors for fauna accessing patches of remnant and regrowth native vegetation and grazing ground for macropods and other small mammals such as bandicoots.

Disturbed land

This habitat type includes areas that have been previously cleared during historic quarrying activities. These areas are largely devoid of vegetation and provide little habitat for native species.

3.3.6 Mapped Koala habitat

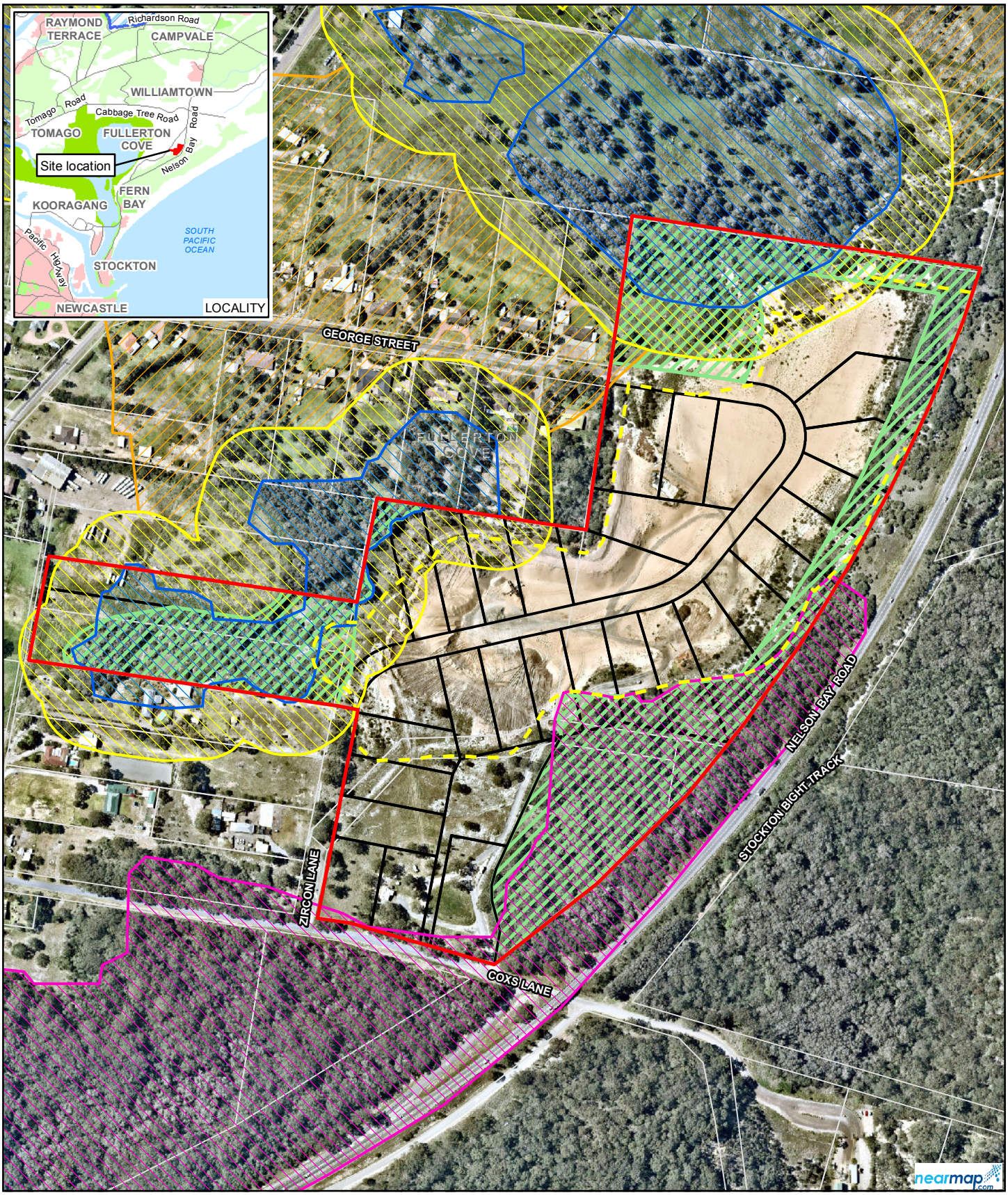
The study area is located within the Port Stephens Council LGA which an LGA to which *State Environmental Planning Policy No. 44: Koala Habitat* Protection (SEPP 44) applies. Port Stephens Council has prepared a *Comprehensive Koala Plan of Management* (CKPoM) for the Port Stephens LGA (Port Stephens Council 2002). There is a record of the Koala within the study area from 1991. Other more recent records are located near the intersection of Coxs Lane and Nelson Bay Road. There are numerous records of the Koala in the locality (OEH 2016a).

A range of Koala feed trees are present in the study area. Swamp Mahogany (*Eucalyptus robusta*), a food tree listed on Schedule 2 of the SEPP, predominantly occurs within the Broad-leaved Paperbark (*Melaleuca quinquenervia*) - Swamp Mahogany (*Eucalyptus robusta*) Swamp Forest vegetation community in the north-western corner of the site. Red Mahogany (*Eucalyptus resinifera*), which also occurs in the Broad-leaved Paperbark - Swamp Mahogany swamp forest vegetation type at the study area, is identified as a secondary feed tree species recovery plan for the Koala (DECC 2008). According to the CKPoM (Port Stephens Council 2002), Broad-leaved Paperbark (*Melaleuca quinquenervia)* is also considered as an important tree species to Koalas in the Port Stephens area. This species occurs within both the Broad-Leaved Paperbark

(*Melaleuca quinquenervia*) Swamp Forest and Broad-leaved Paperbark (*Melaleuca quinquenervia*) - Swamp Mahogany (*Eucalyptus robusta*) Swamp Forest vegetation communities.

The CKPoM (Port Stephens Council 2002) maps various types of Koala habitat in the LGA. Swamp Forest within and adjacent to the study area is mapped as Preferred Koala habitat. Smooth barked Apple (*Angophora costata*) – Red Bloodwood (*Corymbia gummifera*) Woodland/Open Forest in the study area is mapped in the CKPoM as supplementary Koala habitat. Areas between the patches of Swamp Forest are mapped as a 'link over cleared land' (see Figure 3-2). The remainder of the study area is mapped as 'mainly cleared" (Port Stephens Council 2002).

Two Koala habitat corridors run through the site. One includes a narrow vegetated strip of Smooth-barked Apple - Red Bloodwood Woodland and Coastal Tea-tree - Old man Banksia Shrubland and runs along the eastern boundary of the site parallel to Nelson Bay Road. The second includes areas of Broad-leaved Paperbark - Swamp Mahogany Swamp Forest, Coastal Tea-tree - Old man Banksia Shrubland and Broad-leaved Paperbark Swamp Forest along the western boundary of the site. Both of these corridors form edges along a larger patch of vegetation surrounding the site. The movement corridors within the site have been disturbed through past quarrying activities within the site and are partially severed, however it is possible that Koalas would still travel along these corridors.



LEGEND

- Cadastre
- Site boundary
- Approved excavation area
- Lot boundary
- Proposed E2 Environmental Conservation zone

Koala plan of management

- Preferred
- Supplementary
- 50m buffer over cleared
- Link over cleared

Paper Size A4

0 20 40 80 120 160

Metres

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

N

Pulver Cooper and Blackley
Fullerton Cove Sand Quarry
Rezoning Application - Flora and Fauna Assessment
Port Stephen's Council
Koala habitat mapping

Job Number 22-18230
Revision 1
Date 25 May 2017

Figure 3-2

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Data source: Geoscience Australia: 250k Topographic Data Series 3, 2006; LPI: DTDB / DCDB, 2012.; Nearmap: Aerial Imagery, extracted 20170109; PSC: Koala Habitat, 2016. Created by: fmackay, tmorton

3.3.7 Aquatic habitat and species

In the north-western corner of the study area there is an area of permanent/semi-permanent inundation which supports a Freshwater Wetland community. This wetland area is characterised by sedges and rushes. The Freshwater Wetland transitions into Paperbark Swamp Forest throughout the central reaches of the inundated area, which is dominated by *Melaleuca quinquenervia*. This area provides potential habitat for a range of wetland birds, amphibians, reptiles and microbats, as well as Koalas.

No protected marine vegetation listed under the FM Act (including seagrass, mangroves and saltmarsh) occur or have the potential to occur in the study area.

No threatened aquatic species listed under the FM Act are likely to occur.

3.4 Conservation significance

3.4.1 Threatened ecological communities

Two of the vegetation communities recorded in the study area are commensurate with Endangered Ecological Community (EEC) listings under the TSC Act:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Both of these threatened ecological communities are outside of the proposed development footprint of the Proposal. The area that encapsulates both of these communities was excluded from the original development to preserve the conservation value of the area. These communities are also considered GDEs, due to their reliance upon groundwater for suitable habitat.

No communities listed as threatened under the EPBC Act were recorded within the study area.

Swamp Sclerophyll Forest

Both the Broad-leaved Paperbark Swamp Forest and Broad-leaved Paperbark - Swamp Mahogany Swamp Forest vegetation types are commensurate with the EEC listing for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

This community is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20 m elevation, often where floodplains adjoin coastal sand plains. The structure of the community is typically open forest and often occurs in association with wetlands with semi-permanent water bodies.

The community is characterised by a relatively dense tree canopy dominated by *Eucalyptus robusta, Melaleuca quinquenervia* or *Eucalyptus botryoides*, the occasional presence of rainforest elements such as scattered trees or understorey plants; and a groundcover stratum dominated by large sedges and ferns.

Freshwater Wetlands on Coastal Floodplains

The Freshwater Wetland vegetation type is commensurate with the Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC listed under the TSC Act.

This community is associated with periodic or semi-permanent inundation by freshwater. It typically occurs on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Freshwater Wetlands on Coastal Floodplains generally occur below 20 m elevation in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure varies from sedgelands and reedlands to herbfields.

The species composition of this community is largely dependent on the degree of inundation. Areas that lack constant inundation are usually characterised by dense grassland or sedgeland vegetation, to 0.5 m tall and dominated by amphibious plants including *Paspalum distichum* (Water Couch), *Leersia hexandra* (Swamp Rice-grass) and *Carex appressa* (Tussock Sedge). Areas of wetland that are subject to regular inundation and drying may include large emergent sedges over one metre tall, such as *Baumea articulata, Eleocharis equisetina* and *Lepironia articulata*, as well as emergent or floating herbs. As standing water becomes deeper or more permanent floating and submerged aquatic herbs become more abundant.

3.4.2 Threatened flora species

No threatened plants were recorded during surveys in the study area.

Three threatened flora species have the potential to occur within the study area:

- *Maundia triglochinoides*
- Tall Knotweed (*Persicaria elatior*)
- Southern Swamp Orchid (*Phaius australis*)

Maundia triglochinoides and Tall Knotweed have been previously recorded within the locality while the Southern Swamp Orchid is predicted to occur within the study area. Suitable habitat for these species is present within the Freshwater Wetland and Broad-leaved Paperbark Swamp Forest. There is a moderate likelihood that these species would occur within this area, however none were observed during the field survey (see Table 3-3). Surveys were conducted within the flowering season of the Southern Swamp Orchid.

Table 3-3 Threatened flora that have potential habitat within the study area

Species	TSC Act status	EPBC Act status	Likelihood of occurrence	Comment
Maundia triglochinoides	Vulnerable	Not listed	Moderate	Suitable habitat present within Freshwater wetland and Broadleaved Paperbark Swamp Forest
Tall Knotweed (*Persicaria elatior*)	Vulnerable	Vulnerable	Moderate	Suitable habitat present within Freshwater wetland and Broadleaved Paperbark Swamp Forest
Southern Swamp Orchid (*Phaius australis*)	Endangered	Endangered	Moderate	Suitable habitat present within Freshwater wetland and Broadleaved Paperbark Swamp Forest

3.4.3 Threatened fauna species

An assessment of the likelihood of occurrence found eight threatened species listed under the TSC and/or EPBC Acts to have a moderate or high likelihood of occurrence within the study area (see Table 3-4).

Table 3-4 Threatened fauna with a moderate or high potential to occur in the proposal site

Species	TSC Act status	EPBC Act status	Likelihood of occurrence	Comments
Koala	V	V	Likely	Previously recorded in the study area. Preferred Koala habitat is present in Swamp Forest in the study area. Supplementary Koala habitat occurs along much of the eastern boundary within Smooth-barked Apple forest.
Powerful Owl	V	-	Known	Foraging habitat occurs within areas of native vegetation. Recorded within the Coastal Tea-tree Shrubland in the study area (Orogen 2008). Hollow-bearing trees are potential nest sites (if appropriately sized hollows area present).
Grey-headed Flying-fox	V	V	Moderate	May forage within eucalypts in forested areas as well as the Coastal Tea-tree Shrubland due to the presence of flowering shrubs such as Banksias.
Yellow-bellied Sheathtail Bat	V	-	Moderate	Potential foraging habitat present throughout areas of native vegetation. Hollow-bearing trees are potential roost sites.
Large-footed Myotis	V	-	Known	Foraging habitat occurs within Freshwater Wetland. Previously recorded within the Coastal Tea-tree Shrubland in the study area (Orogen 2008).
Greater Broad-nosed Bat	V	-	Known	Foraging habitat occurs in forested areas. Recorded within the Coastal Tea-tree Shrubland in the study area (Orogen 2008). Hollow-bearing trees are potential roost sites.
Little Bent-winged bat	V	-	Known	Foraging habitat occurs in areas of native vegetation. Recorded within the Coastal Tea-tree Shrubland in the study area (Orogen 2008).
Eastern Free-tailed Bat	V	-	Known	Potential foraging habitat occurs. Recorded within the Coastal Tea-tree Shrubland in the study area (Orogen 2008). Hollow-bearing trees are potential roost sites.

3.4.4 Migratory species

Based on an assessment of the nature and condition of habitats available in the study area, there is potential foraging habitat and a moderate potential for three migratory species White-throated Needletail (*Hirundapus caudacutus*), Rainbow Bee-eater (*Merops ornatus*) and Rufous Fantail (*Rhipidura rufifrons*) to occur in the study area (Table 3-5).

Table 3-5 Migratory species with moderate or high potential to occur within the study area

Species	TSC Act status	EPBC Act status	Likelihood of occurrence	Comments
White-throated Needletail	Not listed	M	Moderate	May forage high above the proposal site on occasion.
Rainbow Bee-eater	Not listed	M	Moderate	May occasionally forage within native vegetation in the proposal site.
Rufous Fantail	Not listed	M	Moderate	May occasionally forage within native vegetation in the proposal site.

3.4.5 Threatened aquatic species

A review of species profiles for threatened species listed under the FM Act and EPBC Act indicates that there is no suitable habitat for threatened aquatic species at the study area (Appendix C).

4. Preliminary impact assessment

4.1 Approach

This flora and fauna assessment is intended to assist with determination of the requirement for a Planning Proposal. It is understood that the study area is being considered for future rural residential land use. There is no detailed design for the proposal site at this stage. A preliminary impact assessment has been prepared based on the concept design. The construction footprint is predominantly restricted to within the construction footprint of the approved quarry excavation area and hence the majority of the native vegetation would be retained. A more detailed assessment would be required at the development application stage, and would require preparation of assessments of significance in accordance with Section 5A of the EP&A Act for threatened biota listed on the TSC Act and assessments of significance in accordance with the *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* (DotE 2013) for MNES that may be impacted by the development.

This section presents a general discussion and preliminary assessment of impacts associated with the proposed rezoning and future development of the study area.

4.2 Direct impacts

4.2.1 Vegetation clearing

Preliminary concept design indicates that building emplacement areas would be entirely restricted to the original approved footprint for the quarry. As such, the majority of native vegetation present in the proposal site would be retained, including the existing biodiversity offset areas.

It is likely that if the land was rezoned small areas of regenerated Coastal Tea-tree - Old-man Banksia Shrubland and Smooth-barked Apple – Red Bloodwood Woodland would be impacted. A small area of Broad-leaved paperbark – Swamp Mahogany Swamp Forest (EEC) may also be removed (0.09 ha), however this vegetation may be retained for wildlife connectivity. Additional vegetation clearing may be required due to future consideration for infrastructure and/or of asset protection zone requirements.

Table 4-1 outlines the areas of each vegetation type in the proposal site that have potential to be impacted by the Proposal. The vegetation to be removed for the most part comprises the edges of more extensive stands of native vegetation. Based on the concept design, up to 0.86 ha of native vegetation may be cleared.

Table 4-1 Potential impacts on native vegetation within the proposal site

Vegetation type	OEH Biometric Vegetation Type	Status	Total area present (ha)	Area that may be impacted (ha)	Area within E2 zones (ha)
Smooth barked Apple – Red Bloodwood Woodland/Open Forest	Smooth-barked Apple open forest on sands of the North Coast, Sydney Basin and South East Corner bioregions.	Not listed	3.03	0.15	2.88

Vegetation type	OEH Biometric Vegetation Type	Status	Total area present (ha)	Area that may be impacted (ha)	Area within E2 zones (ha)
Coastal Tea-tree - Old-man Banksia Shrubland	N/A	Not listed	2.71	0.61	2.10
Freshwater Wetland (EEC)	Freshwater Wetland on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.	EEC	0.64	0.00	0.64
Broad-leaved Paperbark - Swamp Mahogany - Swamp Forest (EEC)	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.	EEC	0.95	0.09	0.86
Broad-leaved Paperbark Swamp Forest (EEC)	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.	EEC	0.45	0.00	0.45
Exotic grassland	N/A	NA	0.40	0.05	0.35
Disturbed Land	NA	NA	17.68	16.01	1.67

4.2.2 Flora

The Proposal has the potential to impact on a range of common flora species through the direct clearing of vegetation. Potential threatened flora habitat is associated with EECs which would be protected within the study area within the E2 conservation zones.

4.2.3 Fauna

The majority of the proposed subdivision is located on disturbed or cleared land. These areas have been extensively modified by previous quarrying activities and would have limited value for native fauna.

The development would require the clearing of up to 0.86 ha of native vegetation from the edges of larger patches of vegetation. Native vegetation would have greater habitat value than cleared areas for native fauna. The clearing of vegetation would remove associated habitat resources such as foraging substrate, foraging resources (fruits, nectar, seed etc.) and woody debris. Some hollow-bearing trees may be removed. The loss of this native vegetation would remove foraging and shelter habitat for a range of birds, mammals, reptiles and frogs, including a number of threatened species (see section 4.2.4).

There is an increased risk of injury or mortality of native fauna which may be sheltering in native vegetation. There is, however, scope for native fauna that may use native vegetation in areas to be disturbed to evade injury and/or seek alternative habitat in adjoining native vegetation, including areas of native vegetation within the proposed E2 conservation areas.

There are extensive areas of remnant vegetation to the east of the study area. The removal of vegetation as a result of the Proposal would not sever connectivity between areas of vegetation to the north and south of the study area any further than what already exists. The area of vegetation that would be cleared is unlikely to act as a corridor for the passage of fauna.

Mitigation measures outlined in Section 6 would partially ameliorate these impacts. Furthermore, the planning proposal will incorporate fauna corridors along the eastern and western boundaries which will maintain opportunities for fauna access through the study area to adjoining vegetation, particularly for the Koala.

4.2.4 Threatened fauna

The Proposal has the potential to impact eight threatened fauna species listed under the TSC and/or EPBC Acts which are known or likely to occur within the study area.

There are a number of nearby records of the Koala and much of the native vegetation in the proposal site has been mapped as Koala habitat in the CKPoM (Port Stephens Council 2002). The Proposal would remove native vegetation from along the edges of larger tracts of vegetation. Three large patches of native vegetation in the proposal site will be retained as E2 conservation zones. In addition, a 30 metre wide corridor along the eastern and northern boundary of the site would be retained and zoned E2 conservation to ensure connectivity is maintained through the Proposal site. Two additional areas of vegetation on the western side of the site, which are mapped as preferred Koala habitat would also be conserved under an E2 zoning.

Four microchiropteran bat species have been recorded in the proposal site (Greater Broad-nosed Bat, Little Bentwing Bat, Large-footed Myotis and Eastern Free-tail Bat) and the Yellow-bellied Sheathtail Bat and Grey-headed Flying-fox may also occur. The Proposal would remove a very small area of foraging habitat for these species. Foraging habitat for the Large-footed Myotis would be protected in an E2 conservation area. Limited roosting habitat is likely to be impacted. The Proposal may result in some hollow-bearing trees being removed. Many hollow-bearing trees would be present in surrounding vegetation. No potential breeding habitat for the Grey-headed Flying-fox or Little Bentwing Bat is present. The proposed development would not impact connectivity for these species.

The Proposal would impact a small area of foraging habitat for the Powerful Owl. This would comprise a negligible proportion of the species' home range. It is possible that hollow-bearing trees would be removed. These may represent potential roost habitat; however this species usually nests in dense forest near drainage lines. The proximity to the quarry may further reduce the likelihood that this species would nest in the proposal site. The proposed development would not impact connectivity for these species.

Given the small area of clearing that is likely to occur, the protection of native vegetation within the E2 conservation zones, which also include movement corridors, the Proposal (based on the concept design) is unlikely to result in a significant impact on these species. Additional detailed studies would be required to assess the significance of impacts on these species during future stages of the Proposal.

4.2.5 Migratory species

The study area is likely to provide potential seasonal foraging habitat for three EPBC Act listed migratory species; the White-throated Needletail (*Hirundapus caudacutus*), Rainbow Bee-eater (*Merops ornatus*) and Rufous Fantail (*Rhipidura rufifrons*).

The Proposal would remove disturbed native vegetation from along the edges of larger tracts of vegetation. The habitat proposed for removal is not considered to constitute critical or important habitat for any listed species under the migratory bird provisions of the EPBC Act. The Proposal is unlikely to create a barrier to migration, increase the risk of injury or mortality or otherwise impact on migratory species. Therefore, the Proposal 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.

4.3 Indirect ecological impacts

4.3.1 Degradation of surface water

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

- Erosion and sedimentation from quarry bunds/access tracks
- Runoff from hardstand areas, including access roads
- Leakage or spillage of chemicals from vehicles

Potential water quality impacts may be associated with construction if risks are not effectively managed and appropriate mitigation measures implemented. Altered water movement within the construction footprint may increase the potential for sediment and contaminant mobilisation and transport. Negative effects on aquatic habitats may include increases in sediment load as a result of construction. This would result in impacts to hydrology which has the potential to impact the groundwater dependant Freshwater Wetland/Paperbark Swamp Forest and associated fauna in the north-west of the study area.

Soil and erosion protection measures and techniques would require implementation prior to, during and at the completion of any proposed construction works in the study area. Protection of these areas in the E2 conservation zone and buffer areas would further reduce the risk of impact.

4.3.2 Groundwater and groundwater dependent ecosystems

A preliminary groundwater assessment has been conducted by GHD (2016) for the Proposal to assess the potential impacts of rezoning the study area to rural residential on groundwater and on GDEs such as Freshwater Wetland/Paperbark Swamp Forest. A summary of the results of the assessment are provided below.

Groundwater levels

The proposed rezoning of the study area to rural residential may introduce the following activities that may impact groundwater levels:

- Increases in impervious areas may result in a localised drawdown and flattening of the groundwater table.
- Excavations associated with the development and construction of a rural residential estate on the study area would potentially intercept groundwater if they extend to a level below approximately 2 m AHD.
- The construction of additional production bores may cause temporary groundwater drawdown in the immediate vicinity of each bore during use.

Groundwater quality

The sandy groundwater sources would be considered highly vulnerable to contamination due to the shallow unconfined groundwater table and the high conductivity of the aquifer. As such, there is potential for localised contamination of groundwater from construction and development related activities including:

- Storage of fuels and chemicals
- Movement and stockpiling of potentially contaminated soil across the study area
- Onsite effluent disposal

Mitigation measures outlined in Section 6.2 would be implemented to mitigate the risk and severity of these impacts.

4.3.3 Sediment, dust and runoff

The area of Freshwater Wetland/Paperbark Swamp Forest in the north-west of the study area is a sensitive environmental receptor. A portion of these communities occur in the proposal site and would be protected in an E2 conservation zone. Possible indirect impacts on flora and fauna from activities associated with the Proposal are likely to include sediment, dust and vehicle exhaust emissions generated from vehicles and equipment. Mitigation measures outlined in Section 6 would be implemented to mitigate the risk and severity of these impacts.

4.3.4 Weed invasion and edge effects

'Edge effects' is a term that refers to changed environmental conditions at the interface of intact native vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Edge effects are likely to result from clearing of vegetation within the study area and would continue to impact on vegetation and habitats in adjoining areas.

There are significant infestations of weeds surrounding the area of Freshwater Wetland/Paperbark Swamp Forest. Construction activities may further increase the degree of weed infestation through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water) and via workers' shoes and clothing and through construction vehicles. Increases in weeds may also occur following construction as a result of introduction of garden plants.

4.3.5 Pests and pathogens

Construction activities have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and frog chytrid fungus (*Batrachochytrium dendrobatidis*) throughout the study area.

A 'clean on entry, clean on exit' policy would need to be implemented for operational activities within proximity to the area of Freshwater Wetland/Paperbark Swamp Forest to prevent the spread of these pathogens. Hygiene measures including decontamination of personnel and plant equipment prior to entering the study area would need to be developed to protect the environmental sensitive area of Freshwater Wetland/Paperbark Swamp Forest. These measures would need be developed with reference to OEH hygiene protocol for the control of disease in frogs (DECC 2008).

4.3.6 Noise, vibration, traffic and lighting

Fauna injury or death would be possible, particularly during initial vegetation clearing. Native vegetation that would be cleared represents habitat for a range of fauna species. Mobile species would be able to evade injury, however nestlings and small animals are more at risk of injury or death.

Artificial lighting during construction (such as night-time security lighting) can potentially discourage habitat use where diffuse light penetrates into adjoining areas of vegetation. The foraging regimes of some nocturnal native animals can be disrupted by lighting and make them vulnerable to predation by cats, dogs and foxes. The eyesight of nocturnal species (such as owls and amphibians) is hindered by bright lights, and can affect their foraging ability or deter them from using certain areas. Clearing of vegetation and operational activities would be conducted during daylight hours to prevent lighting impacts.

Construction noise and vibration also have the potential to impact fauna. This would not be a novel impact as current quarrying activities and associated impacts have been continuously operating on site. Noise and vibration impacts associated with the Proposal are likely to have a minor effect on native fauna.

4.4 Key threatening processes

A threatening process is something that threatens, or could potentially threaten, the survival or evolutionary development of a species, population or ecological community. Future rural-residential development at the proposal site has the potential to introduce or increase Key Threatening Processes (KTP) listed under the TSC Act and/or EPBC Act as outlined below. Mitigation measures outlined in Section 6 would be implemented to mitigate the risk and severity of these KTPs.

Table 4-2 Key threatening processes

KTP	Status	Comment
Clearing of native vegetation	EPBC Act TSC Act	Clearing of native vegetation has occurred historically within and around the study area and any further clearing of native vegetation would increase this KTP. The development will be located in existing disturbed land with minimal vegetation clearing required (up to 0.86 ha based on the concept design).
Removal of hollow-bearing trees	TSC Act	The Proposal may result in the removal of hollow-bearing trees, which could provide nesting habitat for a range of fauna species.
Removal of dead trees and dead wood	TSC Act	The Proposal may result in the removal of dead trees and logs, which could provide nesting or shelter habitat for a range of fauna species.
Infection of native plants by *Phytophthora cinnamomi*	EPBC Act TSC Act	Construction activities have the potential to introduce the root-rot fungus Phytophthora *cinnamomi* into the study area, which could lead to dieback of vegetation.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	EPBC Act TSC Act	Construction activities have the potential to introduce or spread amphibian chytrid fungus around the study area, which could lead to mortality of local frogs.

KTP	Status	Comment
Invasion, establishment and spread of *Lantana camara*	TSC Act	*Lantana camara* is present in low abundance within the study area. Construction activities have the potential to spread *Lantana camara* within and surrounding the study area, which could lead to the further invasion of this species into native plant communities.
Invasion of native plant communities by exotic perennial grasses	TSC Act	Exotic perennial grasses are present in high abundance within the study area. Construction activities have the potential to spread exotic perennial grasses within and surrounding the study area, which could lead to the further invasion of these species into native plant communities.

5. Ecological constraints

5.1 Overview

Ecological constraints within the study area have been categorised into two broad constraint classes: high and low. Ecological constraints have been identified based on presence or absence of native vegetation, EECs, and Koala habitat mapping. A discussion of performance criteria with respect to Koala habitat for rezoning applications is provided below, which then feeds into the classification of ecological constraint classes.

5.2 Koala habitat

Rezoning applications within the Port Stephens LGA must consider the performance criteria specified in Appendix 2 of the CKPoM. As discussed in Section 3.3.6, Swamp Forest within and adjacent to the study area is mapped as Preferred Koala habitat, Smooth barked Apple (*Angophora costata*) – Red Bloodwood (*Corymbia gummifera*) Woodland/Open Forest is mapped as supplementary Koala habitat and areas between the patches of Swamp Forest are mapped as a 'link over cleared land' (Port Stephens Council 2002). These habitat areas have been taken into account in identifying ecological constraints at the study area and are detailed in Figure 5-1 (see section 5.3 below). A summary of the attributes of the proposed rezoning in relation to the performance criteria of the Port Stephens CKPoM is provided in Table 5-1. Based on the following considerations, the proposed rezoning generally meets the performance criteria of the CKPoM.

Table 5-1 Koala habitat performance criteria

Performance criteria	Comment
a) not result in development within areas of Preferred Koala Habitat or defined Habitat Buffers	The majority of Preferred Koala Habitat will be protected in the western and northern E2 conservation areas. Small areas that are not mapped by the CKPoM as Preferred Koala Habitat that do not fall within the proposed E2 zoning have been previously cleared as part of the approved extraction area. The associated '50 m buffer over cleared' land in the west would need to be revised to match the existing Preferred Koala Habitat. The 50 m buffer over cleared land in the north is predominantly protected by the northern E2 conservation area. A small portion of Preferred Koala Habitat and an area of '50 m buffer over cleared' land is located within the proposed lots however it is proposed that the Koala Plan of Management that would be attached to the title of the land would restrict land use around the edges of these lots and provide for fencing and restrictions on dog ownership.

Performance criteria	Comment
b) not impact areas of Supplementary Koala Habitat and Habitat Linking Areas	The majority of Supplementary Koala Habitat will be protected in the southern and eastern E2 conservation areas. Parts of the area mapped by the CKPoM as Supplementary Koala Habitat has been previously cleared as part of the approved extraction area. A small area of 'link over cleared' land would be protected by the northern E2 conservation area. The remainder of this link would be impacted by the extension of George Street (which is mapped elsewhere as a similar link).
c) minimise the removal of any individuals of preferred koala food trees, wherever they occur on the study area	Swamp Mahogany, a primary feed tree listed under SEPP 44, predominantly occurs within Broad-leaved Paperbark (*Melaleuca quinquenervia*) - Swamp Mahogany (*Eucalyptus robusta*) Swamp Forest which will be protected by the E2 conservation areas.
d) not result in development which would sever koala movement across the study area. This should include consideration of the need for maximising tree retention on the study area generally and for minimising the likelihood of impediments to safe/unrestricted koala movement.	Well-vegetated portions of the proposal site will be protected by the E2 conservation areas. Koala movement corridors would also be conserved along the eastern and northern boundaries of the site within areas zoned as E2. These areas would provide links between the E2 conservation areas and surrounding native vegetation. It is proposed that the Koala Plan of Management that would be attached to the title of the land would also restrict land use around the edges of these lots and provide for appropriate fencing and restrictions on dog ownership.

5.3 Constraints assessment

5.3.1 High ecological constraints

High ecological constraint areas within the study area comprise:

- E2 conservation areas in the west, north and south of the proposal site.
- Areas of two endangered ecological communities: Swamp Sclerophyll Forest and Freshwater Wetlands listed under the TSC Act (these are included in the western and northern E2 conservation areas).
- Areas mapped in the CKPoM as preferred Koala habitat, supplementary habitat or links over cleared land.
- Other areas of native vegetation.

Areas that have been designated as biodiversity offset areas as part of the approved consent for the Fullerton Cove Sand Quarry (see Figure 1-1) will be retained as conservation areas as part of any future development and would not be impacted on by the Proposal. Furthermore, these would be expanded to include the proposed E2 environmental conservation areas (see Figure 5-1). The identification of links for Koala habitat would also link these conservation areas.

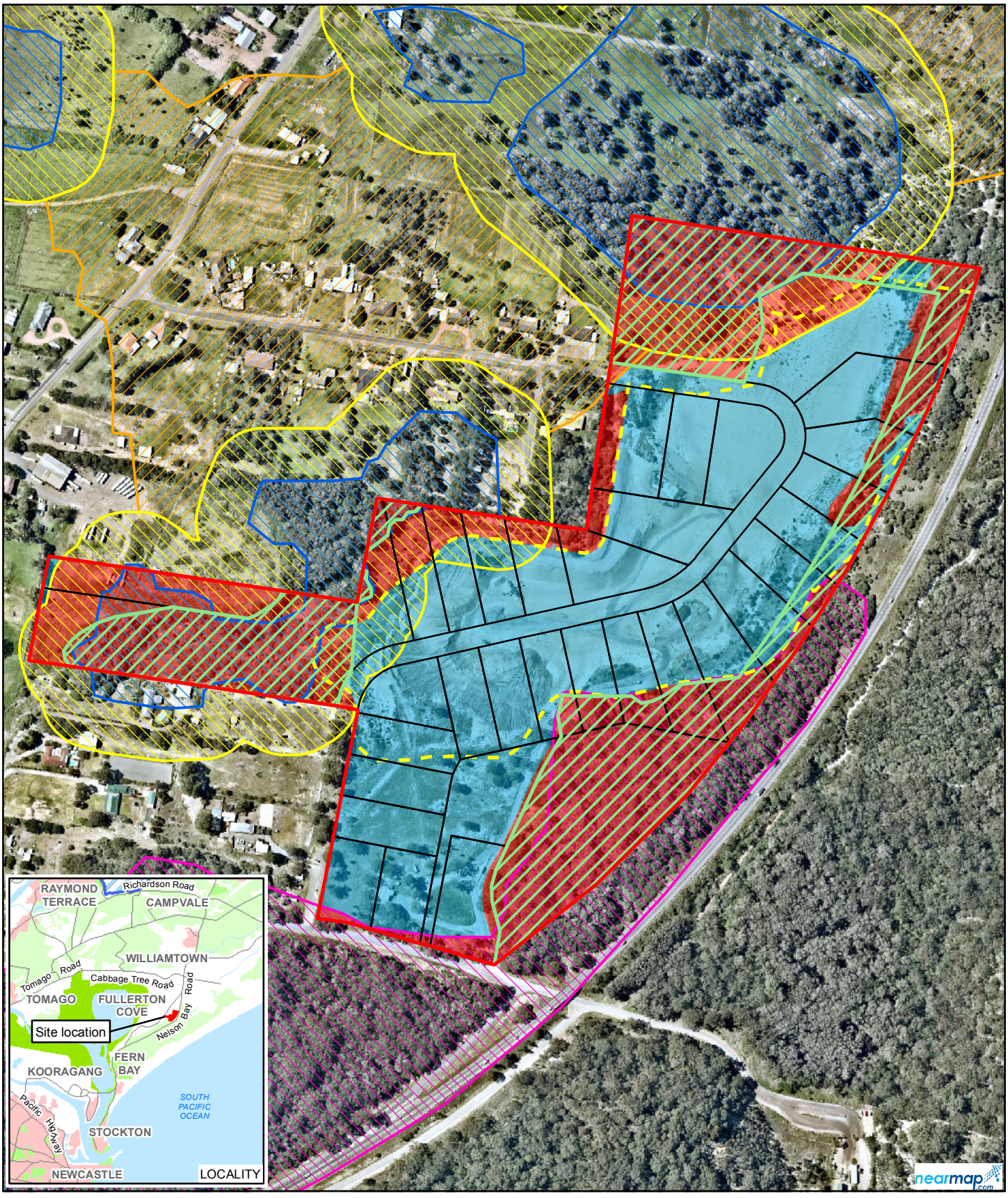
The endangered ecological communities are considered to be groundwater dependent ecosystems. As such, it is recommended that any proposed development within the vicinity of these areas be subject to further assessment to determine any potential impacts to groundwater.

Other areas of native vegetation contribute to fauna habitat and movement corridors can provide linkages between areas of remnant and regrowth vegetation to support the movement of mobile fauna (including threatened microchiropteran bats). Areas mapped as Woodland and Shrubland constitute potential foraging habitat and may provide movement corridors for mobile fauna such as birds, bats and arboreal mammals. There are also a number of large hollow-bearing trees in the area of Smooth-barked Apple Woodland, which may provide potential nesting or denning habitat for mobile hollow-dependant fauna, including threatened species such as the Powerful Owl and microbats.

The areas identified as of high ecological constraint are shown in Figure 5-1.

5.3.2 Low ecological constraints

Areas mapped as Disturbed Lands are predominantly considered to be of low ecological constraint and represent the areas proposed for future development which are unlikely to have significant ecological impacts as shown in Figure 5-1. Some portions of the disturbed land have, however, been identified as high constraint due to Koala habitat mapping (refer Figure 5-1).



LEGEND

- Site boundary
- Proposed E2 Environmental Conservation zone
- Lot boundary
- Approved excavation area

Koala plan of management

- Preferred
- Supplementary
- 50m buffer over cleared
- Link over cleared

Contraints

- High
- Low

Paper Size A4

0 20 40 80 120 160

Metres

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

N

Pulver Cooper and Blackley
Fullerton Cove Sand Quarry
Rezoning Application - Flora and Fauna Assessment

Ecological constraints within the proposal site

Job Number 22-18230
Revision 1
Date 25 May 2017

Figure 5-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18001\GIS\Maps\Deliverables\2218230\FloraFauna_Assessment\2218230_FFA003_Constraints_1.mxd

Data source: Geoscience Australia: 250k Topographic Data Series 3, 2006; LPI: DTDB / DCDB, 2012.; Nearmap: Aerial Imagery, extracted 20160420; PSC: Koala Habitat, 2016 Created by: fmackay, tmorton

6. Recommendations to avoid or mitigate impacts

Future development in the study area should be planned to avoid impacts on areas of high ecological constraint where possible. Development in areas of high ecological constraint would require mitigation and also, potentially, offsetting.

6.1 Impact avoidance

The concept design has located the majority of the proposed development areas within previously cleared land to avoid impacts on native biodiversity values as far as possible. Some small areas of native vegetation would, however, need to be cleared.

The majority of the areas of EEC within the study area have been designated as biodiversity offset areas as part of the original Fullerton Cove Sand Quarry approval and will not be impacted by the Proposal. Additional areas would be retained and managed to provide connectivity corridors for Koalas between the biodiversity offset areas and adjoining habitats outside of the study area. These corridors are indicatively mapped on Figure 1-2 as areas as E2 conservation areas.

In addition to maintaining the established biodiversity offset areas, a buffer area of 40 metres will be retained around the area of Freshwater Wetland/Paperbark Swamp Forest in the north-west of the study area, where possible. A portion of this buffer is located over the proposed access road and is not possible to maintain. Freshwater Wetland/Paperbark Swamp Forest is listed as an EEC under the TSC Act. It provides potential habitat for threatened species, particularly for wetland birds and amphibians and is of high sensitivity due to its status as a groundwater dependent ecosystem.

E2 conservation areas have been proposed to protect the larger patches of intact native vegetation, EECs and Koala habitat and movement corridors.

6.2 Mitigation of impacts

Mitigation measures are recommended to reduce the impact on identified biodiversity values where avoidance is not possible. In general, the project Proposal should consider and minimise potential indirect ecological impacts on threatened ecological communities and threatened and migratory fauna habitats. The following management plans should be incorporated into the Construction Environment Management Plan (CEMP):

- A soil and water management plan, which would require:
  - Installation of erosion and sediment control measures prior to commencement of development.
  - Regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality.
  - The Proposal will consider the potential for runoff and ensure that runoff from access roads/tracks is diverted into stormwater drainage systems and not discharged into the natural system.
  - Implementation of measures to minimise the generation of dust during operations.

- A groundwater management plan, which should consider the following:
  - Measures to minimise impermeable surface area as part of the proposed development, which may involve designing impermeable areas to be small and disconnected and ensuring a sufficient buffer distance is provided between impermeable areas and GDEs.
  - Regulations to minimise the size and depth of any excavation below the water table (approximately 2 m AHD).
  - Continuation of groundwater level monitoring at existing groundwater monitoring locations.
  - Protocols to backfill or line excavations as soon as practicable.
  - Ensure a sufficient buffer distance between bores/excavations and GDEs.
  - New bores to be installed and operated in accordance with the rules of the WSP.
  - Fuels should be stored in bunded areas during construction. Refuelling should occur in bunded areas.
  - Identify areas of soil contamination and implement appropriate contaminated soil handling methods during construction.
  - The use of secondary treatment with disinfection has been recommended at the study area. The following treatment systems have been considered to be applicable:
    - Septic tank with secondary treatment, such as a recirculating sand filter or ameliorated soil mounds.
    - Standard Aerated Wastewater Treatment System (AWTS) with chlorine or UV disinfection.
    - Mounded effluent disposal area to increase the separation between effluent and groundwater.
    - Any tank systems would be required to be designed to withstand a fluctuating and high groundwater level.
- A vegetation management plan is to be prepared for the site as part of future development, which should include (but not be limited to) the following:
  - Linked to the 88B instrument over future lots
  - Delineation and protection of exclusion zones around native vegetation to be retained.
  - 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 wash-down stations for all equipment and personnel working in areas of native vegetation.
- A weed management plan which should include (but not be limited to) a description of the following:
  - Type and location of weeds of concern (including noxious weeds) within the study area.
  - Sensitive receivers (such as native vegetation and waterways) within or adjacent to the study area.
  - Measures to prevent the spread of weeds, including hygiene procedures for equipment, footwear and clothing.
  - Proposed weed control methods and targeted areas.
  - Weed disposal protocols.

- A Fauna management plan which should include (but not be limited to) the following:
  - Clearing protocols, including measures to ensure 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.
  - If habitat features (fallen logs and tree hollows) are removed from the study area, they should be salvaged and relocated within adjacent areas of retained vegetation.
  - 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 2008).
- A Revegetation Plan which should include (but not be limited to) the following
  - The revegetation of areas cleared of native vegetation within E2 conservation areas should be carried out in such a way that it increases the habitat value of the site and aims to minimise edge effects by complementing and protecting adjoining native vegetation where possible.
  - Planting of locally occurring species, including plants representative of groundcover, understorey and canopy strata. An ecologist or qualified bush regenerator should be consulted regarding the choice of species, particularly in areas adjacent to existing areas of endangered ecological communities.
  - Planting of preferred food trees for native fauna, including appropriate eucalypt species for the Koala. The planting of winter-flowering trees is also recommended to supplement seasonal foraging habitat for a wide range of birds and arboreal mammals.
  - Mapping of areas to be revegetated.
  - Monitoring and maintenance of plantings.
  - Managing and controlling weeds.
- A Property Vegetation Plan for future developments will be prepared to include (but not be limited to) the following:
  - How revegetated areas are preserved and maintained by each future lot owner.
  - How Koala corridors, particularly within the E2 corridor are to be maintained and used, including Koala friendly fencing, land uses and domestic animal access.

6.3 Further survey assessments and approvals

Once a development footprint has been designed, a flora and fauna impact assessment report would need to be prepared to accompany the development application. This would need to include additional targeted surveys for threatened flora and fauna, and an assessment of the likely significance of impacts on threatened species, populations or ecological communities (or their habitats) listed on the TSC Act and EPBC Act to determine the requirement or otherwise for a Species Impact Statement (SIS) or Referral.

It is noted that impacts to the majority of threatened biota and MNES identified in this report as known or potentially occurring at the study area could be avoided if the highly constrained areas outlined in Section 4.2.2 are avoided and appropriate mitigation and management measures documented here are implemented. In particular, these would include measures to protect the E2 conservation areas and Koala habitat and links.

Based on a preliminary assessment of the concept design, and the proposed measures to avoid and mitigate impacts, future development is unlikely to result in a significant impact on threatened biota or migratory species.

6.4 Koala management

A Property Vegetation Plan will be prepared for any future developments which will be attached to the lot titles, detailing restrictions on land use, vegetation maintenance and management and domestic animal access within the E2 zones. In particular, this plan would provide for Koala friendly fencing and restrictions on dog access and ownership. Fencing and land-use restrictions would need to be of acceptable construction to allow for Koala passage and apply to the lots containing an E2 conservation area zoning. Restrictions will be placed on the E2 zoning area of relvant lots, prohibiting dogs in the E2 conservation areas (e.g., through designation of these areas as 'Wildlife Protection Areas' where dogs are prohibited under the *Companion Animals Act 1998*), restricting dog ownership, and/or educating dog owners on responsible ownership.

Habitat restoration is recommended in the E2 conservation areas to develop and maintain Koala connectivity corridors along the eastern and northern boundaries of the site. Any planting should be undertaken in accordance with the site Revegetation Management Plan and use stock propagated from local provenance seed (Port Stephens Council 2002). Tree species should include Swamp Mahogany, Red Mahogany and/or Broad-leaved Paperbark as these Koala feed trees already occur at the study area.

Koala-sensitive traffic management should be incorporated into the subdivision design. It is recommended that this would include a combination of 'Koala Warning Signs' and restrictions on speed limits and/or use of traffic calming devices.

7. Conclusion

This flora and fauna assessment has been prepared to evaluate the conservation significance of biodiversity at the Fullerton Cove Sand Quarry and identify flora and fauna constraints and opportunities for the proposed rural residential rezoning of the study area. The majority of the study area is cleared and disturbed due to historic land use. This area is of low ecological constraint (refer to Figure 5-1) and is suitable for future development with minimal ecological impacts likely. Areas mapped as high ecological constraints contain areas proposed as E2 conservation zones, EECs and other areas of native vegetation, and Koala habitat and fauna movement corridors. Mitigation and management measures are proposed to minimise impacts on high constraint areas and to protect habitat and habitat links for the Koala, in accordance with the Port Stephens Council Comprehensive Koala Plan of Management (Port Stephens Council 2002).

Two endangered ecological communities were recorded at the study area, Swamp Sclerophyll Forest and Freshwater Wetlands. These EECs provide potential habitat for a range of threatened flora and fauna species and migratory fauna species. The majority of these areas will be retained as E2 conservation zones part of the Proposal. The majority of the woodland habitat in the study area will also be retained as an E2 conservation zone.

No threatened flora species were recorded. Threatened flora species predicted to occur based on habitat assessments would likely only occur in the area of Freshwater wetland/Paperbark Swamp Forest in the study area, which is part of the proposed E2 conservation zones and would not be impacted by the Proposal.

Eight threatened fauna species have been previously recorded on site, including the Koala, Grey-headed Flying-fox, Powerful Owl and microchiropteran bats (OEH 2016a, Orogen 2008). Additional threatened species may also occur in the study area. A number of migratory species may also occur on occasion. The proposed subdivision is unlikely to result in a significant impact on any of these species given that any clearing of native vegetation would be restricted to the disturbed edges of larger tracts of vegetation.

The proposed subdivision has taken into account Koala habitat mapping and the Port Stephens Council Comprehensive Koala Plan of Management (Port Stephens Council 2002). The proposed rezoning for a residential subdivision generally meets the performance criteria of the CKPoM. In particular:

- All Preferred Koala Habitat will be protected in E2 conservation areas.
- All Supplementary Koala Habitat will be protected in an E2 conservation area.
- Primary feed trees at the study area will be protected by the E2 conservation areas.
- A Vegetation Management Plan would be attached to the title of the lots containing E2 zoning which would restrict land use, fencing, revegetation maintenance and management and dog access in all E2 areas.
- Habitat restoration is proposed to provide additional links.
- Responsible dog management and traffic management will be incorporated into the subdivision to minimise the risk of mortality of Koalas.

Once a development footprint has been designed, a flora and fauna impact assessment report would need to be prepared to accompany the development application. This would need to include additional targeted surveys for threatened flora and fauna, and an assessment of the likely significance of impacts on threatened species, populations or ecological communities (or their habitats) listed on the TSC Act and EPBC Act to determine the requirement or otherwise for a Species Impact Statement (SIS) or Referral.

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Appendices

Appendix A – Flora species recorded in the study area

Family	Exotic	Scientific name	Common name	TSC status	EPBC status
Aizoaceae		*Carpobrotus* spp.	-	Not listed	Not listed
Aizoaceae	*	*Galenia pubescens*	Galenia	Not listed	Not listed
Amaranthaceae		*Amaranthus* spp.	Amaranth	Not listed	Not listed
Apiaceae	*	*Hydrocotyle bonariensis*	-	Not listed	Not listed
Asteraceae	*	*Ambrosia artemisiifolia*	Annual Ragweed	Not listed	Not listed
Asteraceae	*	*Chrysanthemoides monilifera*	-	Not listed	Not listed
Asteraceae	*	*Conyza bonariensis*	Flaxleaf Fleabane	Not listed	Not listed
Asteraceae		*Euchiton spp.*	A Cudweed	Not listed	Not listed
Asteraceae	*	*Facelis retusa*	-	Not listed	Not listed
Asteraceae	*	*Hypochaeris radicata*	Catsear	Not listed	Not listed
Asteraceae		*Pseudognaphalium luteoalbum*	Jersey Cudweed	Not listed	Not listed
Asteraceae	*	*Senecio madagascariensis*	Fireweed	Not listed	Not listed
Asteraceae	*	*Sonchus oleraceus*	Common Sowthistle	Not listed	Not listed
Bignoniaceae		*Pandorea pandorana*	Wonga Wonga Vine	Not listed	Not listed
Caryophyllaceae	*	*Petrorhagia nanteuilii*	Proliferous Pink	Not listed	Not listed
Commelinaceae		*Commelina cyanea*	Native Wandering Jew	Not listed	Not listed
Cyperaceae		*Baumea rubiginosa*	-	Not listed	Not listed
Cyperaceae		*Cyperus* spp.	-	Not listed	Not listed
Cyperaceae		*Eleocharis acuta*	-	Not listed	Not listed
Cyperaceae		*Eleocharis gracilis*	-	Not listed	Not listed
Cyperaceae		*Isolepis inundata*	Club-rush	Not listed	Not listed
Cyperaceae	*	*Isolepis prolifera*	-	Not listed	Not listed
Dennstaedtiaceae		*Pteridium esculentum*	Bracken	Not listed	Not listed
Dicksoniaceae		*Calochlaena dubia*	Rainbow Fern	Not listed	Not listed
Dilleniaceae		*Hibbertia fasciculata*	-	Not listed	Not listed
Ericaceae		*Astroloma pinifolium*	Pine Heath	Not listed	Not listed
Ericaceae		*Monotoca elliptica*	Tree Broom-heath	Not listed	Not listed

Family	Exotic	Scientific name	Common name	TSC status	EPBC status
Fabaceae (Faboideae)		*Dillwynia retorta*	-	Not listed	Not listed
Fabaceae (Faboideae)		*Hardenbergia violacea*	False Sarsaparilla	Not listed	Not listed
Fabaceae (Faboideae)		*Kennedia rubicunda*	Dusky Coral Pea	Not listed	Not listed
Fabaceae (Faboideae)	*	*Trifolium dubium*	Yellow Suckling Clover	Not listed	Not listed
Fabaceae (Mimosoideae)		*Acacia longifolia* subsp. *longifolia*	Sydney Golden Wattle	Not listed	Not listed
Fumariaceae	*	*Fumaria muralis* subsp. *muralis*	Wall Fumitory	Not listed	Not listed
Juncaceae		*Juncus usitatus*	-	Not listed	Not listed
Juncaginaceae		*Triglochin procera*	Water Ribbons	Not listed	Not listed
Myrtaceae		*Leptospermum laevigatum*	Coast Teatree	Not listed	Not listed
Myrtaceae		*Leptospermum polygalifolium*	Tantoon	Not listed	Not listed
Myrtaceae		*Melaleuca linariifolia*	Flax-leaved Paperbark	Not listed	Not listed
Myrtaceae		*Melaleuca quinquenervia*	Broad-leaved Paperbark	Not listed	Not listed
Orchidaceae		*Calochilus robertsonii*	Purplish Beard Orchid	Not listed	Not listed
Oxalidaceae		*Oxalis perennans*	-	Not listed	Not listed
Philydraceae		*Philydrum lanuginosum*	Frogsmouth	Not listed	Not listed
Phormiaceae		*Dianella caerulea*	Blue Flax-lily	Not listed	Not listed
Pinaceae	*	*Pinus radiata*	Radiata Pine	Not listed	Not listed
Poaceae	*	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	Not listed	Not listed
Poaceae	*	*Briza maxima*	Quaking Grass	Not listed	Not listed
Poaceae	*	*Cortaderia selloana*	Pampas Grass	Not listed	Not listed
Poaceae	0	*Cynodon dactylon*	Common Couch	Not listed	Not listed
Poaceae	*	*Ehrharta erecta*	Panic Veldtgrass	Not listed	Not listed
Poaceae	*	*Eragrostis curvula*	African Lovegrass	Not listed	Not listed
Poaceae	*	*Holcus lanatus*	Yorkshire Fog	Not listed	Not listed
Poaceae		*Isachne globosa*	Swamp Millet	Not listed	Not listed
Poaceae	*	*Melinis repens*	Red Natal Grass	Not listed	Not listed

Family	Exotic	Scientific name	Common name	TSC status	EPBC status
Poaceae	*	*Melinis repens*	Red Natal Grass	Not listed	Not listed
Poaceae	*	*Paspalum dilatatum*	Paspalum	Not listed	Not listed
Poaceae	*	*Paspalum urvillei*	Vasey Grass	Not listed	Not listed
Poaceae	*	*Sporobolus africanus*	Parramatta Grass	Not listed	Not listed
Poaceae	*	*Stenotaphrum secundatum*	Buffalo Grass	Not listed	Not listed
Polygonaceae	*	*Acetosella vulgaris*	Sheep Sorrel	Not listed	Not listed
Polygonaceae	*	*Persicaria chinensis*	Chinese knotweed	Not listed	Not listed
Proteaceae		*Banksia serrata*	Old-man Banksia	Not listed	Not listed
Ranunculaceae		*Ranunculus inundatus*	River Buttercup	Not listed	Not listed
Rosaceae	*	*Rubus fruticosus* sp. agg.	Blackberry complex	Not listed	Not listed
Rubiaceae		*Pomax umbellata*	Pomax	Not listed	Not listed
Santalaceae		*Exocarpos cupressiformis*	Cherry Ballart	Not listed	Not listed
Scrophulariaceae	*	*Verbascum* spp.	-	Not listed	Not listed
Selaginaceae	*	*Hebenstretia dentata*	-	Not listed	Not listed
Solanaceae	*	*Solanum mauritianum*	Wild Tobacco Bush	Not listed	Not listed
Solanaceae	*	*Solanum nigrum*	Black-berry Nightshade	Not listed	Not listed
Typhaceae		*Typha orientalis*	Broad-leaved Cumbungi	Not listed	Not listed
Verbenaceae	*	*Lantana camara*	Lantana	Not listed	Not listed

Appendix B – Fauna species recorded in the study area

Class	Scientific name	Common name	Exotic	TSC Act	EPBC Act
Amphibia	*Crinia signifera*	Clicking Froglet		Not listed	Not listed
Amphibia	*Litoria fallax*	Eastern Sedge Frog		Not listed	Not listed
Aves	*Acanthorhynchus tenuirostris*	Eastern Spinebill		Not listed	Not listed
Aves	*Anthochaera chrysoptera*	Little Wattlebird		Not listed	Not listed
Aves	*Phylidonyris niger*	White-cheeked Honeyeater		Not listed	Not listed
Aves	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo		Not listed	Not listed
Aves	*Cormobates leucophaea*	White-throated Treecreeper		Not listed	Not listed
Aves	*Grallina cyanoleuca*	Magpie-lark		Not listed	Not listed
Aves	*Haliastur sphenurus*	Whistling Kite		Not listed	Not listed
Aves	*Meliphaga lewinii*	Lewin's Honeyeater		Not listed	Not listed
Aves	*Pardalotus punctatus*	Spotted Pardalote		Not listed	Not listed
Aves	*Rhipidura albiscapa*	Grey Fantail		Not listed	Not listed
Aves	*Zosterops lateralis*	Silvereye		Not listed	Not listed
Aves	*Smicrornis brevirostris*	Weebill		Not listed	Not listed
Mammalia	*Oryctolagus cuniculus*	European Rabbit	*	Not listed	Not listed
Mammalia	*Vulpes vulpes*	Fox	*	Not listed	Not listed
Reptilia	*Lampropholis* sp.	Sun Skink		Not listed	Not listed
Reptilia	*Varanus* sp.	Goanna		Not listed	Not listed
Reptilia	*Amphibolurus muricatus*	Jacky Lizard		Not listed	Not listed

Appendix C – Likelihood of occurrence assessment

Assessment of the Likelihood of Occurrence of Threatened Ecological Communities and Flora Species

This assessment investigates the likelihood of occurrence of threatened and migratory biota or the habitat occurring within the study area. The assessment involved a review of the desktop survey results (i.e. EPBC Act Protected Matters Report, BioNet extracts); relevant literature (e.g. Commonwealth Species Profile and Threats Database (SPRAT), field guides); and field survey results.

Note: Marine species which are restricted to marine environments only (such as whales, dolphins, sharks and albatross) are excluded from the Likelihood of Occurrence Table as there is no marine habitat in the proposal site.

A likelihood of occurrence ranking was attributed to each threatened community, or threatened or migratory species, based on the following framework:

Likelihood of occurrence scale

Category	Description
Known	Biota confirmed as present within the study area from either previous records or field survey results.
High	Species previously recorded within the locality and/or; suitable habitat occurs within the study area. These species are likely to occur in the study area and the Proposal may result in direct or indirect impacts on these species, including through the removal of habitat resources that may be relied upon by local populations of these species.
Moderate	Species known or predicted to occur within the locality and potentially suitable habitat occurs within the study area. These species may occur in the study area on a transitory, seasonal or opportunistic basis. The Proposal may result in minor direct or indirect impacts on habitat for these species, but would not remove any habitat resources that are relied upon by local populations of these species for their ongoing survival in the locality.
Low	Species not previously recorded within the locality; study area is outside of the biota's known distribution; and/or suitable habitat not present within the study area. The Proposal is very unlikely to result in any direct or indirect impacts on these species or their habitats.
Unlikely	Study area is outside of the biota's known or potential distribution. The Proposal would not result in any direct or indirect impacts on these species or their habitats.

Threatened biota known or predicted from the locality, habitat association and likelihood of occurring within the study area

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Threatened Ecological Communities							
Central Hunter Valley eucalypt forest and woodland		-	CEEC	Occurs in the Hunter Valley region, generally on soils derived from the Permian sedimentary bedrock found on the valley floors and on lower hillslopes and low ridges. This community is an open forest or woodland, typically dominated by eucalypt species; it has an open to sparse mid-layer of shrubs and a ground layer of grasses, forbs and small shrubs. The canopy is dominated by one or more of the following four eucalypt species: *Eucalyptus crebra*, *Corymbia maculata*, *E. dawsonii* and *E. moluccana.*	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area.	Nil. The community is not present in the project site.
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions		EEC	CEEC	Occurs on Permian sediments in the Hunter Valley. Typically forms a woodland dominated by *Eucalyptus crebra*, *Brachychiton populneus subsp. populneus* and *Eucalyptus moluccana*. A shrub layer may also be present and common shrub species include *Notelaea microcarpa var. microcarpa*, *Breynia oblongifolia, Bursaria spinosa subsp. spinosa, Cassinia quinquefaria* and *Dodonaea viscosa*. Ground cover can be moderately dense to dense, and consist of numerous forbs and grass species, and a small number of ferns, sedges and twiners.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area.	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions		EEC	CEEC	Generally occurs on Permian sediments in the Hunter Valley. Typically forms an open forest to woodland *dominated by Eucalyptus crebra, Corymbia maculata* and *Eucalyptus moluccana*. A sparse layer of small trees may be present in some areas, typically including *Allocasuarina luehmannii* or *Acacia parvipinnula*. The shrub layer is typically sparse or absent in some cases, through to moderately dense. Ground cover can be sparse to moderately dense, and consists of numerous forbs, a few grass species, and a limited number of ferns, sedges or other herbs.	**Known** to occurs within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area.	Nil. The community is not present in the project site.
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		EEC	V	Coastal Saltmarsh occurs on the landward side of mangrove stands in intertidal zones along the shores of estuaries and lagoons that are permanently or intermittently open to the sea. This community is 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. This community occurs in the intertidal zone along the NSW coast.	**Predicted** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area.	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Freshwater Wetlands on Coastal Floodplains of the New South Wales 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.	**Known** to occur within 10 km (OEH 2016a)	Known Occurs as a small patch in the west of the study area.	Low The Proposal would not remove any of this community and mitigation measures would be implemented prevent indirect impacts to the community.
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions		EEC	-	Generally occurs on floodplains and associated floodplain rises on alluvial soils along the Hunter River and tributaries. The community typically forms a tall woodland. It has been recorded from the local government areas of Maitland, Muswellbrook, Singleton, and Upper Hunter but may occur elsewhere within the Sydney and NSW North Coast Bioregions. Typically forms a tall to very tall (18-35m) woodland. Stands on major floodplains are generally dominated by Eucalyptus camaldulensis (River Red Gum), often as a sole dominant canopy species. Shrubs are generally very sparse or absent. There are many dominant groundcover species, such as *Cynodon dactylon, Alternanthera denticulata, Austrostipa verticillata, Dichondra repens,* and *Glycine tabacina*. This EEC is known to contain an endangered population of *Eucalyptus camaldulensis.*	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions		EEC	-	Hunter Lowland Redgum Forest is an open structure forest. Characteristic canopy species include *Eucalyptus tereticornis* and *E. punctata*. Frequently occurring species include *Angophora costata, Corymbia maculata, E. crebra and E. moluccana*. Mid-storey stratum is open and sparse, characterised by species such as *Breynia oblongifolia, Leucopogon juniperinus, Daviesia ulicifolia* and *Jacksonia scoparia*. The ground cover comprises grasses and herbs. Occurring from Muswellbrook to the Lower Hunter in the Sydney Basin and North Coast bioregions, it has been recorded from the Maitland, Cessnock, Port Stephens, Muswellbrook and Singleton LGAs, though may occur elsewhere in these bioregions.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion		VEC	CEEC	Hunter Valley Footslopes Slaty Gum Woodland mainly occurs on the southern side of the Hunter Valley from near Bulga to the Bylong/Goulburn River National Park area. It occurs on colluvial soils on exposed footslopes associated with the interface between Triassic Narrabeen sandstones and Permian sediments. Hunter Valley Footslopes Slaty Gum Woodland is known to occur in Singleton, Muswellbrook and Upper Hunter LGAs, and may occur in the Mid-western Regional LGA.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions		EEC	-	Hunter Valley Vine Thicket has a highly restricted geographic distribution in the central Hunter Valley. The community occurs mostly as patches of less than 10 ha, with a few larger patches exceeding 100 ha. Approximately 85% of the pre-European distribution of the community remains. The largest occurrence is at Brushy Hill adjacent to Glenbawn Dam, north east of Scone. The only stand known to occur in a conservation reserve is at Mt Dangar within the Goulburn River National Park. Hunter Valley Vine Thicket has been recorded from the local government areas of Muswellbrook, Singleton, and Upper Hunter but may occur elsewhere within the Sydney Basin Bioregion and NSW North Coast Bioregion.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.
Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion		EEC	CEEC	This Woodland community ranges from a dense to open tree canopy to about 15 m tall, depending on disturbance and regrowth history. This woodland is dominated by *Acacia pendula*, with *Eucalyptus crebra*, *A. salicina* and/or trees within the *A. homalophylla A. melvillei* complex also occurring. Understorey species may or may not be present, and can include *Canthium buxifolium*, Dodonaea viscosa, *Geijera parviflora* , Notelaea microphylla var. microphylla and *Senna zygophylla* as well as a dense to sparse ground-layer comprised of grasses and herbs. This community only occurs in the Muswellbrook and Singleton LGAs, however may occur elsewhere in the Upper Hunter LGA within the Brigalow Belt South bioregion. A section of this community occurring in the brown clay soil at Jerry's Plains in the Hunter Valley is listed as Critically Endangered under the Commonwealth listing.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Kurri Sand Swamp Woodland in the Sydney Basin Bioregion		EEC	-	Known to occur within the Kurri Kurri- Cessnock area of the lower Hunter, on soils derived from poorly-drained Tertiary sand deposits. It is a low woodland or heathland rarely higher than 15 m with a shrubby understorey. Dominant canopy species include *Eucalyptus parramattensis subsp decadens* and *Angophora bakeri*.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.
Littoral Rainforest in the NSW North Coast, Sydney Basin and SE Corner Bioregions		EEC	CEEC	Littoral Rainforest is generally 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, such as *Angophora costata, Banksia integrifolia, Eucalyptus botryoides* and *Eucalyptus tereticornis* 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 found in the NSW North Coast Bioregion, Sydney Basin Bioregion and South East Corner Bioregion.	**Predicted** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.
Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion		EEC	-	Restricted to an range of approximately 65 x 35 km area centred on Cessnock-Beresford in the central and lower Hunter Valley. Occurs on Permian geology and is strongly associated with yellow podsolic and solodic soils of the Lower Hunter Aberdare, Branxton and Neath landscapes. Undisturbed remnants are typically open forests, but may occur as woodland or dense sapling thickets if disturbed. The canopy is dominated by *Corymbia maculata* and *Eucalyptus fibrosa*, with a shrub layer marked by *Acacia parvipinnula*, *Daviesia ulicifolia, Bursaria spinosa, Melaleuca nodosa* and *Lissanthe strigosa* and a diverse understorey.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions		VEC		Lower Hunter Valley Dry Rainforest mainly occurs on the Barrington footslopes along the northern rim of the Hunter Valley Floor, where it occupies gullies and steep hillslopes with south facing aspects. It has been recorded from the local government areas of Cessnock, Maitland and Port Stephens. Lower Hunter Valley Dry Rainforest typically has a canopy of 15-25 m high with 40-80% cover. The most common canopy trees include *Elaeocarpus obovatus* (Hard Quandong), *Baloghia inophylla* (Brush Bloodwood), *Streblus brunonianus* (Whalebone Tree), *Mallotus philippensis* (Red Kamala), *Capparis arborea* (Brush Caper Berry), *Olea paniculata* (Native Olive) and *Dendrocnide excelsa* (Giant Stinging Tree). Emergent trees 20 to 30 m tall such as *Brachychiton populneus* subsp. *populneus* (Kurrajong), *Corymbia maculata* (Spotted Gum), *Brachychiton discolor* (Lacebark) and *Ficus rubiginosa* (Port Jackson Fig) are often present.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions		EEC	CEEC	This vegetation occurs north from the Hawkesbury River Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions is an ecological community of subtropical rainforest and some related, structurally complex forms of dry rainforest. Lowland Rainforest, in a relatively undisturbed state, has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes results in an irregular canopy appearance. The trees are taxonomically diverse at the genus and family levels, and some may have buttressed roots. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
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 *Eucalyptus tereticornis, E. amplifolia, Angophora floribunda* and *A. subvelutina. Eucalyptus baueriana and E. botryoides. E. saligna* and *E. grandis* may occur north of Sydney. *Melaleuca decora, M. styphelioides, Backhousia myrtifolia, Melia azaderach, Casuarina cunninghamiana* and *C. glauca* may also occur.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.
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. 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, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter. Varying salinity levels alter groundcover species.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
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.	**Known** to occur within 10 km (OEH 2016a)	Known Occurs as a small patch in the west of the study area.	Low The Proposal would remove 0.09 ha of this community. Mitigation measures would be implemented prevent indirect impacts to the community.
Sydney Freshwater Wetlands in the Sydney Basin Bioregion		EEC	-	Occurs on sand dunes and low-nutrient sandplains along coastal areas in the Sydney Basin bioregion. It is known from the Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Woollahra, Waverley, Botany, Rockdale, Randwick, Sutherland and Wollongong local government areas, but is likely to occur elsewhere within the bioregion. Has been extensively cleared and filled and remnants are often small and disturbed. Largely restricted to freshwater swamps in swales and depressions on sand dunes and low nutrient sandplains such as those of the Warriewood and Tuggerah soil landscapes.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions		EEC	-	*Themeda* Grassland on seacliffs and coastal headlands is found on a range of substrates. Stands on sandstone are infrequent and small. Larger stands are found on old sand dunes above cliffs, and on metasedimentary headlands. Individual stands of the community are often very small, often only a few square metres, but at some sites larger stands are up to several hectares or tens of hectares. Overall, the community has a highly restricted geographic distribution comprising small, but widely scattered patches. *Themeda australis* is the dominant species of this vegetation community. A number of woody species including *Banksia integrifolia* subsp. *integrifolia, Westringia fruticose* and *Acacia sophorae* are listed as part of the community. However, these are usually sparsely distributed and may be absent from some stands.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.
Warkworth Sands Woodland of the Sydney Basin Bioregion		EEC	-	Warkworth Sand Woodland occurs on aeolian sand deposits south of Singleton in the Hunter Valley and is confined to a small area near Warkworth, about 15 km south-west of Singleton in the Hunter Valley. Only approximately 800 ha of Warkworth Sands Woodland remains, none of which occurs within a conservation reserve. It is currently known to occur only in the Singleton LGA, but may occur elsewhere in the Sydney Basin Bioregion.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland		EEC	CEEC	White Box Yellow Box Blakely's Red Gum Woodland is an open woodland or forest community, and is characterized by White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*). Intact sites contain a high diversity of plant species, including dominant and additional tree species, shrubs, climbers, grass species and a high diversity of herbs. Intact stands that contain diverse upper and mid-storeys and groundlayers are rare. Modified sites include the following areas where the main tree species are present ranging from an open woodland formation to a forest structure, with the groundlayer predominantly being composed of exotic species. On sites where the trees have been removed, only the grassy groundlayer and some herbs remain. The Commonwealth listing of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland differs slightly from the NSW listing. Areas that are part of the listed ecological community must have either an intact tree layer and predominately native ground layer or an intact native ground layer with a high diversity of native plant species but no remaining tree layer. Box-Gum Woodland is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW.	**Known** to occur within 10 km (OEH 2016a)	Unlikely. The ecological community was not observed in the study area	Nil. The community is not present in the project site.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Endangered Populations							
Dromaius novaehollandiae – endangered population	Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	EP	-	On the NSW north coast, Emus occur in a range of predominantly open lowland habitats, including grasslands, heathland, shrubland, open and shrubby woodlands, forest, and swamp and sedgeland communities, as well as the ecotones between these habitats. The population is now isolated and largely restricted to coastal and near-coastal areas between Ballina – Evans Head and Red Rock. There have also been some recent records from the Port Stephens area. The population of Emus in the NSW North Coast Bioregion and Port Stephens LGA is of significant conservation value as the last known population in northern coastal NSW.	**Known** to occur within 10 km (OEH 2016a)	Unlikely No suitable habitat within study area	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Threatened plants							
Angophora inopina	Charmhaven Apple	V	V	Endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset. Occurs most frequently in four main vegetation communities: (i) *Eucalyptus haemastoma–Corymbia gummifera–Angophora inopina* woodland/forest; (ii) *Hakea teretifolia–Banksia oblongifolia* wet heath; (iii) *Eucalyptus resinifera–Melaleuca sieberi–Angophora inopina* sedge woodland; (iv) *Eucalyptus capitellata–Corymbia gummifera–Angophora inopina* woodland/forest.	**Recorded** within 10 km (OEH 2015b)	Unlikely. No suitable habitat present within study area..	Low
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with *Cryptostylis subulata* and *Cryptostylis erecta*. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	**Predicted** within 10 km (DoE 2015)	Possible Marginal habitat present within freshwater wetland and Broad-leaved paperbark swamp forest.	Low- areas of potential habitat do not occur within project area and freshwater wetland and Broad-leaved paperbark swamp forest would not be impacted by the Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Eucalyptus camfieldii	Camfield's Stringybark	V	V	This species 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 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*).	**Predicted** within 10 km (DoE 2015) **Recorded** within 10 km (OEH 2015b)	Unlikely. No suitable habitat present within study area.	Low
Eucalyptus parramattensis subsp *decadens*	Earp's Gum	V	V	This woodland tree generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey and also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. There are two separate meta-populations of the tree: The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Aberdare in the south. Large aggregations of the sub-species are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. In the Kurri Kurri area, very little is known about the biology or ecology of this species, apart from the flowering period which is from November to January. Propagation mechanisms are currently poorly known while seed dispersal is likely to be effected by wind and animals.	**Predicted** within 10 km (DoE 2015) **Recorded** within 10 km (OEH 2015b)	Unlikely. Marginal habitat present but was not identified during flora survey	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Commerconia prostrata	Dwarf Kerrawang	E	E	Dwarf Kerrawang occurs on sandy, sometimes peaty soils in a wide variety of habitats. It is found in the Southern Highlands and Southern Tablelands, a larger population in the Thirlmere Lakes area and on the North Coast (less than 100 plants at the Tomago sandbeds north of Newcastle). Dwarf Kerrawang is a ground-hugging shrub that forms mats to more than 1 m across. Associated native species may include *Imperata cylindrica, Empodisma minus* and *Leptospermum continentale*.	**Predicted** within 10 km (DoE 2015) **Recorded** within 10 km (OEH 2015b)	Unlikely. Marginal habitat present but was not recorded during flora survey	Low
Grevillea parviflora subsp parviflora	Small-flower Grevillea	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.	**Predicted** within 10 km (DoE 2015) **Recorded** within 10 km (OEH 2015b)	Unlikely. Marginal habitat present but was not recorded during flora survey	Low
Maundia triglochinoides		V		Restricted to coastal NSW and extending into southern Queensland. It grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. It is often found growing in association with wetland species e.g. *Triglochin procerum*.	**Recorded** within 10 km (OEH 2015b)	Moderate - suitable habitat present within Freshwater wetland and Broadleaved Paperbark Swamp Forest	Low – wetland areas where this species could potentially occur would not be impacted by Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Melaleuca biconvexa	Biconvex Paperbark	V	V	Scattered, disjunct populations in coastal areas from Jervis Bay to Port Macquarie, with most populations in the Gosford-Wyong areas. Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Persicaria elatior	Tall Knotweed	V	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary -an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	Moderate - suitable habitat present within Freshwater wetland and Broadleaved Paperbark Swamp Forest	Low – wetland areas where this species could potentially occur would not be impacted by Proposal.
Phaius australis	Southern Swamp Orchid	E	E	Occurs in Queensland and north-east NSW as far south as Coffs Harbour. Grows in swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	**Predicted** within 10 km (DoE 2015)	Moderate - suitable habitat present within Freshwater wetland and Broadleaved Paperbark Swamp Forest	Low – wetland areas where this species could potentially occur would not be impacted by proposal.
Tetratheca juncea	Black-eyed Susan	V	V	Regarded as extinct within the Sydney area, current range from Wyong north to Bulahdelah and inland 50 km to edge of Sugarloaf Range. Occurs predominately in areas of over 1000 mm annual rainfall, within dry sclerophyll forest, and sometimes heath and moist forest, with a preference for Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Threatened and migratory bird species							
Actitis hypoleucos	Common Sandpiper		M	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks further upstream.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Anthochaera phrygia	Regent Honeyeater	CE	E, M	This species inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes. This species breeds in only three known key areas: the Capertee Valley and the Bundarra-Barraba region in NSW and Chiltern-Albury in Victoria. In NSW they are confined to the two main breeding areas and surrounding fragmented regions. Non-breeding flocks are sporadically seen in coastal areas, foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought or resource availability.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Apus pacificus	Fork-tailed Swift	-	M	Non- breeding, and almost exclusively aerial while in Australia. Occurs over urban and rural areas as well as areas of native vegetation. Recorded in all regions in NSW. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Suitable habitat present within study area. May Fly-over study area.	Low – aerial species that would not be impacted by project.
Ardea alba	Great Egret	-	M	This species of wetland bird occurs in a variety of habitats including marshes, swamps, river margins, lake shorelines, flooded grasslands, sea-grass flats, mangrove swamps, coastal lagoons, and offshore coral reefs. Feeds in shallow to moderately deep water, on shore next to the water, or on dry ground primarily on fish, insects and shrimp.	**Predicted** within 10 km (DoE 2015)	**Moderate**. **S**uitable habitat present within study area..	Low – wetland areas where this species could potentially occur would not be impacted by Proposal.
Ardea ibis	Cattle Egret	-	M	Occurs across NSW. Principal breeding sites are the central east coast from Newcastle to Bundaberg. Also breeds in major inland wetlands in north NSW (notably the Macquarie Marshes). Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. Uses predominately shallow, open and fresh wetlands with low emergent vegetation and abundant aquatic flora. Sometimes observed in swamps with tall emergent vegetation and commonly use areas of tall pasture in moist, low-lying areas.	**Predicted** within 10 km (DoE 2015)	**Moderate**. **S**uitable habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Arenaria interpres	Ruddy Turnstone	-	M	In Australasia, the Ruddy Turnstone is mainly found on coastal regions with exposed rock coast lines or coral reefs. It has occasionally been sighted in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed beds of seagrass, around sewage ponds and on mudflats. Mainly forages between lower supralittoral and lower littoral zones of foreshores, from strand-line to wave-zone. Roosts on beaches, above the tideline, among rocks, shells, beachcast seaweed or other debris. They have also been observed roosting on rocky islets among grassy tussocks, and on mudflats and sandflats.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Botaurus poiciloptilus	Australasian Bittern	E	E	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. It is widespread but uncommon and may be found over most of NSW except the far north-west. It hides during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Marginal habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Burhinus grallarius	Bush Stone-curlew	E	-	This species inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber and general lack of shrubby understorey, or in structurally similar tidal and estuarine habitats near the coast. Generally not found on the escarpments but at lower elevations on the coast or west of the Great Divide, typically in areas of above 300 mm annual rainfall. Largely nocturnal, being especially active on moonlit nights, it feeds on insects and small vertebrates, such as frogs, lizards and snakes and will forage in a range of habitats including irrigated/pasture improved paddocks, playing fields, waste disposal facilities, mangroves, saltmarsh, mudflats, swamps and woodland remnants. Nests are on the ground in a scrape or small bare patch, often in cleared or disturbed areas without native vegetation.	**Recorded** within 10 km (OEH 2015b)	Unlikely. No suitable habitat present within study area.	Low
Calidris acuminata	Sharp-tailed Sandpiper	-	M	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Calidris canutus	Red Knot	-	E, M	The Red Knot is common in all the main suitable habitats around the coast of Australia (Barrett et al. 2002b). Not found in significant numbers on coast on NSW. In Australasia the Red Knot mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. Occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use swamps or inland lakes.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Calidris ferruginea	Curlew Sandpiper	E	CE, M	This species mainly occurs on intertidal mudflats in sheltered coastal areas. It forages on mudflats and nearby shallow water. Widespread east of the Great Divide, especially in coastal regions of NSW.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Calidris melanotos	Pectoral Sandpiper	-	M	In NSW the distribution of the Pectoral Sandpiper is widespread, but scattered. In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. This species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Marginal habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Calidris ruficollis	Red-necked Stint	-	M	It is distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. The Red-necked Stint has been recorded in all coastal regions, and found inland in all states when conditions are suitable. In Australasia, the Red-necked Stint is mostly found in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats. Occasionally they have been recorded on exposed or ocean beaches. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland. They sometimes use flooded paddocks or damp grasslands.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Calonectris leucomelas	Streaked Shearwater	-	M	This is a marine species that feeds primarily on fish and squid. Breeding occurs in colonies on offshore islands where is nests in burrows on forested hills.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Calidris tenuirostris	Great Knot	V	CE, M	This species breeds in Siberia. In Australia, it occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats where individuals forage for invertebrates.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Charadrius bicinctus	Double-banded Plover	-	M	Found in both coastal and inland areas. During the non-breeding season, it is common in eastern and southern Australia. Found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Charadrius leschenaultii	Greater sand-plover	V	V, M	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.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Charadrius mongolus	Lesser Sand-plover	V	E, M	This species breeds in central and north-eastern Asia and migrates south in Winter. In Australia it is found on the entire coastline but is most common in the Gulf of Carpentaria and along the east coast of Qld and northern NSW. Rarely recorded south of the Shoalhaven, and internationally important sites in NSW include the Hunter River estuary, Tuggerah Lakes and the Clarence River estuary. Nationally important sites in NSW include the Richmond River estuary, Shoalhaven River estuary and Botany Bay. In NSW the species is almost entirely coastal and favours the beaches of sheltered bays, mudflats, harbours and lagoons. It forages for crustaceans, molluscs and worms on wet ground at low tide, usually away from the water's edge.	**Predicted** within 10 km (DoE 2015) **Recorded** within 10 km (OEH 2015b)	Unlikely. No suitable habitat present within study area.	Low
Dasyornis brachypterus	Eastern Bristlebird	E	E	Inhabits low dense vegetation in a broad range of habitat types including sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest. It occurs near the coast, on tablelands and in ranges. Found in habitats with a variety of species compositions, but are defined by a similar structure of low, dense, ground or understorey vegetation.	**Predicted** within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. This species breeds during summer, nesting in or near a freshwater swamp.	**Recorded** within 10 km (OEH 2015b)	**Moderate**. Marginal habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by Proposal.
Epthianura albifrons	White-fronted Chat	V	-	This species occurs from southern Queensland to Western Australia and down to Tasmania, mostly in temperate to arid climates and very rarely in sub-tropical areas. It is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands. Along the coast they are found in estuarine and marshy habitats with vegetation <1 m tall, and in open grasslands and areas bordering wetlands. Inland, they are often observed in grassy plains, saltlakes and saltpans along waterway margins.	**Recorded** within 10 km (OEH 2015b)	**Moderate**. Marginal habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by Proposal.
Gallinago hardwickii	Latham's Snipe	-	M	Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabit permanent and ephemeral wetlands up to 2000 m asl. Typically in open, freshwater wetlands with low, dense vegetation (incl. swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Marginal habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by the Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Gallinago megala	Swinhoe's Snipe		M	During the non-breeding season Swinhoe's Snipe occurs at the edges of wetlands, such as wet paddy fields, swamps and freshwater streams. The species is also known to occur in grasslands, drier cultivated areas and market gardens.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Marginal habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by theProposal.
Gallinago stenura	Pin-tailed Snipe		M	During non-breeding period the Pin-tailed Snipe occurs most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. The species is also found in drier, more open wetlands such as claypans in more arid parts of species' range. It is also commonly seen at sewage ponds; not normally in saline or inter-tidal wetlands	**Predicted** within 10 km (DoE 2015)	**Moderate**. Marginal habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by theProposal.
Glossopsitta pusilla	Little Lorikeet	V	-	Distributed in dry, open eucalypt 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. Usually forage in small flocks, often with other species of lorikeet. They feed primarily on nectar and pollen of profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box *Eucalyptus albens* and Yellow Box *E. meliodora* are particularly important food sources for pollen and nectar respectively. Nest hollows have small openings (approximately 3cm diameter)and are mostly found in living, smooth-barked eucalypts, especially Manna Gum *Eucalyptus viminalis*, Blakely's Red Gum *E. blakelyi* and Tumbledown Gum *E. dealbata*.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Grantiella picta	Painted Honeyeater	V	V	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and Acacias. Prefers mistletoes of the genus *Amyema*.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Haematopus fuliginosus	Sooty Oystercatcher	V	-	Evenly distributed along NSW coast, including offshore islands. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide. Breeds almost exclusively on offshore islands, and occasionally on isolated promontories.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low
Haematopus longirostris	Pied Oystercatcher	E	-	Primarily a coastal species, favouring intertidal flats of inlets and bays, open beaches and sandbanks. It nests on the ground just above the tideline in the littoral zone of beaches and estuaries.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low
Haliaeetus leucogaster	White-bellied Sea-eagle	-	M	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	**Predicted** within 10 km (DoE 2014)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Heteroscelus brevipes	Grey-tailed Tattler	-	M	In NSW the Grey-tailed Tattler is distributed along most of the coast from the Queensland border, south to Tilba Lake (near Narooma). It is more heavily distributed along coastal regions north of Sydney. The Grey-tailed Tattler is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It is occasionally found around near-coastal wetlands, such as lagoons and lakes and ponds in sewage farms and saltworks. The Grey-tailed Tattler usually forages in shallow water, on hard intertidal substrates, such as reefs and rock platforms, in rock pools and among rocks and coral rubble, over which water may surge.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Hieraaetus morphnoides	Little Eagle	V	-	The Little Eagle 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. The Little Eagle is distributed throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low
Hirundapus caudacutus	White-throated Needletail	-	M	This species migrates from Siberia, the Himalayas, and Japan to Australia in Summer, arriving mid-October and departing mid-April. It is known to inhabit a variety of habitats including forests, woodlands, farmlands, plains, lakes, coasts and towns (Pizzey and Knight 1999). Nests in tree hollows and feeds on insects during flight, chiefly ahead of weather changes.	**Predicted** within 10 km (DoE 2015)	Moderate. Suitable habitat present within study area.	**Moderate** may occasionally forage within Coastal tea-tree shrubland.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Lathamus discolor	Swift Parrot	E	CE	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, Spotted Gum, Red Bloodwood, Mugga Ironbark, and White Box. Commonly used lerp infested trees include Grey Box, Inland Grey Box and Blackbutt 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.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Limicola falcinellus	Broad-billed Sandpiper	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.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Limosa lapponica baueri	Bar-tailed Godwit	-	V, M	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. The Bar-tailed Godwit usually forages near the edge of water or in shallow water, mainly in tidal estuaries and harbours. Occasionally they have been known to forage among mangroves, or on coral reefs or rock platforms among rubble, crevices and holes.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	-	CE, M	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. The Bar-tailed Godwit usually forages near the edge of water or in shallow water, mainly in tidal estuaries and harbours. Occasionally they have been known to forage among mangroves, or on coral reefs or rock platforms among rubble, crevices and holes.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Limosa	Black-tailed Godwit	V	M	Primarily a coastal species, *L. limosa* is 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.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Merops ornatus	Rainbow Bee-eater	-	M	This species of small bird occurs in a variety of habitat but seems to prefer open forests and woodlands, shrublands, and various cleared or semi-cleared habitats, including farmland and areas of human habitation often located close to permanent water. This species migrates north for the winter months within Australia after breeding has occurred.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Suitable habitat present within study area.	**Moderate**- may forage within the project area on occasion.
Monarcha melanopsis	Black-faced Monarch	-	M	This species of bird usually inhabits dense gullies of rainforest, sclerophyll forests and eucalypt woodlands and coastal scrub long the coastal regions from Victoria to Cape York and is migratory over much of its range.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Monarcha trivirgatus	Spectacled Monarch	-	M	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. It prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Myiagra cyanoleuca	Satin Flycatcher	-	M	This is a migratory species which breeds around the Calliope Ranges in QLD southward to Tasmania during September/October to January/February before migrating north to southern and eastern Papua New Guinea and adjacent islands over winter. Prefers heavily vegetated gullies in forests, tall woodlands and during migration, coastal forests, woodlands, mangroves, trees in open country, and even gardens (Pizzey & Knight 1998).	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Ninox strenua	Powerful Owl	V	-	This species is a nocturnal, solitary and sedentary species. 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.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low
Numenius madagascariensis	Eastern Curlew	-	CE, M	This species breeds in the northern hemisphere and occurs along the coast of Australia during the non-breeding season. It is primarily coastal and is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. The Eastern Curlew mainly forages on soft sheltered intertidal sandflats or mudflats and roosts on sandy spits or islands or in saltmarsh or mangroves.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Numenius minutus	Little Curlew	-	CE, M	The Little Curlew is widespread in the north of Australia and scattered elsewhere. It breeds in Siberia and is seen on passage through Mongolia, China, Japan, Indonesia and New Guinea. Little Curlews may gather in large flocks on coastal and inland grasslands and black soil plains in northern Australia, near swamps and flooded areas. They also feed on playing fields, paddocks and urban lawns.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Numenius phaeopus	Whimbrel	-	M	The Whimbrel is a regular migrant to Australia, with a primarily coastal distribution. It is found in all states but is more common in the north. Often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms. It has been infrequently recorded using saline or brackish lakes near coastal areas. It also used saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and saltfields.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Pandion cristatus	Eastern Osprey	V		This species occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. It is mostly found in coastal areas but occasionally travel inland along major rivers. It requires extensive areas of open fresh, brackish or saline water for foraging. This species occurs in low numbers in NSW and the breeding population is small and fragmented.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Philomachus pugnax	Ruff (Reeve)	-	M	This species is generally found on fresh, brackish of saline wetlands with exposed mudflats at the edges. It is found in terrestrial wetlands including lakes, swamps, pools, lagoons, tidal rivers, swampy fields and floodlands. They are occasionally seen on sheltered coasts, in harbours, estuaries, seashores and are known to visit sewage farms and saltworks.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Suitable habitat present within study area	Low – wetland areas where this species could potentially occur would not be impacted by the Proposal.
Pluvialis fulva	Pacific Golden Plover	-	M	Occurs along the east coast, especially along Queensland and New South Wales. Usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. They are less often recorded in terrestrial habitats, usually wetlands such as fresh, brackish or saline lakes, billabongs, pools, swamps and wet claypans, especially those with muddy margins and often with submerged vegetation or short emergent grass.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Suitable habitat present within study area	Low – wetland areas where this species could potentially occur would not be impacted by the Proposal.
Pluvialis squatarola	Grey Plover	-	M	In non-breeding grounds in Australia, Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (Marchant & Higgins 1993 and references therein). On their breeding grounds they inhabit tundra (Dement'ev & Gladkov 1951).	**Predicted** within 10 km (DoE 2015)	**Moderate**. Suitable habitat present within study area	Low – wetland areas where this species could potentially occur would not be impacted by the Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Rhipidura rufifrons	Rufous Fantail	-	M	This species is a breeding migrant to southeast Australia during July to December, wintering in Papua New Guinea. It prefers wetter eucalypt forests, gullies, coastal scrub, watercourses, and rainforests where it feeds on insects. Occasional reports have this species utilising parks and gardens during migration (Pizzey & Knight 1998).	**Predicted** within 10 km (DoE 2015)	**Moderate**. Suitable habitat present within study area	**Moderate** May occasionally forage within Coastal tea-tree shrubland.
Rostratula australis	Australian Painted Snipe	E	E	This species is found in permanent and temporary shallow inland and coastal wetlands (can be freshwater or brackish), particularly where there is a cover of vegetation. Individuals have been known to use artificial wetlands such as sewage ponds, dams and water-logged grasslands. This species is most common in eastern Australia, with records at scattered locations throughout much of NSW.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Suitable habitat present within study area	Low – wetland areas where this species could potentially occur would not be impacted by the Proposal.
Sternula albifrons	Little Tern	E	M	Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers. It is a migratory or party migratory seabird that migrates from eastern Asia. In NSW, it arrives from September to November. It nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	**Moderate**. Suitable habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by the Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Tringa stagnatilis	Marsh Sandpiper	-	M	The Marsh Sandpiper lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In south-east Australia they prefer inland saline lakes and coastal saltworks. They are found infrequently around mangroves (Higgins & Davies 1996).	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Tyto longimembris	Eastern Grass Owl	V	-	This species is found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. In NSW it is more likely to be resident in the north-east. Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low
Tyto novaehollandiae	Masked Owl	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.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Xenus cinereus	Terek Sandpiper	V	M	This species is a medium sized migratory wader. It 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.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Crinia tinnula	Wallum Froglet	V		In NSW the species extends from north of the Queensland border south to Kurnell. Found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country.	**Recorded** within 10 km (OEH 2015b)	**Moderate**. Suitable habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by the Proposal.
Threatened frogs							
Litoria aurea	Green and Golden Bell Frog	E	V	This species inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and instream wetlands. It prefers 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 (DEC 2006). Plague Minnow (*Gambusia holbrooki*) is a key threatening process as they feed on Green and Golden Bell Frog eggs and tadpoles. OEH have a recovery plan for this species.	**Predicted** within 10 km (DoE 2015)	**Moderate**. Broadly Suitable habitat present within study area.	Low – wetland areas where this species could potentially occur would not be impacted by the Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Mixophyes balbus	Stuttering Frog	E	V	The Stuttering Frog is typically found in association with permanent streams through temperate and sub-tropical rainforest and wet sclerophyll forest, rarely in dry open tableland riparian vegetation (Mahony et al. 1997), and also in moist gullies in dry forest (Gillespie & Hines 1999). The species occurs along first order streams and is occasionally associated with springs. The species is not associated with ponds or ephemeral pools. Tadpoles do occur with several species of native fish (Mahony et al. 1997a).	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Threatened mammals							
Chalinolobus dwyeri	Large-eared Pied Bat	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, rock crevices and mines and has been most commonly recorded from dry sclerophyll forests and woodlands. In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys (DoE 2015b). C. dwyeri is an insectivorous species that flies relatively slowly over the canopy or along creek beds (Churchill 2008).	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Miniopterus australis	Little Bentwing-Bat	V	-	The Little Bentwing Bat occurs from Cape York to Sydney in NSW. This species congregates in maternal roost caves during summer. In NSW, there is only one known breeding colony which shares a cave with a colony of Eastern Bentwing-bats, and females will travel over 200 km to reach this site. Outside the breeding season, this bat will roost in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. It forages for insects beneath the canopy of well-timbered habitats including rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets (Churchill 2008, Hoye and Hall 2008).	**Recorded** within 10 km (OEH 2015b)	**Moderate**. Broadly suitable foraging habitat present within Paperbark swamp forest	Low – Paperbark swamp forest where this species could potentially forage occur would not be impacted by the Proposal.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	This species occurs along the east coast from Cape York to Castlemaine in Victoria, generally east of the Great Dividing Range (Churchill 2008). It is known from a variety of habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. It has a direct flight pattern and forages above the canopy in forested areas or close to the ground in open areas (Churchill 2008). It is essentially a cave bat but also utilises man-made habitats such as road culverts, storm-water tunnels and other man-made structures. Maternity caves have very specific humidity and temperature regimes and there are only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Breeding takes place in October and females may travel several hundred kilometres to the nearest maternal colony (Churchill 2008).	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	This species occurs from southern NSW to southern QLD in dry sclerophyll forest and woodland east of the Great Dividing Range. It forages in natural and artificial openings in the vegetation, typically within a few kilometres of its roost. The species roosts primarily in tree hollows but has also been recorded from man-made structures or under bark. Females give birth in late November/early December and lactation lasts until late January (Churchill 2008).	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low
Myotis macropus	Large-footed (southern) Myotis	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.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Petaurus norfolcensis	Squirrel Glider	V	-	This species of glider is widely though sparsely distributed 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.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low
Petauroides volans	Greater Glider	-	V	This species occurs in eucalypt forests and woodlands, particularly in tall moist forests. The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species.	**Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	This species prefers dry sclerophyll forest with a sparse groundcover of herbs, grasses, shrubs or leaf litter. They also inhabit heath, swamps, rainforest and wet sclerophyll forest.0 They forage mostly in rough barked trees and feed mostly on arthropods but will eat other invertebrates, nectar and occasionally small vertebrates.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low
Phascolarctos cinereus	Koala	V	V	The Koala has a fragmented distribution throughout eastern Australia. It is limited to areas of preferred feed trees (includes any of over 70 eucalypt and 30 non-eucalypt species) in eucalypt woodlands and forests.	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Potorous tridactylus	Long-Nosed Potoroo	V	V	This species of small mammal is generally restricted to areas with high annual rainfall, inhabiting coastal heath and dry and wet sclerophyll forests. Its major habitat requirement is relatively thick ground cover with occasional open areas and may consist of grass trees, sedges, ferns or heath, or low shrubs of tea-trees and Melaleucas where soil is light and sandy. It feeds on the fruiting bodies of underground-fruiting fungi, roots, tubers, insects and their larvae, and other soft-bodied animals in the soil. Breeding occurs biannually in late winter/early spring and in late summer, with one young being reared (Johnston 1995). In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with a n annual rainfall exceeding 760 mm.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low
Pseudomys novaehollandiae	New Holland Mouse	-	V	The New Holland Mouse occurs in disjunct, coastal populations in SE Australia from Tasmania to Queensland. In NSW it has been found in a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). It is commonly referred to as a 'disturbance enhanced' or early successional species as populations have demonstrated the capacity to recolonise and increase in size in areas of regenerating native vegetation after wildfire, clearing and sandmining. The species' presence has been strongly correlated with the density of understorey vegetation, and with a high floristic diversity in regenerating heath (Lock and Wilson 1999).	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	**Unlikely**. No suitable habitat present within study area.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Dasyurus maculatus (SE mainland population)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [	V	E	This species has a preference for mature wet forest habitats, particularly in areas of 600 mm rainfall p.a. , but has been recorded from 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. Fem occupy home ranges of up to 750 ha and males up to 3,500 ha, which are usually traversed along densely vegetated creek lines.	**Predicted** to occur within 10 km (DoE 2015)	Unlikely. No suitable habitat present within study area.	Low
Pteropus poliocephalus	Grey-headed Flying-fox	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 to exploit winter flowering tree species (Eby and Law 2008). This species will also forage in urban gardens and cultivated fruit crops.	**Recorded** within 10 km (OEH 2015b) **Predicted** within 10 km (DoE 2015)	**Moderate**. Broadly suitable foraging habitat present within Paperbark swamp forest and Coastal Tea-tree Shrubland	**Moderate-** small area of Coastal Tea-tree Shrubland will be impacted. Contains a small number of Banksia individuals that could provide foraging habitat for this species
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	This species forages for insects, flying high and fast over the forest canopy, but lower in more open country. It forages in most habitats across its very wide range, with and without trees and appears to defend an aerial territory. It roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to use mammal burrows.	**Recorded** within 10 km (OEH 2015b)	**Moderate**. Broadly suitable foraging habitat present within study area	**Moderate-** small area of potential foraging habitat would be impacted

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Association	Nature of Record	Likelihood of Occurrence within study area	Likelihood of impact
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	This species occurs on the east coast and Great Dividing Range from the Atherton Tablelands in QLD to northern Victoria. It inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, as well as remnant paddock trees and timber-lined creeks, typically in areas below 500 m elevation (Hoye and Richards 2008, Churchill 2008). It has a direct flight pattern and forages for insects (and potentially other bats) in relatively uncluttered areas, using natural or man-made openings in denser habitats. It generally roosts in tree hollows or fissures but may also roost under exfoliating bark or in the roofs of old buildings. The young are born in January in communal maternal roosts in suitable hollow trees (Hoye and Richards 2008, Churchill 2008).	**Recorded** within 10 km (OEH 2015b)	**Unlikely**. No suitable habitat present within study area.	Low

All information in this table is taken from NSW OEH and Commonwealth DoE Threatened Species profiles (OEH 2015 & DoE 2015) unless otherwise stated.

The codes used in this table are: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population; CEEC – Critically Endangered Ecological Community; EEC – Endangered Ecological Community; M – Migratory Species; Prel. – subject to preliminary determination by the NSW Scientific Committee.

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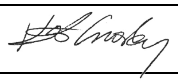
5	A Quin K Baker	K. Crosby		M Collins-Roe		26/05/2017

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