

Appendix D Biodiversity Development Assessment Report







Biodiversity Development Assessment Report



AGL Energy Limited

Newcastle Power Station Project
1940 Pacific Highway, Tomago NSW

29 October 2019

Biodiversity Development Assessment Report

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1940 Pacific Highway, Tomago NSW

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Project No: 20191297
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BAAS Case number: 00012104
BAM Calculator number: 00012104/BAAS17039/19/00015291
0012104/BAAS17039/19/00018030

Prepared for:

AGL ENERGY LIMITED

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Document Control:

Version	Description	Date	Author	Reviewer
1.0	Draft for client review	1 May 2019	E. Connolly K. Peters M. Dean D. Russell	S. Schulz D. O'Brien
2.0	Second draft to client	21 May 2019	D. O'Brien	S. Schulz
3.0	Final to client	3 September 2019	D. O'Brien	A. Blundell
4.0	Update to address comments	3 October 2019	D. Coleman	S. Schultz
5.0	Update to address Supplementary Environmental	29 October 2019	D. Coleman	S. Schulz

Kleinfelder Australia Pty Ltd

95 Mitchell Road
Cardiff NSW 2285
Phone: (02) 4949 5200

ABN: 23 146 082 500

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1. INTRODUCTION

1.1 SCOPE

Kleinfelder was engaged by Aurecon on behalf of AGL Energy Limited (AGL) to undertake a Biodiversity Development Assessment Report (BDAR) within Lot 2, 3 and 4 DP 1043561, Lot 1203 DP 1229590, Lot 1202 DP 1229590, and Lot 202 DP 1173564, Tomago New South Wales (NSW). This assessment has been undertaken in accordance with the Biodiversity Assessment Method 2017 (BAM) (OEH, 2017) to support a Development Application for the Newcastle Power Station project, Tomago NSW (the Proposal).

The following terms are used throughout this report to describe particular geographical areas:

- Study Area: Lot 2, 3 and 4 DP 1043561, Lot 1203 DP 1229590, Lot 1202 DP 1229590 and Lot 202 DP 1173564, Tomago NSW (**Figure 1**).
- Development Site: the area to be directly impacted due to the proposed development (**Figure 1**).
- Locality: land within a 5 km radius of the Study Area (**Figure 2**).

1.2 PROJECT BACKGROUND

The proposed power station location is in the eastern portion of Lot 3 DP 1043561 at 1940 Pacific Highway, Tomago. Pipeline and electricity easement corridors are to extend into Lot 4 DP 1043561, Lot 1203 DP 1229590, Lot 1202 DP 1229590 and Lot 202 DP 1173564. AGL owns Lot 2 and Lot 3 DP 1043561 (**Figure 1**). The remaining Lots in the Study Area are owned by the Tomago Aluminium Company (TAC).

The Study Area is 87.1 ha. Of this, the Development Site is 24.48 ha and currently consists of remnant and managed native vegetation, managed grassland/shrubland and a wetland area on the corner of the Pacific Highway and Old Punt Road, Tomago. Existing infrastructure includes an electricity transmission line and easement, roads and access tracks, and one single story dwelling located on Lot 3. The Development Site has been previously used mainly for rural activities including grazing and agricultural purposes. The Hunter River is

approximately 450 metres north-west. The site retains some isolated trees and stands of native vegetation are generally confined to the boundaries (**Figure 2**).

The power station project was declared as critical State Significant Infrastructure (critical SSI) in December 2018 by the NSW Department of Planning & Environment (DoPE). The Development Site is currently zoned IN1 – General Industrial under the Port Stephens Local Environmental Plan (LEP) 2013 which is a listed zoning in Clause 34(1) and is therefore permissible with consent under the Infrastructure State Environmental Planning Policy (SEPP).

1.3 LOCAL CONTEXT

The Study Area occurs within the Port Stephens Council Local Government Area (LGA), located approximately five kilometres south-west of Raymond Terrace and about two kilometres north-east of Hexham. Royal Australian Air Force (RAAF) Base Williamtown and adjoining Newcastle Airport are approximately 5 km from the site to the north-east.

The surrounding land use is mixed with the Tomago industrial area located to the south and some residential properties to the east and west, the closest of which is 2 km from the proposed power station site. The Study Area is partly within the industrial buffer area surrounding the TAC smelter. Immediately to the north, east and south of the Study Area is vegetated land owned by TAC and Hunter Water Corporation (HWC). Large areas of land further to the south, west and east of Tomago are covered with native vegetation or have been cleared for open pastures. Tilligerry State Conservation Area is located 3.5 km to the north east, covering an area of 4,689 ha which extends further north-east through the Tomago sand beds.

The Hunter River flows in a southwest direction approximately 450 m north-west of the site. A bend in the river then directs the flow towards the southeast into the Hunter Estuary Wetland Ramsar site, approximately 2.5 km south and east of the proposed power station site. The Pacific Highway, a major north-south transport corridor linking Sydney and Brisbane, borders the northern boundary of the power station site and separates it from the Hunter River. Additionally, the Development Site is bound by the Newcastle Gas Storage Facility (NGSF) to the east, large areas of intact native vegetation which extend from the northern, eastern and south-eastern boundaries of the Development Site and the Tomago industrial area directly to the south. Throughout these large connective habitats, there are some cleared easements and tracks/roads which are generally no wider than 25 m.

1.4 PROPOSED DEVELOPMENT

AGL proposes to develop a power station at 1940 Pacific Highway, Tomago, NSW. The Newcastle Power Station would be a dual fuel (gas and diesel) fast-start peaking power station with a nominal operating capacity of 250MW at Tomago in NSW. The Newcastle Power Station would supply electricity to the grid at short notice during periods of high electricity demand, and/or low supply, particularly during periods where intermittent renewable energy supply is low or during supply outages. This operation is aligned with AGL's move to a renewable energy mix. While the primary role of the Newcastle Power Station would be to provide firming or peaking capacity to the National Electricity Market, to maximise operational flexibility each unit of the power station would be designed for continuous operation.

Both lots owned by AGL are zoned IN1 – General Industrial under the PSC LEP. Road access to the proposed power station site will be provided via a new access road that would extend from Old Punt Road.

The proposed location of utilities (gas and electricity) are shown in **Figure 1**. The utilities areas would contain a new 132kV transmission line and one or more new gas pipelines (Northern and Southern pipelines) (**Figure 1**). The pipeline(s) would supply the proposed power station with gas from the existing Newcastle high pressure pipeline (HPP) in Old Punt Road NGSF. A direct connection to the Newcastle Gas Storage Facility (NGSF) is also proposed – Transmission Line Corridor (**Figure 1**). The new electricity transmission line would transfer the electricity produced by the proposed power station to the national electricity network via a connection to the existing 132kV TransGrid switchyard.

The Proposal has a capital investment value of approximately \$400 million. Construction of the Proposal is planned to commence in 2021 and become operational by the end of 2022. The Development Site is 24.48 ha and includes:

- A power station with necessary supporting ancillary equipment and infrastructure. The power station would be capable of operating with either gas or diesel fuel.
- 132kV electricity transmission line to the existing Tomago switching yard, operated by TransGrid.
- Gas transmission/storage pipeline(s) and receiving station, compressor units and ancillary infrastructure.
- Storage tanks and laydown areas.

- Water management infrastructure including pond(s), a connection to Hunter Water potable and non-potable service and discharge infrastructure in line with Hunter Water requirements.
- Diesel storage and truck unloading facilities.
- Site access road.
- Office / administration, amenities, workshop / storage areas and car parking.

1.4.1 Power station

The proposed power station is a dual fuel power plant capable of generating approximately 250MW of electricity. Power generation will either be by the use of reciprocating engine generators or aero-derivate gas turbine generators. Generation units would be dual fuel capable, meaning they would be able to be supplied by natural gas and/or liquid fuel.

The power sector is exposed to rapidly changing technologies and AGL is seeking to use the tender and contractual processes to determine the most cost-effective technology best suited to the site and statutory requirements of NSW. The decision to install gas turbines or reciprocating technology will, therefore, be made based on a range of environmental, social, engineering and economic factors that will be considered as part of the power station design processes.

1.4.2 Ancillary facilities

The power station, regardless of the chosen technology, requires supporting ancillary facilities. These would include:

- Natural gas reception yard potentially including gas metering, pressure regulation, compression, heating stations, pigging facilities, and provision for flaring.
- Generator circuit breakers, generator step-up transformers and switchyard including overhead line support gantry.
- Water collection and treatment facilities.
- Water storage tanks and ponds.
- Truck loading/unloading facilities.
- Liquid fuel storage tanks.
- Emergency diesel generators with associated fuel storage.
- Closed circuit cooling systems.
- Control room.

- Offices and messing facilities.
- Electrical switch rooms.
- Occupational health and safety systems including an emergency warning and evacuation system.
- Workshop and warehouse.
- Firefighting system.
- Communication systems.
- Security fence, security lighting, stack aviation warning lights (if required) and surveillance system.
- Landscaped areas and car parking areas.
- Concrete foundations, bitumen roadways, concrete pads in liquid fuel unloading station and gas turbine or engine unit maintenance areas.
- Concrete bunded areas with drains for liquid fuel tanks, liquid chemicals store, oil filled transformers (if installed) and other facilities where contaminated liquids are stored.
- Construction and laydown area/s.
- Engineered batters to support and protect the power plant platform.
- Sedimentation pond/s and associated diversion drain/s and earth bunding.

1.4.3 Gas pipeline

The primary source of natural gas for the NPS would be via the NGSF DN 400 pipeline (PL 42). Gas can be drawn from the network subject to availability. New gas pipeline connections would be made on the eastern side of Old Punt Road within a gas receiving yard. The pipeline would be designed as per AS 2885 and constructed of approximately DN 300 (12") pipe and buried at a depth of approximately 900 to 1200 mm. To supplement supply from the Jemena Gas Network (JGN), AGL would construct new gas pipeline capable of storing natural gas in compressed gaseous form. Gas would be drawn from the JGN during periods of low gas demand, compressed, and stored for use by the NPS during periods of high-power demand. These pipelines would be of multiple diameters where the larger pipeline would be approximately DN 1050 (42"). The pipeline would be buried at a depth of approximately 900 to 1200mm. These new gas pipeline would either be constructed via trenching or horizontally directionally drilled (**Figure 1**).

1.4.4 Electricity transmission line

A high voltage 132kV electricity transmission line would be required to connect the proposed power station to the TransGrid 132kV switchyard, approximately 500 metres south-east. The switching station would transfer the electricity produced at the power station to the regional electricity transmission system. The transmission line would be located alongside the existing transmission line running northwest from the switchyard before heading west to the proposed power station site.

1.4.5 Water and wastewater

Water would be used for a range of services and systems at the Newcastle Power Station including:

- Input to demineralised water treatment plant (if required)
- Inlet air cooling (if required)
- Input to power generation units (if required)
- Workshops
- Amenities
- Drinking water
- Firefighting and emergency facilities
- Plant wash water and landscaping irrigation.

Water would be received from the local water authority network on Old Punt Road via a new connection or delivered by truck to site as a secondary source when necessary. Annualised water consumption based on peaking load and continuous operation (average hours per day) would be approximately 120,000m³ and 800,000m³ respectively.

The Proposal would generate wastewater streams from the operation of the NPS, including:

- Gas turbine compressor wash water (as relevant to technology proposed)
- Gas turbine power augmentation water blowdown (as relevant to technology proposed depending on water quality used)
- Auxiliary cooling water system wastewater (drain down events for maintenance)
- Water treatment plant waste
- Plant wash down water and service water drains
- Pond sludge
- Chemical drains
- Oily drains collected from bunds and workshops

- Contaminated/dirty storm water (collected from roads, hardstand areas, etc)
- Potable water drains
- Sewage.

Process wastewater and solids/sludge would be periodically removed from site via tankers and trucked off site for disposal at a licensed wastewater facility. A tanker loading facility would be provided within the NPS for wastewater collection and removal.

1.4.6 Vehicular access

The area around Tomago is serviced by a road network well suited to heavy haulage vehicles due to the surrounding industrial land uses. Old Punt Road is a sealed single lane, two-way council owned road. Old Punt Road connects to the Pacific Highway approximately one kilometre to the north of the proposed power station access point.

During construction, it is proposed that oversized or heavy items would be transported along the Pacific Highway and Old Punt Road.

During operation, vehicular access to the Development Site would be provided via the newly formed access off Old Punt Road. This access would be used by operational staff. Parking for visitors and staff would be provided on site. It is acknowledged that Roads and Maritime Services (RMS) are proposing an extension of the M1 Pacific Motorway to the Pacific Highway at Raymond Terrace which may change access during the operation of the facility.

1.4.7 Construction activities and construction staging

The power station is anticipated to be in operation in 2022.

Key construction activities for the Proposal include:

- Clearing of vegetation at the proposed power station site and as required along the electrical transmission, road and gas pipeline(s) easements.
- Demolition of the existing dwelling if not repurposed during construction and operation.
- Installation of gas pipeline(s) and electrical transmission line infrastructure.
- Earthworks to prepare the power station site and construction areas.
- Installation of foundations and underground services.
- Installation of aboveground civil, mechanical and electrical plant and equipment.

- Commissioning and testing.

1.5 SITE SELECTION

AGL investigated a range of potential sites within the Tomago area for the power station as part of the current study (**Figure 3**). This review of sites considered key selection parameters including environmental, infrastructure, economic, engineering, stakeholder views and land use constraints and opportunities. The Development Site was selected because it best satisfies the criteria for a power station and its ancillary infrastructure needs, whilst minimising the potential for environmental and social impacts.

The site has previously been the subject of an Environmental Impact Statement (EIS) with development consent granted for a power station in 2002. That development consent has now lapsed. The attributes of the site that made the location optimal for a power station in 2002 are still relevant today. Many of the key location requirements for power facilities exist at the proposed site, including:

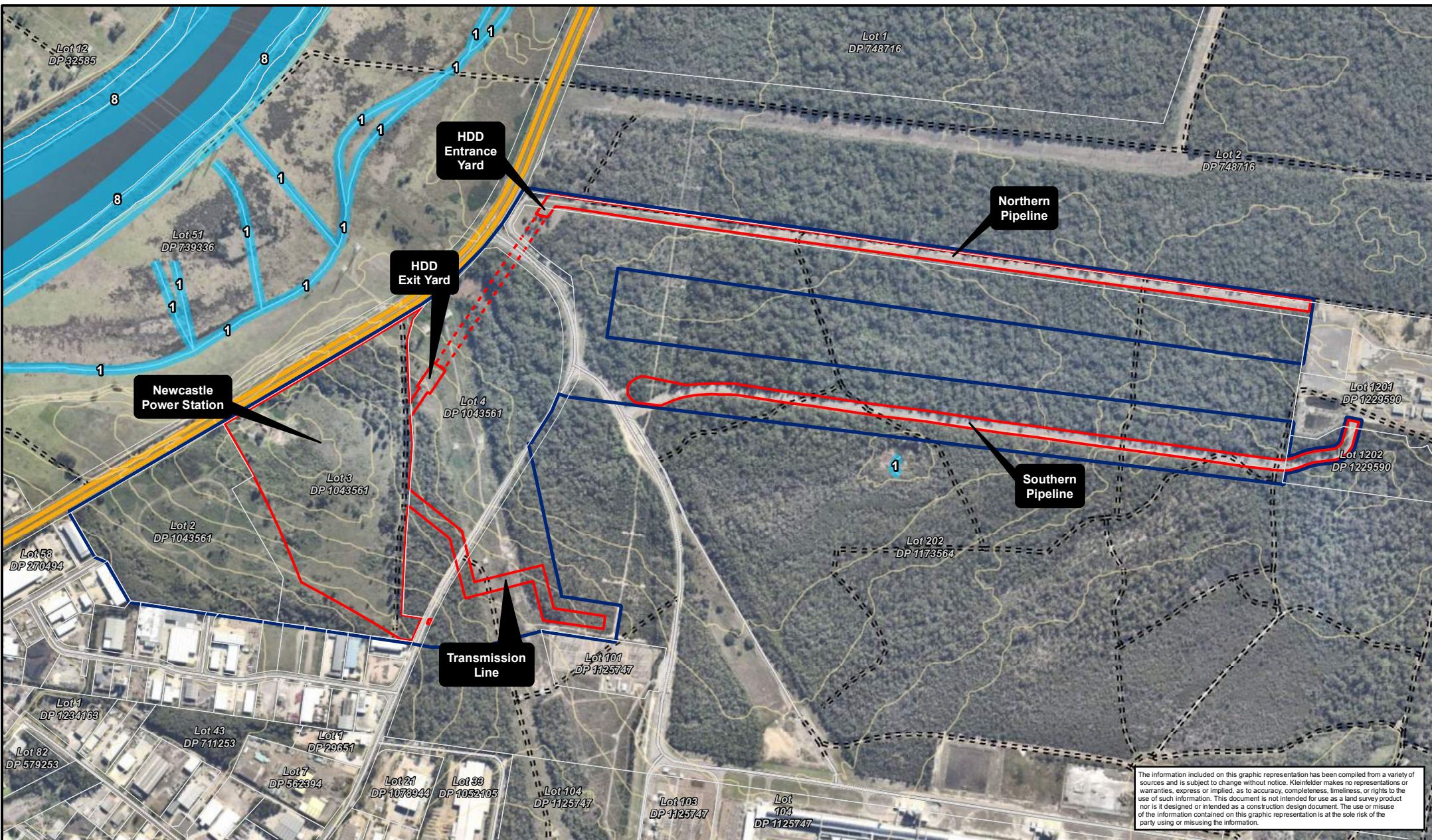
- Proximity to gas supply pipelines and gas storage facilities.
- Proximity to the high voltage electricity transmission network and high electricity demand centres.
- Capacity of the transmission network to deliver electricity produced without constraint.
- Availability of suitably zoned land with compatible existing land use.
- Access for the delivery of heavy construction loads and ongoing liquid fuel transport routes.
- Availability of skilled construction and operations workforce.
- Proximity to centres for operational maintenance resourcing.
- Ready availability of water and wastewater management facilities.
- Local businesses and infrastructure sufficient to support a power station.

1.6 INFORMATION SOURCES

The following information sources were utilised to inform the biodiversity development assessment which provided knowledge of existing literature pertaining to the Development Site and broader locality:

- The NSW Office of Environment and Heritage BioNet Vegetation Classification (formerly known as the NSW Vegetation Information System Classification Database) (OEH, 2019);

- The NSW Office of Environment and Heritage Threatened Biodiversity Data Collection (formerly known as the Threatened Species Profile Database) (OEH, 2019);
- The NSW Office of Environment and Heritage BioNet Atlas of NSW (formerly known as the NSW Wildlife Atlas) (OEH, 2019);
- The Department of the Environment and Energy (DoEE) Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES);
- Previous ecological studies within the Study Area and wider locality (see **Section 8**);
- Relevant published literature (see **Section 8**).



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Legend

- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)
- HDD Pipe Alignment (No direct impact)
- Watercourse (Labelled with stream order)
- Riparian Buffers
- Lot Boundaries
- Contours (2m)
- Primary Road
- Local Road
- Track

Metres

0 50 100 200 300 400 500

N

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DATA SOURCE:
NSW DFSI - 2019
Nearmap - 2019

Development Site Map

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Biodiversity Development Assessment Report
AGL Newcastle Power Station Project
Tomago NSW

FIGURE:
1



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Legend

- Development Site
- - - HDD Pipe Alignment (No direct impact)
- Mitchell Landscapes Boundary (V3)
- IBRA Sub-region Boundary
- 1500m Landscape Assessment Boundary
- Landscape Assessment - Native Vegetation
- Primary Road
- Arterial Road
- Sub-arterial Road
- Local Road
- Watercourse (Labelled with stream order)
- Riparian Buffers

0 0.1 0.2 0.4 0.6 0.8 1 km

N

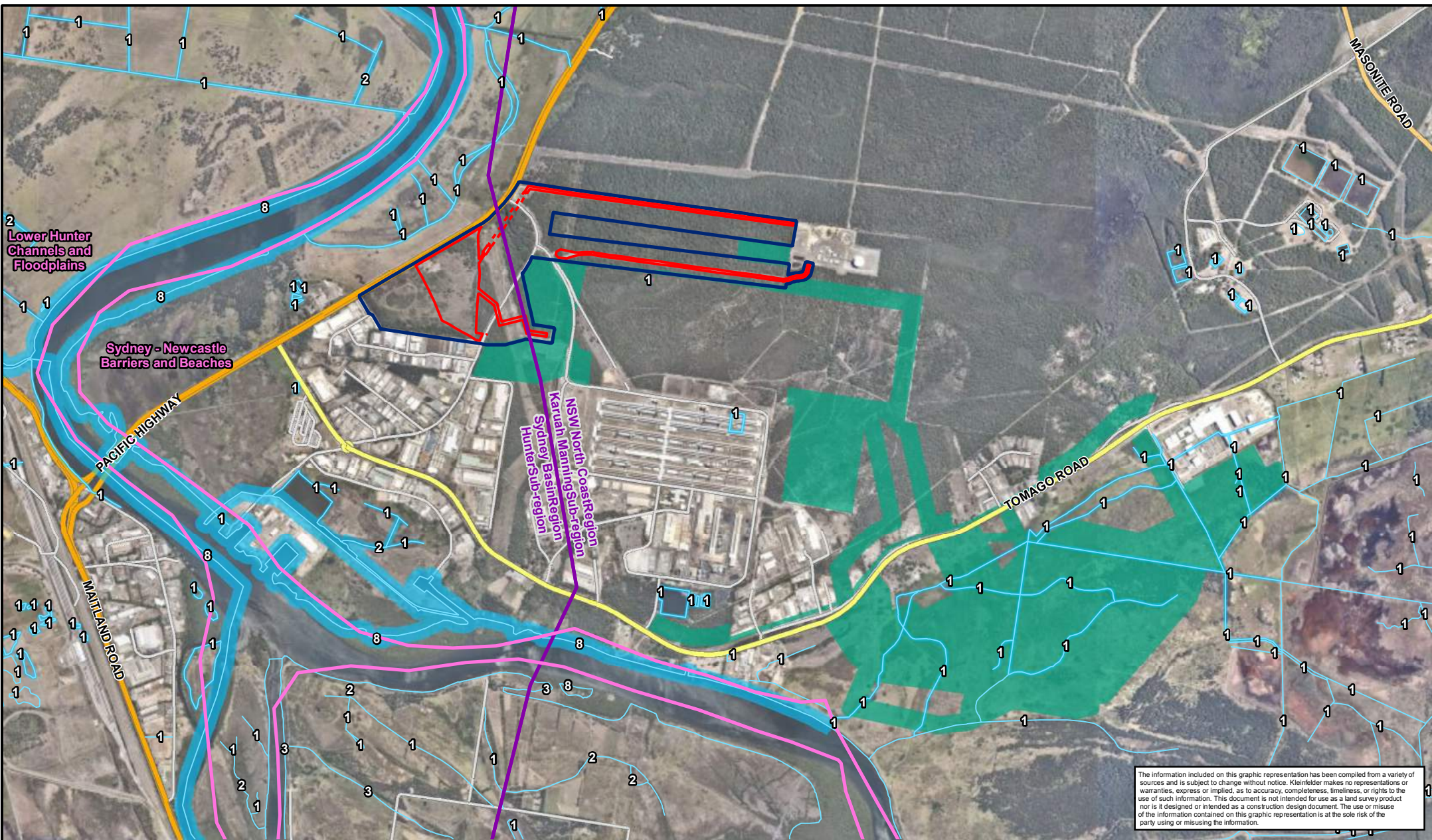
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 DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2019

**Development Site
Location Map**

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FIGURE:
2



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Alternate Site Options Considered	Primary Road
Development Site	Arterial Road
HDD Pipe Alignment (No direct impact)	Sub-arterial Road
Mitchell Landscapes Boundary (V3)	Local Road
IBRA Sub-region Boundary	Watercourse (Labelled with stream order)
Study Area	Riparian Buffers

0 0.1 0.2 0.4 0.6 0.8 1 km

PROJECT REFERENCE: 20191297
 DATE DRAWN: 1/05/2019 09:41 Version 1
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 DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2019

Alternate Site Options Considered

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FIGURE:
3

1.7 LEGISLATIVE CONTEXT

Assessment of the Proposal was undertaken in accordance with and in consideration of the following Acts and Policies:

- Commonwealth:
 - *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- State:
 - *Biodiversity Conservation Act 2016* (NSW) (BC Act);
 - *Biodiversity Conservation Regulation 2017* (NSW) (BC Regulation);
 - *Environmental Planning and Assessment Act 1979* (EP&A Act);
 - *Biodiversity Conservation (Savings and Transitional) Regulation 2017*;
 - *Biosecurity Act 2015*;
 - *Local Land Services Act 2013* (LLS Act);
 - State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017;
 - State Environmental Planning Policy (Coastal Management) 2018;
 - State Environmental Planning Policy No. 44 – Koala Habitat Protection;
 - Draft Amendment to State Environmental Planning Policy No. 44 – Koala Habitat Protection;
 - Draft State Environmental Planning Policy (Environment); and
 - Biodiversity Assessment Method (OEH, 2017).
- Local:
 - Port Stephens Council Local Environmental Plan 2014 (PSCLEP 2013);
 - Lake Macquarie Development Control Plan 2014 (PSCDCP 2014); and
 - Port Stephens Council Comprehensive Koala Plan of Management 2002.

1.7.1 ***Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)***

Under the EPBC Act assessment, an approval is required for actions that are likely to have a significant impact on matters of national environmental significance (MNES). An action includes a project, development, undertaking, activity, or series of activities. When a person proposes to take an action they believe may need approval under the EPBC Act, they must refer the proposal to the Australian Government Minister for the Environment. The Act identifies nine MNES:

1. World Heritage properties;
2. National heritage places;
3. Wetlands of international importance (Ramsar Convention);

4. Listed threatened species and communities;
5. Migratory species listed under international agreements;
6. Great Barrier Reef Marine Park;
7. Commonwealth marine areas;
8. Nuclear actions; and
9. Water resources in respect to Coal Seam Gas and large coal mines.

While this BDAR is not required to address MNES, the proponent is required to address the EPBC Act as part of their development application to the NSW DoPE. Items 3, 4 and 5 are relevant to the current proposal.

An EPBC referral was made to the Commonwealth Department of the Environment and Energy who determined that the project was a controlled action under section 75 of the EPBC Act. Environmental assessment requirements (EARs) for the project were provided by the Commonwealth Government on 11 September 2019. Refer to **Section 7.1** for a summary of the assessment.

1.7.2 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (NSW) (**EP&A Act**), the *Environmental Planning and Assessment Regulation 2000* (NSW) and associated environmental planning instruments (including State Environmental Planning Policies (**SEPPs**) and Local Environmental Plans (**LEPs**)) provide the framework for the assessment of the environmental impact of development proposals in NSW.

Sections 5.12 and 5.13 of Part 5 of the EP&A Act provide for the declaration of SSI and critical SSI. Section 5.12(4) of the EP&A Act enables a SEPP or an order of the NSW Minister for Planning (published on the NSW legislation website) to declare development to be SSI. Section 5.13 enables the Minister to declare SSI to be critical SSI if "...in the opinion of the Minister, it is essential to the State for economic, environmental or social reasons".

The NSW Minister for Planning declared the Proposal to be critical SSI in December 2018 after a request was made to the Minister by AGL on 5 November 2018. The Declaration by the Minister came into effect in December 2018 and has been included within Schedule 5 of the State and Regional Development SEPP.

In accordance with section 5.16 of the EP&A Act, the Planning Secretary has prepared the Secretary's Environmental Assessment Requirements (SEARs), which require the preparation of an EIS for the Proposal for submission to the consent authority, the NSW Minister for Planning. SEARs were issued to AGL on 18 February 2019.

1.7.3 Biodiversity Conservation Act 2016 (NSW)

1.7.3.1 Biodiversity Assessment Pathway

As per Part 7.9 of the Biodiversity Conservation Act (BC Act), an application for development consent under Part 5.1 of the EP&A Act to carry out State Significant Infrastructure must be accompanied by a BDAR unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values.

In accordance with section 5.16 of the EP&A Act, the Planning Secretary has prepared the SEARs and it was determined that a BDAR is required for the Proposal.

1.7.3.2 Biodiversity Assessment Method

The Proposal has been assessed under the BAM (OEH, 2017).

The Biodiversity Accredited Assessor System (BAAS) Case number for the project is 00012104. The BAM Calculator number for the majority of vegetation zones is 00012104/BAAS17039/19/00015291. The BAM Calculator number for one zone (Zone 2), identified as containing vegetation consistent with an EEC listed under the BC Act, is 00012104/BAAS17039/19/00018030.

1.7.4 Port Stephens Comprehensive Koala Plan of Management 2002

The Port Stephens Comprehensive Koala Plan of Management (CKPoM) applies to all development applications on land within the Port Stephens LGA. It aims to ensure the long-term sustainability of any local Koala populations. Within the Port Stephens LGA, fulfilment of requirements of the Port Stephens CKPoM satisfies the requirements of SEPP 44 as it applies to all development applications on land within the Port Stephens LGA.

Potential impacts of the Proposal on Koala habitat are addressed in **Section 7.2**.

1.7.5 Biosecurity Act 2015 (NSW)

Under the *Biosecurity Act 2015* (NSW) all plants are regulated with a general biosecurity duty “to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.” Under the Act, a biosecurity impact “is an adverse effect on the economy, environment, or the community that arises, or has the potential to arise, from a biosecurity matter.”

This legislation is addressed in **Section 7.3**.

2. LANDSCAPE CONTEXT

2.1 LANDSCAPE FEATURES

The landscape features and site context detailed in Section 4 of the BAM (OEH, 2017) are described in **Table 1**. These landscape features are also shown in **Figure 2**.

Table 1: Landscape features of the Development Site

Landscape Features	Development Site
IBRA bioregion	Sydney Basin and NSW North Coast Interim Biogeographic Regionalisation for Australia (IBRA) bioregion. The Development Site occurs within the northern portion of the Sydney Basin IBRA Region and extends into the southern portion of the NSW North Coast bioregion.
IBRA subregion	Hunter IBRA sub-region. The Development Site occurs within the boundary between the Hunter and Karuah Manning IBRA sub-region; however, the largest proportion of impact will occur within the Hunter IBRA sub-region.
LGA	Port Stephens Local Government Area.
Mitchell Landscapes	Sydney - Newcastle Barriers and Beaches. This landscape occurs on Quaternary coastal sediments on long recurved quartz sand beaches between rocky headlands backed by sand dunes and intermittently closed and open lagoons. Includes areas of more extensive high dunes often located on top of the headlands. General elevation is 0 to 30 m, local relief to 10 m (Mitchell 2002).
Rivers, streams and estuaries	The Hunter River lies 450 m to the north-west of the Development Site and 1,800 m to the south. There are no mapped watercourses in the Study Area or Development Site.
Wetlands	The closest Important Wetland (SEPP Coastal Wetland) is located 450 m to the north-west of the Development Site which borders the edge of the Hunter River. One wetland also occurs within the north-eastern portion of the Study Area. The Hunter Estuary Wetlands, a Ramsar listed wetlands, are located to the south and east of the Development Site. The Kooragang component is closest to the development site and is located about 2.5 km south of the Development Site at its closest point.
Connectivity of different areas of habitat	The NSW Government has identified a number of green corridors that run through the Lower Hunter Region (Department of Planning 2006). The Lower Hunter Regional Strategy recognises the importance of large vegetated areas being linked via habitat corridors at a landscape scale. The Development Site lies within a large wildlife corridor that extends from the Watagan Ranges in the south to Port Stephens in the North. This corridor is likely to provide a highly significant link between southern sandstone ranges and the coastal heaths and wetlands of Port Stephens. Specifically, wildlife corridors enable a range of benefits to biodiversity such as access to critical resources, genetic exchange between individuals of the same species and dispersal of juveniles. On a local level the Development Site is situated to the north of the industrial precinct of Tomago with Old Punt Road dissecting the middle of the site in a north/south bearing. There is limited connectivity south through the industrial estate, however linear vegetation strips exist along a powerline easement connecting the Development Site to riparian areas of the North Channel of the Hunter River. Another stretch of the Hunter River lies approximately 450 m to the north-west of the Development Site separated

	by grazed marshlands and the Pacific Highway. Large areas of intact native vegetation extend from the northern and eastern boundaries of the Development Site. The areas provide linkage to Tilligerry State Conservation Area (4.689 ha) which extends north-east through the Tomago sand beds. Throughout these large connective habitats, there are some cleared easements and tracks/roads which are generally no wider than 25 m. These barriers are unlikely to fragment local fauna populations; however, Old Punt Road and Masonite Road are likely to restrict movement of less mobile species. The large areas of intact native vegetation to the north are owned by Hunter Water and have been secured for conservation under a Biobank agreement (ID 173 – 105.1 ha). The majority of vegetation directly to the south / south-east of the Development Site is owned by TAC as part of their buffer lands. Connectivity of habitat is impeded to the north-west by the Pacific Highway and to the south-west and south by the Tomago industrial precinct.
Areas of geological significance and soil hazard features	The Development Site lies within an area of both 'Low Probability Acid Sulfate Soil Risk' and an area of 'High Probability Acid Sulfate Soil Risk' (Class 2 and Class 4 under the Port Stephens LEP). There are no areas of geological significance within the Development Site.
Areas of outstanding biodiversity value	There are no areas of outstanding biodiversity value mapped within the Development Site.

2.2 SITE CONTEXT

Details of the landscape assessment for the Development Site, according to the BAM (OEH, 2017) using the site-based assessment methodology and determined by remote sensing and GIS are detailed below.

2.2.1 Native Vegetation Cover

Native vegetation cover estimated to remain in the landscape proximal to the Development Site (1,500 m site buffer) has an area of 1,605 ha which has a woody vegetation cover of 853 ha or 53% (**Figure 2**).

2.3 GEOLOGY AND SOILS

The Study Area is mapped as occurring on several Soil Landscapes of the Newcastle 1:100,000 Sheet (Matthei, 1995). The Tea Gardens (variant a) occurs across the majority of the gas pipeline easement investigation area, while the Beresfield soil landscape occurs across areas proposed for the power station. One small patch of Shoal Bay (variant a) soil landscape occurs within the eastern area, in proximity to the NGSF. The Tea Gardens soil landscape is described as occurring on Pleistocene beach ridges and sandsheets on the

Tomago Coastal Plain. Soils are deep (>200 cm), and the dominant materials include sandy peat, loose loamy sand and coarse smelly saturated sand. The Beresfield soil landscape is described as occurring on undulating low hills and rises on Permian sediments in the East Maitland Hills region. Soils are moderately deep (<120 cm) and the dominant materials include sandy loams, plastic clays and silty clays.

3. NATIVE VEGETATION

3.1 METHODOLOGY

Native vegetation at the Development Site was assessed in accordance with Section 5 of the BAM (OEH, 2017).

3.1.1 Data Review

Vegetation mapping completed as part of the Lower Hunter and Central Coast Regional Environmental Management Strategy (NPWS, 2003) was reviewed to assist with the determination of Plant Community Types (PCTs) within the Study Area.

3.1.2 Vegetation Mapping Surveys

Vegetation Mapping and Surveys

Detailed vegetation surveys were conducted across the Study Area between 14 August 2018 and 29 March 2019.

The boundaries of each of the identified vegetation communities within the Study Area were mapped using a combination of rapid data points (RDP) and walking transects, using the polygons produced through aerial photo interpretation (API) to assist in targeting survey effort. RDPs involved collecting waypoints over the Study Area using a handheld Trimble™ GPS unit and recording dominant species, structure and condition. Walking transects involved verifying polygons where homogenous in floristic composition and condition, as well as walking vegetation ecotones and using the recorded tracks to define vegetation community boundaries. The RDPs and survey tracks were then overlaid on an aerial photograph and used to delineate and/or clarify vegetation boundaries.

Linework and Attribution

RDPs and plots were classified and tagged with a PCT by field surveyors. Polygons produced from the API work adopted the PCT of the sample point that they intersected.

Plant Community Type Determination

Each vegetation community identified within the Study Area was assigned to the closest equivalent PCT from those listed in the BioNet Vegetation Classification database (OEH, 2017). The closest equivalent PCT for each vegetation community was determined through a comparison of the floristic descriptions of PCTs in the database with the plot / transect data collected from the site. In addition to floristic and structural similarity, the landscape position, soil type and other diagnostic features of the vegetation communities on the site were compared to the descriptions in the database to determine the most suitable PCT. Threatened ecological communities (TECs) as defined in NSW and Commonwealth legislation were also identified if present.

Vegetation Zones

Vegetation zones were identified and delineated on the Development Site in accordance with Section 5.3 of the BAM (OEH, 2017). A vegetation zone is defined in the BAM as a relatively homogenous area that is the same vegetation type and broad condition.

Assessing Vegetation Integrity (Site Condition)

Following stratification of the Development Site into vegetation zones, plots/transects were undertaken to collect site condition data for the composition, structure and function attributes listed in **Table 2** in accordance with Section 5.3 of the BAM (OEH, 2017). The location of the plots/transects were selected through stratified random sampling to provide a representative sample of the variation in vegetation composition and condition within each vegetation zone. Due to the linear nature of one of the vegetation zones within the Development Site (Zone 6), one of the survey plots (Q1) was modified to a 10 m x 40 m plot for the composition and structure attributes, and a 10 x 100 m plot for the function attributes.

Table 2: Composition, Structure and Function components of vegetation integrity

Growth form groups used to assess composition (species richness) and structure (percent foliage cover)	Function attributes
<ul style="list-style-type: none"> ● Tree (TG) ● Shrub (SG) ● Grass and grass-like (GG) ● Forb (FG) ● Fern (EG) ● Other (OG) 	<ul style="list-style-type: none"> ● Number of large trees ● Tree regeneration (presence/absence) ● Tree stem size class (presence/absence) ● Total length of fallen logs ● Litter cover ● High threat exotic vegetation cover (HTE) ● Hollow-bearing trees (HBT)

The number of plots/transects undertaken across the site meets the minimum number of transects required for each vegetation zone area as detailed in Section 5.3.4, Table 4 of the BAM (OEH, 2017). Twelve plots were undertaken within the Study Area. The locations of the plots / transects undertaken on the Development Site are shown on **Figure 4**.

Floristic Identification and Nomenclature

Floristic identification and nomenclature was based on Harden (1992, 1993, 2000 and 2002) with subsequent revisions as published on PlantNet (<http://plantnet.rbgsyd.nsw.gov.au>).

3.2 ASSESSMENT RESULTS

3.2.1 Vegetation within the development site

3.2.1.1 Vegetation Description

Two PCTs were identified within the Development Site (**Table 3**); PCT 1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest; and, PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast. Additionally, the Development Site contains cleared areas of existing roads and infrastructure.

Table 3: Plant Community Types within the Development Site

PCT	Vegetation Formation	Vegetation Class	Area (ha)
PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Hunter-Macleay Dry Sclerophyll Forests	15.13
PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Dry Sclerophyll Forests (Shrubby sub-formation)	Coastal Dune Dry Sclerophyll Forests	0.41
Cleared / roads / infrastructure	-	-	8.95
Total			24.48

3.2.1.2 Vegetation Zones

The two PCTs identified within the Development Site were allocated zones based on condition and variations. PCT 1590 was split into the following three zones:

- Zone 1 – PCT 1590 Moderate/good.

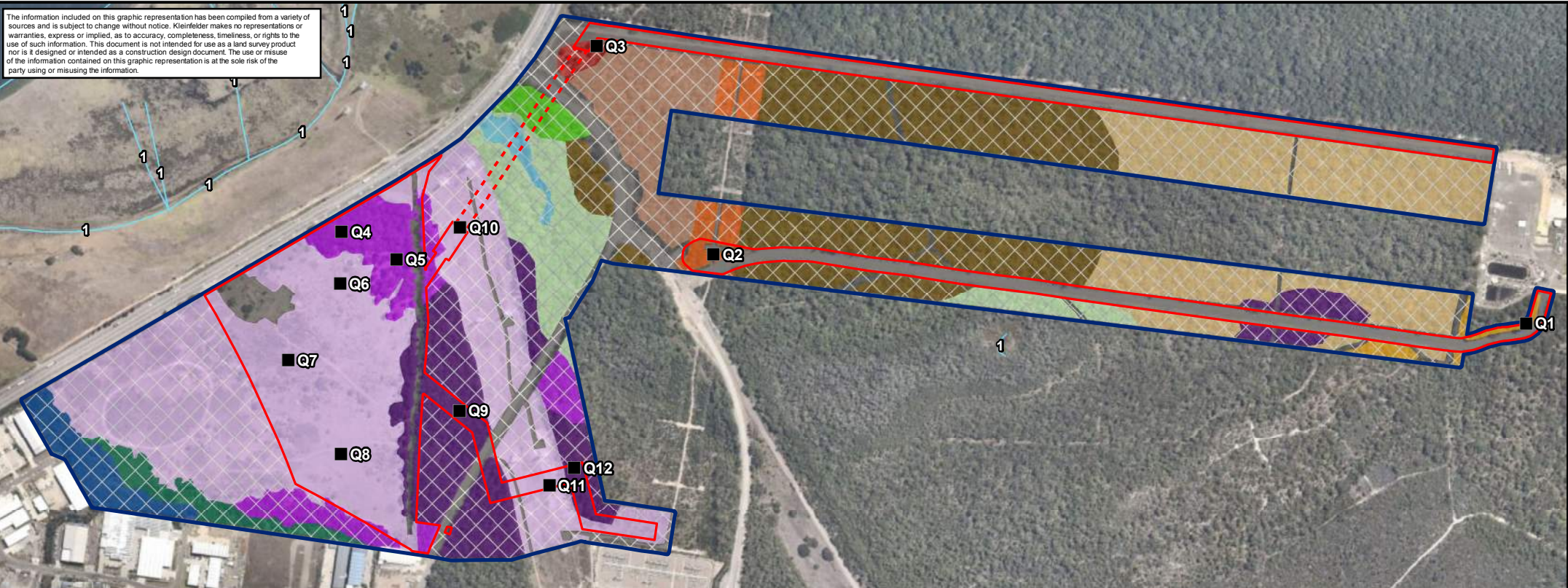
- Zone 2 – PCT 1590 Moderate/good – Endangered Ecological Community (EEC). This vegetation zone was identified as being consistent with the *Lower Hunter Spotted Gum – Ironbark Forest* EEC listed under the BC Act (see following section for justification).
- Zone 3 – PCT 1590 Low.

PCT 1646 was split into the following three zones:

- Zone 4 – PCT 1646 Managed.
- Zone 5 – PCT 1646 Managed Powerline.
- Zone 6 – PCT 1646 Rehabilitation).

Details on these vegetation zones (including condition class, area, patch size, survey effort and vegetation integrity score) are outlined in **Table 4**, and full descriptions of each vegetation zone are provided in the following sub-sections. **Figure 4** shows the distribution of PCTs and vegetation zones within the Development Site. Plot data is provided in **Appendix 1**.

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Plant Community Type and Vegetation Zone within the Development Site

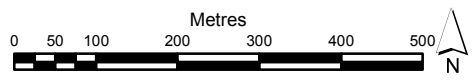
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good) - **Zone 1**
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC) - **Zone 2**
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low) - **Zone 3**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed) - **Zone 4**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline) - **Zone 5**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation) - **Zone 6**
- Cleared

Plant Community Type outside Development Site

- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good)
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC)
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed)

- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate_Good)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Mesic variant)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Red Gum variant)
- 1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (Moderate_Good)
- 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Moderate_Good)
- 1568: Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Moderate_Good)
- 1724: Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
- 1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
- Cleared

- Legend**
- Plot Transect
 - ▭ Development Site
 - - - HDD Pipe Alignment (No direct impact)
 - ▭ Study Area
 - Watercourse (Labelled with stream order)



PROJECT REFERENCE: 20191297
 DATE DRAWN: 1/05/2019 09:42 Version 3
 DRAWN BY: GJoyce

DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2019

Vegetation Zones and Plot Locations

Aurecon
 Biodiversity Development Assessment Report
 AGL Newcastle Power Station Project
 Tomago NSW

FIGURE:
4

Vegetation Zone 1



Plate 1: PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest – Red Ironbark

Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	
PCT ID	1590
Condition Class	Moderate/Good
Area within Development Site	2.39 ha
Vegetation Formation / Class	Dry Sclerophyll Forests (Shrub/grass sub-formation)/ Hunter-Macleay Dry Sclerophyll Forests
Survey Effort	Required: 2 plot/transects.
	Conducted: 2 plot/transects; Q 4 and Q5.
Floristic description	<p>Over the two plots undertaken the canopy was dominated by: <i>Corymbia maculata</i> and <i>Eucalyptus paniculata</i> subsp. <i>paniculata</i>.</p> <p>The midstorey was dominated by <i>Glochidion ferdinandi</i>. Other common species included <i>Acacia falcata</i>, <i>Acacia longifolia</i> and <i>Breynia oblongifolia</i>.</p> <p>Dominant ground layer species included <i>Entolasia stricta</i>, <i>Themeda triandra</i>, <i>Echinopogon ovatus</i>, <i>Aristida vagans</i>, <i>Arthropodium milleflorum</i>, <i>Brunoniella australis</i>, <i>Pratia purpurascens</i>, <i>Dianella caerulea</i> var. <i>producta</i>, <i>Lomandra filiformis</i> and <i>Lomandra multiflora</i> subsp. <i>multiflora</i></p> <p>Other common ground layer species included <i>Panicum simile</i>, <i>Cymbopogon refractus</i>, <i>Cynodon dactylon</i>, <i>Dichelachne micrantha</i>, <i>Microlaena stipoides</i>, <i>Juncus usitatus</i>, <i>Centella asiatica</i>, <i>Glycine clandestina</i>, <i>Billardiera scandens</i> and <i>Lagenophora stipitata</i>.</p> <p>The most commonly occurring high threat weed was <i>Paspalum dilatatum</i>.</p>
Condition within Development Site	This Vegetation Zone represents areas which have all strata present. There is evidence of historic disturbance and impacts from edge effects due to localised patches of exotic species.

Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	
Justification for PCT selection	<p>The vegetation within the Study Area most closely resembles a Dry Sclerophyll Forest within the shrub/grass sub-formation due to the presence of a semi-continuous cover of grasses and a sparse shrub layer.</p> <p>Other Spotted Gum – Ironbark dominated Dry Sclerophyll Forests in the shrub/grass sub-formation which occur within the Hunter IBRA sub-region were considered; a total of 7 PCTs were considered - 1600, 1601, 1602, 1589, 1590, 1592 and 1593.</p> <p>PCT 1600 and 1601 were excluded due to the lineage of these PCT, which is derived from Central Hunter Mapping Project and the Greater Hunter Vegetation mapping Project and is more representative of vegetation community types occurring further to the north-west of the Study Area. Additionally, PCT 1602 was excluded due to the dominance of <i>E. crebra</i> within this PCT which is more representative of Central Hunter Spotted Gum – Ironbark Forest.</p> <p>PCT 1593 was excluded as this PCT is described as being dominated by <i>E. fibrosa</i>. PCT 1592 was excluded due to the presence of <i>E. punctata</i> in this PCT, which is lacking from the Study Area.</p> <p>PCT 1590 and 1589 were deemed to be the most floristically aligned PCTs to vegetation within the Study Area. These two PCTs have very similar vegetation descriptions and occur in similar positions in the landscape. The vegetation on site has floristics similar to both PCTs, however PCT 1590 was determined to be the more accurate fit for the vegetation on site (presence of <i>Eucalyptus fibrosa</i> in Vegetation Zone 3, presence of <i>Cheilanthes sieberi</i> and <i>Lepidosperma laterale</i> and lack of some key diagnostic species from PCT 1589. Additionally, the percent cleared estimate of PCT 1590 was determined to more accurately represent the vegetation on-site (48% cleared for PCT 1590, compared to 71% cleared for PCT 1589).</p>
Status	<p>BC Act: Not Listed.</p> <p>EPBC Act: Not Listed.</p>
% Cleared	48%

Vegetation Zone 2



Plate 2: PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest - Red Ironbark (EEC)

Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	
PCT ID	1590
Condition Class	Moderate/Good/EEC
Area within Development Site	1.91 ha
Vegetation Formation / Class	Dry Sclerophyll Forests (Shrub/grass sub-formation)/ Hunter-Macleay Dry Sclerophyll Forests
Survey Effort	Required: 1 plot/transect.
	Conducted: 2 plot/transects; Q9 and Q12.
Floristic description	<p>The canopy is dominated by <i>Corymbia maculata</i>, <i>Eucalyptus fibrosa</i> and <i>Eucalyptus umbra</i>. The midstorey typically contained <i>Melaleuca nodosa</i> and <i>Glochidion ferdinandi</i>. The dominant shrubs were <i>Breynia oblongifolia</i> and <i>Bursaria spinosa</i>. Other common shrub layer species included <i>Dillwynia retorta</i>, <i>Pultenaea echinula</i> and <i>Pittosporum undulatum</i>.</p> <p>The ground layer was dominated by <i>Entolasia stricta</i>, <i>Rytidosperma pallidum</i>, <i>Dianella caerulea</i> var. <i>producta</i> <i>Brunoniella australis</i>, <i>Themeda triandra</i>, <i>Pratia purpurascens</i> and <i>Lomandra multiflora</i> subsp. <i>multiflora</i>.</p> <p>Other common ground layer species included <i>Aristida vagans</i>, <i>Oplismenus</i> spp, <i>Cheilanthes sieberi</i>, <i>Capillipedium spicigerum</i>, <i>Ptilothrix deusta</i>, <i>Panicum simile</i>, <i>Microlaena stipoides</i>, <i>Parsonsia straminea</i>, <i>Dichondra repens</i> and <i>Goodenia heterophylla</i> subsp. <i>eglandulosa</i>.</p> <p>The most commonly occurring high threat weed was <i>Lantana camara</i> and occasionally <i>Ligustrum sinense</i>.</p>
Condition within Development Site	This vegetation zone represents areas which have all strata present, contains minimal exotic species and contains signature canopy species and mid-strata species which meet the criteria of the Lower Hunter Spotted Gum – Ironbark Forest EEC listed under the BC Act (see below).

Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	
Justification for PCT selection	<p>This vegetation zone was assessed as being the same PCT as Vegetation Zone 1. While there are some floristic variations between this vegetation zone and Vegetation Zone 1 (mainly the presence of <i>Eucalyptus fibrosa</i>), these two zones are broadly similar and represent floristic variation within the same PCT.</p> <p>The justification for PCT selection is as per Vegetation Zone 1.</p>
Status	<p>BC Act: This vegetation zone is consistent with the <i>Lower Hunter Spotted Gum – Ironbark Forest</i> EEC listed under the BC Act.</p> <p>Inclusion of this community in the Study Area within the EEC was determined through comparison with the NSW Scientific Committee’s Determination (2011). The community conforms in locality (Sydney Basin Bioregion on Permian geology), position in the landscape (moderately fertile soils in the central to Lower Hunter Valley), and dominant floristic composition and structure (open forest dominated by <i>Corymbia maculata</i>, <i>Eucalyptus fibrosa</i> and <i>E. umbra</i>, <i>Aristida vagans</i>, <i>Cheilanthes sieberi</i> and <i>Lomandra multiflora</i>).</p> <p>EPBC Act: Not Listed.</p>
% Cleared	48%

Vegetation Zone 3



Plate 3: PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest – Low Condition

Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	
PCT ID	1590
Condition Class	Low
Area within Development Site	10.83 ha
Vegetation formation/ Class	Dry Sclerophyll Forests (Shrub/grass sub-formation)/ Hunter-Macleay Dry Sclerophyll Forests

Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	
Survey Effort	Required: 3 plot/transects.
	Conducted: 4 plot/transects; Q6, Q7, Q8 and Q11.
Floristic description	<p>This vegetation zone lacks a canopy layer, with occasional regeneration occurring. There is also scattered <i>Glochidion ferdinandi</i> and <i>Grevillea robusta</i> in the zone (plantings present along the powerline easement). There is a regenerating midstorey dominated by <i>Acacia longifolia</i>, <i>Acacia falcata</i>, <i>Dillwynia retorta</i>, <i>Pultenaea echinula</i>, <i>Callistemon linearis</i> and <i>Breynia oblongifolia</i>.</p> <p>The ground layer is dominated by: <i>Cynodon dactylon</i> and <i>Centella asiatica</i>.</p> <p>Other common ground layer species include <i>Imperata cylindrica</i>, <i>Entolasia stricta</i>, <i>Themeda triandra</i>, <i>Microlaena stipoides</i>, <i>Rytidosperma pallidum</i>, <i>Panicum simile</i>, <i>Goodenia heterophylla</i> subsp. <i>eglandulosa</i>, <i>Dichelachne micrantha</i> and <i>Capillipedium spicigerum</i>.</p> <p>Common exotic species included <i>Paspalum dilatatum</i>, <i>Plantago lanceolata</i>, <i>Andropogon virginicus</i>, <i>Briza maxima</i>, <i>Ambrosia artemisiifolia</i>, <i>Rubus fruticosus</i>, <i>Lantana camara</i>, <i>Setaria sphacelata</i>, <i>Megathyrsus maximus</i>, <i>Chloris gayana</i>, <i>Briza subaristata</i> and <i>Hypochaeris radicata</i>.</p> <p>The eastern plot contained a higher and more diverse percentage of native species despite what appears to be the regular slashing of the powerline easement area.</p>
Condition within Development Site	This vegetation zone represents areas which have been cleared in the past and the western section is actively managed as part of a powerline easement. This area contains minimal canopy and midstorey species and contains a mix of exotic and native species in the ground layer.
Justification for PCT selection	<p>This vegetation was determined to be the same PCT as Vegetation Zone 1 and Zone 3, however it has been modified due to clearing. This was determined through assessment of the adjacent vegetation both within and adjacent to the Study Area.</p> <p>The justification for PCT selection is as per Vegetation Zone 1.</p>
Status	BC Act: Not Listed.
	EPBC Act: Not Listed.
% Cleared	48%

Vegetation Zone 4



Plate 4: PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed)

Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed)	
PCT ID	1646
Condition Class	Managed
Area within Development Site	0.05 ha
Vegetation formation/ Class	Dry Sclerophyll Forests (Shrubby sub-formation)/ Coastal Dune Dry Sclerophyll Forests
Survey Effort	Required: 1 plot/transect.
	Conducted: 1 plot/transect.
Floristic description	The canopy was dominated by <i>Corymbia gummifera</i> and <i>Eucalyptus tereticornis</i> . <i>Melaleuca quinquenervia</i> occasionally occurred in the midstorey. The ground layer was dominated by <i>Cynodon dactylon</i> , <i>Centella asiatica</i> and <i>Oxalis perennans</i> . The dominant exotic species included <i>Setaria pumila</i> , <i>Conyza bonariensis</i> , <i>Hypochaeris radicata</i> , <i>Axonopus compressus</i> and <i>Paspalum dilatatum</i> .
Condition within Development Site	This zone represents areas which appear to have been mowed regularly and contains a significantly reduced diversity and cover of native species.
Justification for PCT selection	PCT 1646 is described as Open Forests to Woodlands dominated by Angophoras with a sparse mid-stratum characterised by Banksias and a range of low shrubs. The ground cover is relatively sparse and is characterised by grasses and ferns. This community extends along the coast from Gosford to Black Head (Darawank Nature Reserve). It is confined to Quaternary dune sands at elevations up to 100 m. Due to the condition of this zone the only in common canopy species within the plot was <i>Corymbia gummifera</i> . The midstorey species were not present to assist with the determination.

Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed)	
	<p>The PCT was assigned to this zone due to this area's proximity to the Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast – (Red Gum Variant) vegetation within the study area. This adjoining zone contains the characteristic species and structure which is typical of PCT 1646.</p> <p>All other Coastal Dune Dry Sclerophyll Forests in the Karuah Manning and Hunter IBRA subregions were considered in undertaking the above determination. However, all other PCTs were ruled out based on floristics, geographic distribution or position in the landscape.</p>
Status	BC Act: Not Listed.
	EPBC Act: Not Listed.
% Cleared	45%

Vegetation Zone 5



Plate 5: PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline)

PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline)	
PCT ID	1646
Condition Class	Managed Powerline
Area within Development Site	0.23 ha
Vegetation formation/ Class	Dry Sclerophyll Forests (Shrubby sub-formation)/ Coastal Dune Dry Sclerophyll Forests
Survey Effort	Required: 1 plot/transect.
	Conducted: 1 plot/transect.

PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline)	
Floristic description	<p>The canopy was sparsely populated with <i>Eucalyptus tereticornis</i> and <i>Corymbia gummifera</i>. The midstorey was densely dominated by <i>Glochidion ferdinandi</i>, <i>Acacia longifolia</i> subsp. <i>longifolia</i> and <i>Alphitonia excelsa</i>. <i>Allocasuarina torulosa</i> and <i>Allocasuarina littoralis</i> were other common midstorey species.</p> <p>The shrub layer was dominated by <i>Breynia oblongifolia</i>, <i>Polyscias sambucifolia</i>, <i>Monotoca elliptica</i> and <i>Cassinia quinquefaria</i>.</p> <p>Common ground layer species included <i>Oplismenus aemulus</i>, <i>Dianella caerulea</i> var. <i>producta</i> and <i>Imperata cylindrica</i>.</p> <p>The dominant high threat weed species were <i>Eragrostis curvula</i>, <i>Lantana camara</i> and <i>Bidens pilosa</i>.</p>
Condition within Development Site	<p>This zone represents areas which have been cleared in the past and may undergo periodic clearing for management of services. The zone contains cleared areas and areas with a mix of exotic species and native species.</p>
Justification for PCT selection	<p>PCT 1646 is described as Open Forests to Woodlands dominated by Angophoras with a sparse mid-stratum characterised by Banksias and a range of low shrubs. The ground cover is relatively sparse and is characterised by grasses and ferns. This community extends along the coast from Gosford to Black Head (Darawank Nature Reserve). It is confined to Quaternary dune sands at elevations up to 100 m.</p> <p>Due to the condition of this zone, the only common canopy species within the plot was <i>Corymbia gummifera</i>. Two dominant ground layer species were present: <i>Imperata cylindrica</i> and <i>Dianella caerulea</i>. It is likely that the disturbance that this zone has undergone has contributed to the degradation of this PCT.</p> <p>The PCT was assigned to this zone due to this area's proximity to the Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast – (Red Gum Variant and Mesic Variant) vegetation within study area. This adjoining zone contains the characteristic species and structure which is typical of PCT 1646.</p> <p>All other Coastal Dune Dry Sclerophyll Forests in the Karuah Manning and Hunter IBRA subregions were considered in undertaking the above determination. However, all other PCTs were ruled out based on floristics, geographic distribution or position in the landscape.</p>
Status	<p>BC Act: Not Listed.</p> <p>EPBC Act: Not Listed.</p>
% Cleared	45%

Vegetation Zone 6



Plate 6: PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation)

Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation)	
PCT ID	1646
Condition Class	Rehabilitation
Area within Development Site	0.13 ha
Vegetation formation/ Class	Dry Sclerophyll Forests (Shrubby sub-formation)/ Coastal Dune Dry Sclerophyll Forests
Survey Effort	Required: 1 plot/transect.
	Conducted: 1 plot/transect.
Floristic description	<p>The canopy was dominated by <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> and <i>Eucalyptus pilularis</i> with occasional <i>Angophora costata</i> and <i>Eucalyptus signata</i>.</p> <p>The midstorey was dominated by <i>Allocasuarina littoralis</i> and the shrub layer was dominated by <i>Dillwynia retorta</i>, <i>Acacia suaveolens</i> and <i>Polyscias sambucifolia</i>.</p> <p>Common climbers included <i>Pandorea pandorana</i> and <i>Parsonsia straminea</i>.</p> <p>The dominant ground layer species were <i>Pteridium esculentum</i>, <i>Lomandra glauca</i>, <i>Imperata cylindrica</i>, <i>Cynodon dactylon</i>, <i>Pomax umbellata</i>, <i>Actinotus helianthi</i> and <i>Centella asiatica</i>.</p>
Condition within Development Site	This zone represents areas which have historically been cleared for sand mining. This vegetation zone forms part of a large area of rehabilitation extending to the south. No exotic species were recorded in this zone.
Justification for PCT selection	Due to the previous rehabilitation efforts, this vegetation zone contains a number of species which are not typical of this PCT. This PCT has been selected for this vegetation zone as it is the closest equivalent and is based on the PCT identified in similarly structured vegetation within the broader study area.

Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation)	
Status	BC Act: Not Listed.
	EPBC Act: Not Listed.
% Cleared	45%

3.2.1.3 Assessment of Patch Size

The patch size for Vegetation Zones 1, 2 and 6 was assessed as >100 ha as these zones are connected to a large intact area of native vegetation extending to the north-east, any gaps in the vegetation patch are less than 100 m. Vegetation Zones 3, 4 and 5 within the Development Site are not considered intact vegetation as the canopy, midstorey / shrub layer and/or the groundcover were lacking from these zones. As such the patch size is zero for these vegetation zones.

3.2.1.4 Vegetation Integrity Score

The current vegetation integrity score of the vegetation zones is outlined in **Table 4**.

Table 4: Current vegetation integrity score for the vegetation zone

Zone	PCT	Condition class	Area (ha)	Condition scores (Current Score)			Vegetation integrity score
				Composition	Structure	Function	
1	1590	Moderate/Good	2.39	69	61.3	53.4	60.9
2	1590	Mod_Good_EEC	1.91	73.7	91.3	46.7	68
3	1590	Low	10.83	23.9	39.9	13.9	23.7
4	1646	Managed	0.05	17.7	39.2	25	25.9
5	1646	Managed Powerline	0.23	64	29.9	25.6	36.6
6	1646	Rehabilitation	0.13	96.7	47.3	100	77.1

3.2.2 Vegetation within the Study Area

In addition to the vegetation within the Development Site, seven PCTs occur within the larger Study Area, but will not be directly impacted as a result of the Proposal (**Figure 4**). Vegetation within the Study Area that occurs outside the Development Site was surveyed during the field assessments to identify dominant species for PCT allocation and confirm vegetation community boundaries. Additionally, a portion of the Study Area (TAC Lands) was previously

surveyed by Kleinfelder for AGL and TAC (Ecobiological 2010; Kleinfelder 2013). This work was used to inform the vegetation mapping across this portion of the Study Area.

PCT 1646: Smooth-barked Apple – Blackbutt – Old Man Banksia Woodland on Coastal Sands of the Central and Lower North Coast occurs along the access tracks to the NGSF. Within the Study Area, this vegetation is dominated by *Angophora costata* and *Eucalyptus pilularis*. Other common overstorey species include *Corymbia gummifera*, *Eucalyptus piperita* and *Eucalyptus signata*. The midstorey is characterised by *Banksia serrata* along with occurrences of *B. aemula*. Common shrubs include *Monotoca elliptica*, *Lambertia formosa*, *Eriostemon australasius*, *Ricinocarpos pinifolius*, *Acacia ulicifolia*, *Persoonia levis* and *Macrozamia communis*. Some areas are heavily infested with *Lantana camara* which can form a dominant shrub layer. The ground layer is typically dominated by *Pteridium esculentum*, along with *Imperata cylindrica* and *Entolasia stricta*. Other common ground species include *Dianella caerulea* var. *assera*, *Pomax umbellata* and *Gonocarpus teucroides*.

A mesic variant of this community occurs in a central portion of the Study Area. The canopy is again dominated by *Angophora costata* and *Eucalyptus pilularis*, however the mid-storey is very different. A dense layer of mesic species including Cheese Tree (*Glochidion ferdinandi* var. *ferdinandi*) and Red Ash (*Alphitonia excelsa*) is apparent, along with Forest Oak (*Allocasuarina torulosa*) and Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*). The shrub layer is formed by a dense layer of the exotic species Lantana (*Lantana camara*).

A larger expanse of the Red Gum variant of this PCT also occurs within the Study Area. The dominant overstorey species include *Angophora costata*, *Eucalyptus pilularis* and Forest Red Gum (*E. tereticornis*), along with occurrences of Rough-barked Apple (*Angophora floribunda*) and Broad-leaved Paperbark (*Melaleuca quinquenervia*). The midstorey comprises Tree Broom Heath (*Monotoca elliptica*), Cheese Tree (*Glochidion ferdinandi* var. *ferdinandi*) and Coast Banksia (*Banksia integrifolia* subsp. *Integrifolia*). Common shrubs include Winged Broom-pea (*Jacksonia scoparia*), Coffee Bush (*Breynia oblongifolia*), Hairpin Banksia (*Banksia spinulosa* var. *collina*) and Thyme Honey-myrtle (*Melaleuca thymifolia*). As mentioned above, some areas are heavily infested with Lantana (*Lantana camara*). The ground layer is characterised by Common Bracken (*Pteridium esculentum*), Blady Grass (*Imperata cylindrica*), Wiry Panic (*Entolasia stricta*), *Oplismenus imbecillis*, Native Wandering Jew (*Commelina cyanea*); and in wetter areas Plume Rush (*Baloskion tetraphyllum* subsp. *meiostachyum*) and Tall Saw-sedge (*Gahnia clarkei*) are common.

PCT 1071: *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin, occurs in the central section of the Study Area. This community is typically dominated by *Baumea articulata*, *Typha orientalis*, and *Phragmites australis*. Other common species include *Philydrum lanuginosum*, *Villarsia exaltata*, *Eleocharis acuta*, *Cyperus polystachyos*, and *Maundia triglochinos*. *Eucalyptus robusta* can occur around the edge of this community.

PCT 1725: Swamp Mahogany – Broad-leaved Paperbark – Swamp Water Fern – Plume Rush swamp forest on the coastal lowlands of the Central Coast and Lower North Coast occurs in the central section of the Study Area. This area will also be avoided using HDD to avoid possible surface disturbance. The dominant overstorey species are *Melaleuca quinquenervia* and *Eucalyptus robusta*. Other associated overstorey species include *Eucalyptus resinifera* subsp. *resinifera* and *Eucalyptus longifolia*. The midstorey comprises *Glochidion ferdinandi* var. *ferdinandi*, *Melaleuca styphelioides*, *M. linariifolia* and *M. sieberi*. Common shrubs include *Leptospermum juniperinum*, *Banksia oblongifolia*, *Melaleuca thymifolia* and *Leptospermum polygalifolium*. Some areas are heavily infested with *Lantana camara*, which forms a dominant shrub layer. The ground layer is characterised by *Gahnia clarkei*, *Carex appressa*, *Blechnum indicum*, *Hypolepis muelleri*, *Maundia triglochinos*, *Enydra fluctuans*, *Baloskion pallens*, *Baloskion tetraphyllum* subsp. *meiostachyum* and *Schoenus brevifolius*. Common grasses include *Pseudoraphis paradoxa*, *Entolasia marginata* and *Entolasia stricta*.

PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion occurs in the southern portion of the AGL owned land. This vegetation is dominated by *Casuarina glauca* in the canopy, with some dense patches purely dominated by *Melaleuca ericifolia*. The midstorey was sparse with the exception of some dense patches of *M. ericifolia* and scattered occurrences of *M. styphelioides* and *Glochidion ferdinandi* var. *ferdinandi*. The ground layer was relatively sparse due to dense regeneration of the Swamp Oak but was dominated by *Imperata cylindrica* and *Entolasia stricta*. Some small cleared patches occur sporadically throughout this community.

PCT 1724: Broad-leaved Paperbark – Swamp Oak Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast occurs in the southern portion of the AGL owned land. This vegetation is dominated by *Melaleuca quinquenervia* in the canopy over a sparse midstorey dominated by *Glochidion ferdinandi* var. *ferdinandi* and a ground layer dominated by *Parsonsia straminea*, *Carex appressa* and *Oplismenus aemulus*. Some dense patches of *Lantana camara* occur around disturbed edges.

PCT 1568: Blackbutt - turpentine – Sydney Blue Gum mesic tall open forest on ranges of the central coast occurs in the central northern section of the study site. The overstorey of this community is primarily dominated by *Eucalyptus grandis*. Other overstorey species including *Eucalyptus pilularis* and *Eucalyptus tereticornis* also occur in low abundance on the edges of this community. The midstorey of this community is primarily dominated by *Glochidion ferdinandi* var. *ferdinandi* and *Melaleuca quinquenervia*. The shrub layer is generally absent with scattered occurrences of *Breynia oblongifolia*. The ground layer is dominated by a mix of ferns, grasses, vines and forbs including *Pteridium esculentum*, *Hypolepis muelleri*, *Entolasia marginata*, *Oplismenus aemulus*, *Stephania japonica* var. *discolor*, *Parsonsia straminea* and *Commelina cyanea*.

4. THREATENED SPECIES

4.1 ASSESSING HABITAT SUITABILITY

To inform the assessment of suitable habitat for threatened species and populations within the Study Area, a database search of the NSW Office of Environment and Heritage (OEH) BioNet Atlas and the Department of Environment and Energy (DoTEE) Protected Matters Search Tool (PMST) were conducted. Results are provided in **Appendix 2**.

4.1.1 Habitat Assessment

4.1.1.1 Flora

Vegetation Zone 1 represents areas which have all strata present, contains localised patches of exotic species and is lacking the signature dominant canopy and midstorey species to meet the criteria for the Lower Hunter Spotted Gum – Ironbark EEC.

Vegetation Zones 3, 4 and 5 within the Development Site are not considered intact vegetation, as the canopy and midstorey / shrub layer were sparse due to clearing practices (powerline easements, regular mowing/slashing). As such, there is marginal habitat present within these zones, and the non-native areas of the Development Site for threatened shrub and tree species. However, it was considered that threatened orchid and other groundcover species could occur within these zones, and surveys were conducted accordingly.

Vegetation Zone 2 represents areas which have all strata present. This zone contains minimal exotic species and contains signature canopy species and mid-strata species which meet the criteria of the Lower Hunter Spotted Gum – Ironbark Forest EEC listed under the BC Act.

Zone 6 represents areas which have been cleared in the past (history of previous sand mining) or disturbed in the construction of the road and have been allowed to regenerate to a condition where all strata are intact and typical of the adjoining vegetation. No exotic species were recorded in this zone.

4.1.1.2 Fauna

Habitat Assessments

The proposed Development Site contains low to moderate value fauna habitat (predominantly cleared with few hollow-bearing trees) and is occupied by a variety of commonly occurring amphibian, reptile, bird and mammal species. Targeted fauna surveys in accordance with the NSW BAM (OEH, 2017) methodology were undertaken between August 2018 and January 2019. Survey methods across the whole Study Area included: small mammal trapping, spotlighting, bat echolocation recording, remote cameras and bird surveys.

The terms low to moderate have been used because of the already disturbed and partially developed nature of the Study Area, surrounded by major roads, commercial and industrial development, and indirect impacts from these land uses (light, noise, vibration). The Development Site area does not contain many of the habitat features required for native fauna species to breed such as an abundance of food resources, hollow-bearing trees, shrub/ground cover layer, leaf litter, logs and rocks. One ephemeral drainage line and ephemeral pond exist within the Study Area and have the potential to provide habitat for commonly occurring amphibian and waterbird species; however, the density of emergent vegetation (mainly *Typha orientalis* and *Eleocharis acuta*) limits the potential for bodies of open water to form after rainfall.

The canopy trees present within the Development Site which are predominantly *Angophora costata*, *Eucalyptus pilularis*, *Corymbia maculata*, *E. paniculata* subsp. *paniculata*, *E. tereticornis* and *E. robusta* have the potential to provide marginal foraging habitat for a range of bird species, the Grey-headed Flying-fox, microchiropteran bat species, Koalas, and other arboreal and ground dwelling mammals. It is unlikely that these small patches of vegetation would be utilised as breeding habitat for any threatened fauna species.

Habitat Tree Survey

A survey of trees within the Study Area was undertaken to locate hollow-bearing trees, dead standing stags and trees containing nests. Within the Development Site this survey was undertaken on 28, 29 and 30 August 2018 and during October 2018. These surveys specifically targeted large hollows (>20 cm) which would indicate the presence of potential Large Forest Owl breeding habitat, and any trees containing large stick nests. Small (<5 cm) to medium (5-20 cm) sized hollows were recorded incidentally if observed during the habitat tree survey. The

location of Habitat Trees and the type of feature it contained was recorded using a handheld GPS.

Four hollow-bearing trees occur with the Development Site; one hollow-bearing tree and one dead snag occur along the perimeter of the electrical transmission corridor; and two hollow-bearing trees and one dead snag occur along the perimeter of the Development Site (**Figure 5**).

No trees containing nests were identified within the Development Site. A large stick nest was recorded in a large Blackbutt (*E. pilularis*) tree near the eastern end of the northern access road to the NGSF. The nest occupant was confirmed to be a Wedge-tailed Eagle (*Aquila audax*).

Koala Habitat

Historical records of the Koala (*Phascolarctos cinereus*) occur on and within 1 km of the Study Area (NSW BioNet Atlas search). Therefore, the species was assumed to be present and targeted surveys were not undertaken. Rather, an assessment of Koala habitat was undertaken in accordance with the Port Stephens CKPoM. **Table 5** lists the CKPoM Koala feed trees with their occurrence in the Development Site noted.

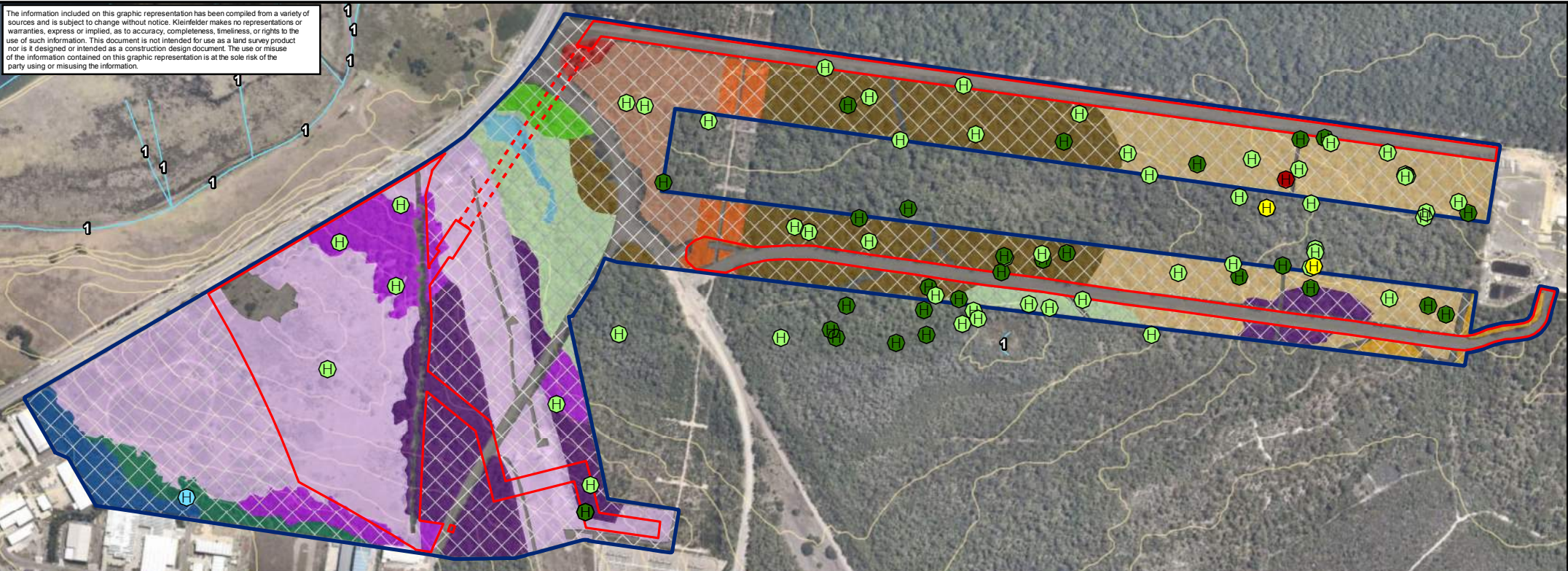
Table 5: Port Stephens CKPoM listed feed tree species in the Development Site

Scientific Name	Common Name	Detected in Development Site	Preferentially Utilised Species
<i>Angophora costata</i>	Smooth-barked Apple	✓	
<i>Casuarina glauca</i>	Swamp Oak		
<i>Eucalyptus acmenoides</i>	White Mahogany		
<i>Eucalyptus capitellata</i>	Brown Stringybark		
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark		
<i>Eucalyptus grandis</i>	Flooded Gum		
<i>Eucalyptus gummifera</i>	Red Bloodwood	✓	
<i>Eucalyptus haemastoma</i>	Broad-leaved Scribbly Gum		
<i>Eucalyptus maculata</i>	Spotted Gum	✓	
<i>Eucalyptus microcorys</i>	Tallowwood		
<i>Eucalyptus nicholii</i>	Small-leaved Peppermint		
<i>Eucalyptus paniculata</i> subsp. <i>paniculata</i>	Grey Ironbark	✓	
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	Earp's Gum	✓	✓
<i>Eucalyptus pilularis</i>	Blackbutt	✓	

Scientific Name	Common Name	Detected in Development Site	Preferentially Utilised Species
<i>Eucalyptus piperita</i>	Sydney Peppermint	✓	
<i>Eucalyptus punctata</i>	Grey Gum		
<i>Eucalyptus resinifera</i>	Red Mahogany	✓	
<i>Eucalyptus robusta</i>	Swamp Mahogany	✓	✓
<i>Eucalyptus saligna</i>	Sydney Blue Gum		
<i>Eucalyptus signata</i>	Scribbly Gum	✓	
<i>Eucalyptus tereticornis</i>	Forest Red Gum	✓	✓
<i>Eucalyptus umbra</i>	Bastard Box	✓	
<i>Melaleuca quinquinerva</i>	Broad-leaved Paperbark	✓	

Thirteen of the species listed above have been recorded from the Development Site. The identification of “Preferred” and “Supplementary” habitat has been assigned to the Study Area using the precise definitions used in Lunney *et al.* (1998). The revised CKPoM mapping and assessment in accordance with the performance criteria is provided in **Section 7.2**.

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Plant Community Type and Vegetation Zone within the Development Site

- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good) - **Zone 1**
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC) - **Zone 2**
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low) - **Zone 3**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed) - **Zone 4**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline) - **Zone 5**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation) - **Zone 6**
- Cleared

Plant Community Type outside Development Site

- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good)
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC)
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed)

- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate_Good)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Mesic variant)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Red Gum variant)
- 1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (Moderate_Good)
- 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Moderate_Good)
- 1568: Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Moderate_Good)
- 1724: Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
- 1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
- Cleared

Legend

- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)
- Contours (2m)
- Watercourse (Labelled with stream order)
- Potential Owl Roost Tree
- Stick nest
- Hollow-bearing Tree
- Dam
- Dead Stag

Metres

0 50 100 200 300 400 500

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PROJECT REFERENCE: 20191297

DATE DRAWN: 1/05/2019 09:44 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2018
Nearmap - 2019

Habitat Features

Aurecon
Biodiversity Development Assessment Report
AGL Newcastle Power Station Project
Tomago NSW

FIGURE:
5

4.1.2 Ecosystem Credit Species

The following assessment of habitat suitability for ecosystem credit species was conducted in accordance with Section 6.2 of the BAM. Ecosystem credits represent threatened species that can be predicted to be present by the type and condition of vegetation at the Development Site. Targeted survey is not required for ecosystem credit species.

Step 1: Identify threatened species for assessment

A list of predicted ecosystem credit species for the Development Site was reviewed in the BAM calculator, according to PCT's present on the subject land.

Step 2: Assessment of the habitat constraints and vagrant species on the subject land

The potential for identified ecosystem credit species to occur on the Development Site was assessed according to species specific habitat requirements, as detailed in **Table 6**.

Where woodland habitat features were not present due to the degraded condition of the site vegetation, ecosystem credit species were determined to not be predicted species and no further assessment was required within these vegetation zones.

Table 6: Assessment of ecosystem credit species within the Development Site.

Scientific name	Common name	Confirmed Predicted Species	Justification
<i>Anthochaera phrygia</i>	Regent Honeyeater	No	Development Site not within mapped Important Habitat
<i>Callocephalon fimbriatum</i> (Foraging)	Gang-gang Cockatoo	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Calyptorhynchus lathami</i> (Foraging)	Glossy Black-Cockatoo	Yes	Glossy-black (Foraging habitat) ruled out from Zone 4 (1648 Managed) as no <i>Allocasuarina</i> species present.
<i>Chthonicola sagittata</i>	Speckled Warbler	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (Eastern sub-species)	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.

Scientific name	Common name	Confirmed Predicted Species	Justification
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat, hollow fallen logs.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Yes	-
<i>Glossopsitta pusilla</i>	Little Lorikeet	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Yes	-
<i>Hieraaetus morphnoides</i>	Little Eagle	Yes	-
<i>Lathamus discolor</i> (Foraging)	Swift Parrot	No	Development Site not within mapped Important Habitat
<i>Lophoictinia isura</i>	Square-tailed Kite	Yes	-
<i>Melanodryas cucullate cucullate</i>	Hooded Robin (south-eastern form)	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Miniopterus australis</i> (Foraging)	Little Bentwing-bat	Yes	-
<i>Miniopterus schreibersii oceanensis</i> (Foraging)	Eastern Bentwing-bat	Yes	-
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	Yes	-
<i>Neophema pulchella</i>	Turquoise Parrot	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Ninox connivens</i>	Barking Owl	Yes	-
<i>Ninox strenua</i> (Foraging)	Powerful Owl	Yes	-
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	Yes	-
<i>Pandion cristatus</i> (Foraging)	Eastern Osprey	Yes	-
<i>Petaurus australis</i>	Yellow-bellied Glider	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Petroica boodang</i>	Scarlet Robin	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Phascolarctos cinereus</i>	Koala	Yes	-
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.

Scientific name	Common name	Confirmed Predicted Species	Justification
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Yes	-
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	Yes	-
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	Yes	-
<i>Stagonopleura guttata</i>	Diamond Firetail	Yes	Presence ruled out from Zone 3 (1590 Low) and Zone 5 (1648 Managed Powerline) as no trees/woodland habitat.
<i>Tyto novaehollandiae</i> (Foraging)	Masked Owl	Yes	-

4.1.3 Species Credit Species

Step 1: Identify threatened species for assessment

A list of predicted species credit species for the Development Site was reviewed in the BAM calculator. Species credits pertain to threatened species that cannot be predicted by the vegetation present.

Step 2: Assessment of the habitat constraints and vagrant species on the subject land & Step 3: Identify candidate species credit species for further assessment

The potential for identified species credit species to occur on the Development Site was assessed according to species specific habitat requirements, as detailed in **Table 6**. A range of Alternative Sites Options were initially surveyed during the options assessment phase of the Proposal (**Figure 3**). As a result, flora and fauna surveys have been conducted over a broader Study Area in order to assess indirect impacts and allow for any project infrastructure design changes. Kleinfelder worked with AGL to select areas that would minimise biodiversity impact and to locate the electrical transmission easement and gas pipeline route options in areas that were already cleared or that contained lower quality native vegetation. This meant that Kleinfelder also undertook targeted threatened flora and fauna surveys in several other PCTs as previously outlined in **Section 3.2.2** which ruled in several additional candidate species.

Where woodland habitat features were not present due to the degraded condition of the site vegetation, species credit species were determined to not be candidate species and no further assessment was required (**Table 7**).

Table 7: Species credit species and justification for inclusion as candidate species.

Scientific name	Common name	Confirmed Candidate Species	Justification
Flora			
<i>Angophora inopina</i>	Charmhaven Apple	Yes	-
<i>Asperula asthenes</i>	Trailing Woodruff	Yes	-
<i>Callistemon linearifolius</i>	Netted Bottle Brush	Yes	-
<i>Commersonia prostrata</i>	Dwarf Kerrawang	Yes	-
<i>Corybas dowlingii</i>	Red Helmet Orchid	Yes	-
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	Yes	-
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Yes	-
<i>Dendrobium melaleucaphilum</i>	Spider Orchid	Yes	Not triggered by final design (as no direct impact on Swamp Oak Forest)
<i>Diuris arenaria</i>	Sand Doubletail	Yes	-
<i>Diuris flavescens</i>	Pale Yellow Doubletail	Yes	-
<i>Diuris praecox</i>	Rough Doubletail	Yes	-
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	Yes	-
<i>Eucalyptus glaucina</i>	Slaty Red Gum	Yes	-
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	Earp's Gum	Yes	-
<i>Grevillea guthrieana</i>	Guthrie's Grevillea	Yes	-
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	Yes	-
<i>Hakea archaeoides</i>	Big Nellie Hakea	Yes	-
<i>Lindernia alsinoides</i>	Noah's False Chickweed	Yes	-
<i>Maundia triglochoides</i>	-	Yes	-
<i>Melaleuca groveana</i>	Grove's Paperbark	Yes	-
<i>Ozothamnus tessellatus</i>	-	No	There are no records of the species east of Singleton, therefore ruled out based on distribution.
<i>Persicaria elatior</i>	Tall Knotweed	Yes	-
<i>Persoonia pauciflora</i>	North Rothbury Persoonia	No	Extremely restricted distribution; all but one of the plants which make up the only known population occur within a 2.5 km radius of the original specimen at North Rothbury in the Cessnock local government area.
<i>Pomaderris queenslandica</i>	Scant Pomaderris	Yes	-
<i>Prostanthera densa</i>	Villous Mint-bush	Yes	-

Scientific name	Common name	Confirmed Candidate Species	Justification
<i>Prostanthera cineolifera</i>	Singleton Mint Bush	Yes	-
<i>Pterostylis chaetophora</i>	-	Yes	-
<i>Rhizanthella slateri</i>	Eastern Australian Underground Orchid	Yes	-
<i>Rutidosia heterogama</i>	Heath Wrinklewort	Yes	-
<i>Tetradlea juncea</i>	Black-eyed Susan	Yes	-
<i>Thesium australe</i>	Austral Toadflax	Yes	-
Amphibians			
<i>Crinia tinnula</i>	Wallum Froglet	Yes	-
<i>Litoria aurea</i>	Green and Golden Bell Frog	Yes	-
<i>Litoria brevipalmata</i>	Green-thighed Frog	Yes	-
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	No	Confined to areas 100-950 m above sea level
<i>Mixophyes balbus</i>	Stuttering Frog	No	Absence of stream habitats
<i>Mixophyes iteratus</i>	Giant Barred Frog	No	Absence of stream habitats
<i>Uperoleia mahonyi</i>	Mahony's Toadlet	Yes	-
Birds			
<i>Anthochaera phrygia</i>	Regent Honeyeater	No	Habitat Constraint Absent - Study Area not within mapped area (Site not within known breeding range)
<i>Burhinus grallarius</i>	Bush Stone-curlew	Yes	-
<i>Callocephalon fimbriatum</i> (Breeding)	Gang-gang Cockatoo	Yes	-
<i>Calyptorhynchus lathami</i> (Breeding)	Glossy Black-Cockatoo	Yes	-
<i>Dromaius novaehollandiae</i> – endangered population	Emu population in the New South Wales North Coast Bioregion and Port Stephens Council LGA	Yes	-
<i>Haliaeetus leucogaster</i> (Breeding)	White-bellied Sea-Eagle	Yes	-
<i>Hieraaetus morphnoides</i> (Breeding)	Little Eagle	Yes	-
<i>Lathamus discolor</i> (Breeding)	Swift Parrot	No	Habitat Constraint Absent - Study Area not within mapped area (Site not within known breeding range)
<i>Lophoictinia isura</i> (Breeding)	Square-tailed Kite	Yes	-
<i>Ninox connivens</i>	Barking Owl	Yes	-

Scientific name	Common name	Confirmed Candidate Species	Justification
<i>Ninox strenua</i> (Breeding)	Powerful Owl	Yes	-
<i>Pandion cristatus</i> (Breeding)	Eastern Osprey	Yes	-
<i>Turnix maculosus</i>	Red-backed Button-quail	Yes	-
<i>Tyto novaehollandiae</i> (Breeding)	Masked Owl	Yes	-
Mammals			
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	Yes	-
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	No	Habitat Constraint Absent – Study Area not within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices, or within 2 km of old mines or tunnels
<i>Miniopterus australis</i>	Little Bentwing-bat	No	Habitat Constraint Absent – Study Area does not contain caves, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	No	Habitat Constraint Absent – Study Area does not contain caves, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet.
<i>Myotis macropus</i>	Southern Myotis	Yes	-
<i>Petaurus norfolcensis</i>	Squirrel Glider	Yes	-
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	No	Habitat Constraint Absent – Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Yes	-
<i>Phascolarctos cinereus</i>	Koala	Yes	-
<i>Planigale maculata</i>	Common Planigale	Yes	-
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Yes	-
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	No	Habitat Constraint Absent – Caves; within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder

Scientific name	Common name	Confirmed Candidate Species	Justification
			piles, or within two kilometres of old mines, tunnels, old buildings or sheds.
Reptiles			
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	No	Habitat degraded – degraded habitat due to fragmentation and lack of hollows within the Development Site
Invertebrates			
<i>Petalura gigantea</i>	Giant Dragonfly	Yes	-

4.2 THREATENED SPECIES SURVEYS

Step 4: Determine presence or absence of candidate species credit species

4.2.2 Candidate Threatened Flora

The following candidate threatened flora species (**Table 8**) were surveyed in accordance with the NSW Guide to Surveying Threatened Plants (OEH 2016). As discussed above, flora surveys were conducted over a broader Study Area in order to assess indirect impacts and allow for design changes regarding the location of the project infrastructure.

Table 8: Survey of requirements and timing conducted for candidate flora species

Scientific name	Common name	Survey Requirements	Survey Timing
<i>Angophora inopina</i>	Charmhaven Apple	All year	22 January – 1 February 2019
<i>Asperula asthenes</i>	Trailing Woodruff	October to March	30 – 31 January 2019
<i>Callistemon linearifolius</i>	Netted Bottle Brush	September to March	22 January – 1 February 2019
<i>Commersonia prostrata</i>	Dwarf Kerrawang	All year	30 – 31 January 2019
<i>Corybas dowlingii</i>	Red Helmet Orchid	June to August	14 – 24 August 2018
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	November to January	29 November – 7 December 2018
<i>Cynanchum elegans</i>	White-flowered Wax Plant	All year	22 January – 1 February 2019
<i>Dendrobium melaleucaphilum</i>	Spider Orchid	August to September	14 – 28 September 2018
<i>Diuris arenaria</i>	Sand Doubletail	August to September	14 – 28 September 2018

Scientific name	Common name	Survey Requirements	Survey Timing
<i>Diuris flavescens</i>	Pale Yellow Doubletail	September to October	14 – 28 September 2018
<i>Diuris praecox</i>	Rough Doubletail	July to September	14 – 24 August 2018
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	All year	22 January – 1 February 2019
<i>Eucalyptus glaucina</i>	Slaty Red Gum	All year	22 January – 1 February 2019
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	Earp's Gum	All year	22 January – 1 February 2019
<i>Grevillea guthrieana</i>	Guthrie's Grevillea	All year	30 October – 2 November 2018 29 November – 7 December 2018
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	All year	30 October – 2 November 2018 29 November – 7 December 2018
<i>Hakea archaeoides</i>	Big Nellie Hakea	All year	30 October – 2 November 2018
<i>Lindernia alsinoides</i>	Noah's False Chickweed	November to February	30 – 31 January 2019
<i>Maundia triglochinoides</i>	-	November to March	30 – 31 January 2019
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	All year	30 – 31 January 2019
<i>Melaleuca groveana</i>	Grove's Paperbark	All year	22 January – 1 February 2019
<i>Persicaria elatior</i>	Tall Knotweed	December to May	30 – 31 January 2019
<i>Pomaderris queenslandica</i>	Scant Pomaderris	All year	29 November – 7 December 2018
<i>Prostanthera densa</i>	Villous Mint-bush	All year	29 November – 7 December 2018
<i>Prostanthera cineolifera</i>	Singleton Mint Bush	All year	29 November – 7 December 2018
<i>Pterostylis chaetophora</i>	-	September to November	30 October – 2 November 2018
<i>Rhizanthella slateri</i>	Eastern Australian Underground Orchid	September to November	30 October – 2 November 2018 29 November – 7 December 2018
<i>Rutidosis heterogama</i>	Heath Wrinklewort	All year	14 – 24 August 2018
<i>Tetradlea juncea</i>	Black-eyed Susan	July to December	30 October – 2 November 2018 29 November – 7 December 2018

Scientific name	Common name	Survey Requirements	Survey Timing
<i>Thesium australe</i>	Austral Toadflax	November to February	29 November – 7 December 2018

4.2.2.1 Surveys outside the specified months

Surveys for *Callistemon linearifolius* (Netted Bottle Brush) were conducted primarily within the survey month for this species (October to January), with the majority of surveys conducted prior to 31 January. However, some surveys were conducted on 1 February 2019. Surveys outside the specified month occurred as the BAM survey requirements were updated between the time of survey and submission of the BDAR. These surveys are still considered to be suitable as they were only one day outside the specified months, and the species is detectable all year, it is just recommended to survey between October and January to assist in identification.

Surveys for *Corybas dowlingii* (Red Helmet Orchid) in August as this species has previously been recognised to flower between June to August. However, surveys for the BDAR were conducted prior to the reduction in survey period under the BAM requirements. The site contains only a small amount of marginal habitat for the species, and would have been detectable at the time of survey (but past peak flowering).

Surveys for *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) were conducted primarily within the survey month for this species (August to November), with the majority of surveys conducted in October and November. However, some surveys were conducted between the 1 and 7 December 2019. Surveys outside the specified month occurred as the BAM survey requirements were updated between the time of survey and submission of the BDAR. These surveys are still considered to be suitable as they were only one week outside the specified months, and the species is detectable all year, it is just recommended to survey between August to November to assist in identification.

Some surveys for *Tetradlea juncea* (Black-eyed Susan) were conducted outside the specified months of survey (September to October). Surveys outside the specified month occurred as the BAM survey requirements were updated between the time of survey and submission of the BDAR. The site contains only marginal habitat for the species, and the species would have been detectable at the time of survey (but past peak flowering).

4.2.2.2 Survey Methodology

The candidate threatened flora species were surveyed in accordance with the NSW Guide to Surveying Threatened Plants (OEH 2016). All surveys were conducted using systematic parallel transects. Parallel field traverses were separated by 5 to 10 m for orchids, herbs and forbs, 10 to 15 m for sub-shrubs, and 10 to 20 m for species in all other life forms (shrubs and trees).

Surveys were undertaken across the Study Area by suitably qualified ecologists. Survey tracks for each round of targeted surveys are shown on **Figure 6 - 10**.

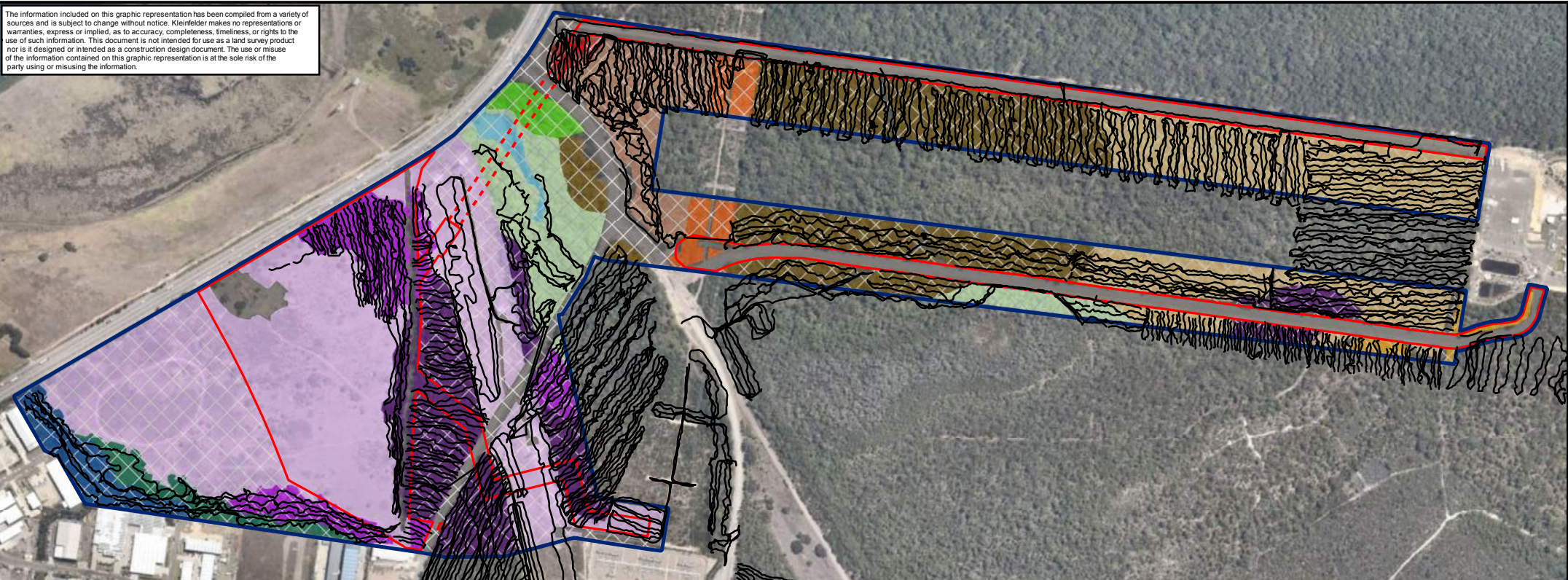
4.2.2.3 Threatened Flora Survey Results

One species credit species, *Eucalyptus parramattensis* subsp. *decadens* (Earp's Gum) was recorded within the Development Site (three individuals) (**Figure 11**). These individuals form part of a much larger population which occurs to the east and south of the NGSF within rehabilitation (post sandmining).

Two other species credit species, *Maundia triglochinooides* and *Grevillea parviflora* subsp. *parviflora* were recorded within the Study Area (**Figure 11**) but will not be directly impacted.

A list of the flora species identified within the Development Site is provided in **Appendix 1**.

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Plant Community Type and Vegetation Zone within the Development Site

- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good) - **Zone 1**
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC) - **Zone 2**
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low) - **Zone 3**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed) - **Zone 4**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline) - **Zone 5**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation) - **Zone 6**
- Cleared

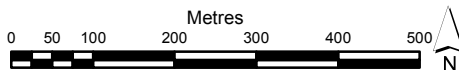
Plant Community Type outside Development Site

- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good)
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC)
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed)

- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline)
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- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Mesic variant)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Red Gum variant)
- 1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (Moderate_Good)
- 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Moderate_Good)
- 1568: Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Moderate_Good)
- 1724: Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
- 1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
- Cleared

Legend

- Targeted Threatened Flora Search Tracks (14-24 August 2018)
- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)



PROJECT REFERENCE: 20191297
 DATE DRAWN: 1/05/2019 09:45 Version 1
 DRAWN BY: GJoyce

DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2019

**Flora Survey Effort
 14-24 August 2018**

Aurecon
 Biodiversity Development Assessment Report
 AGL Newcastle Power Station Project
 Tomago NSW

FIGURE:

6

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- Cleared

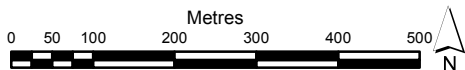
Plant Community Type outside Development Site

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- Cleared

Legend

- Targeted Threatened Flora Search Tracks (14-28 September 2018)
- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)



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 DATE DRAWN: 1/05/2019 09:46 Version 1
 DRAWN BY: GJoyce

DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2019

**Flora Survey Effort
 14-28 September 2018**

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FIGURE:

7

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Plant Community Type and Vegetation Zone within the Development Site

- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good) - **Zone 1**
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- Cleared

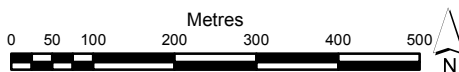
Plant Community Type outside Development Site

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- Cleared

Legend

- Targeted Threatened Flora Search Tracks (30 Oct - 2 Nov 2018)
- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)



PROJECT REFERENCE: 20191297
 DATE DRAWN: 1/05/2019 09:47 Version 1
 DRAWN BY: GJoyce

DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2019

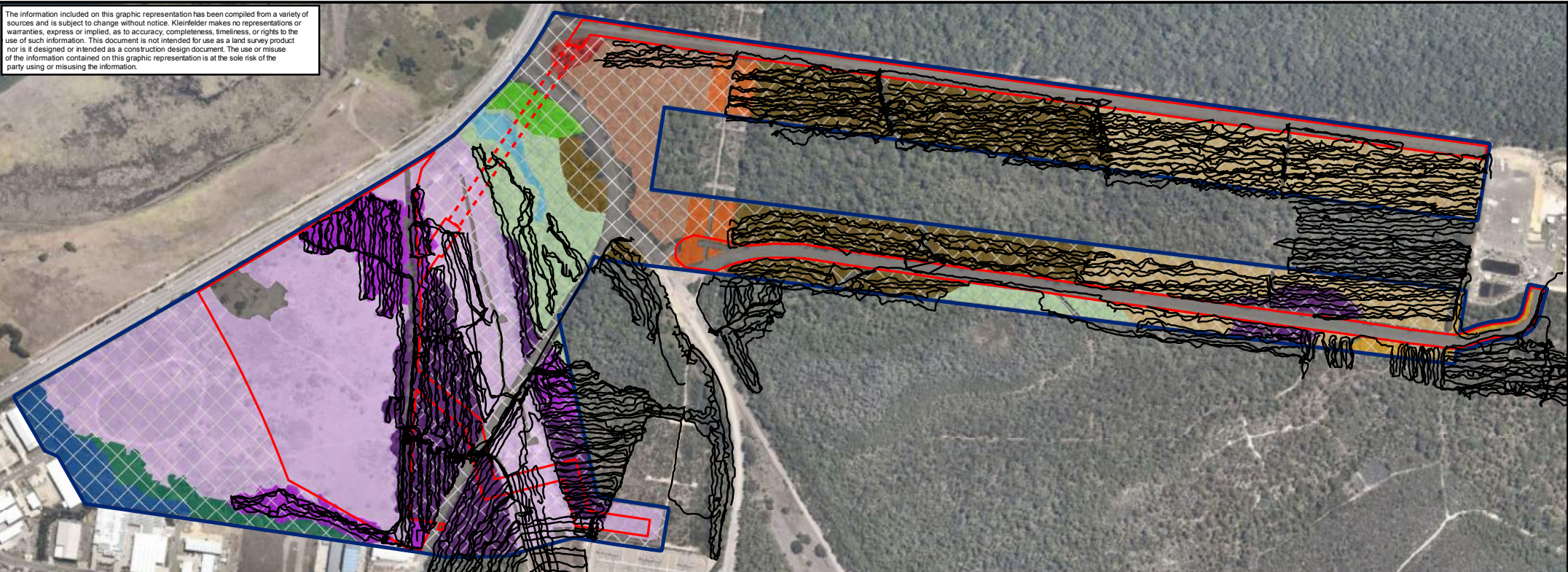
Flora Survey Effort
30 October to 2 November 2018

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FIGURE:

8

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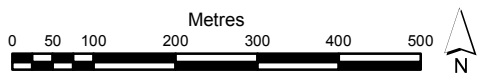
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- Cleared

Legend

- Targeted Threatened Flora Search Tracks (28 Nov to 7 Dec 2018)
- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)



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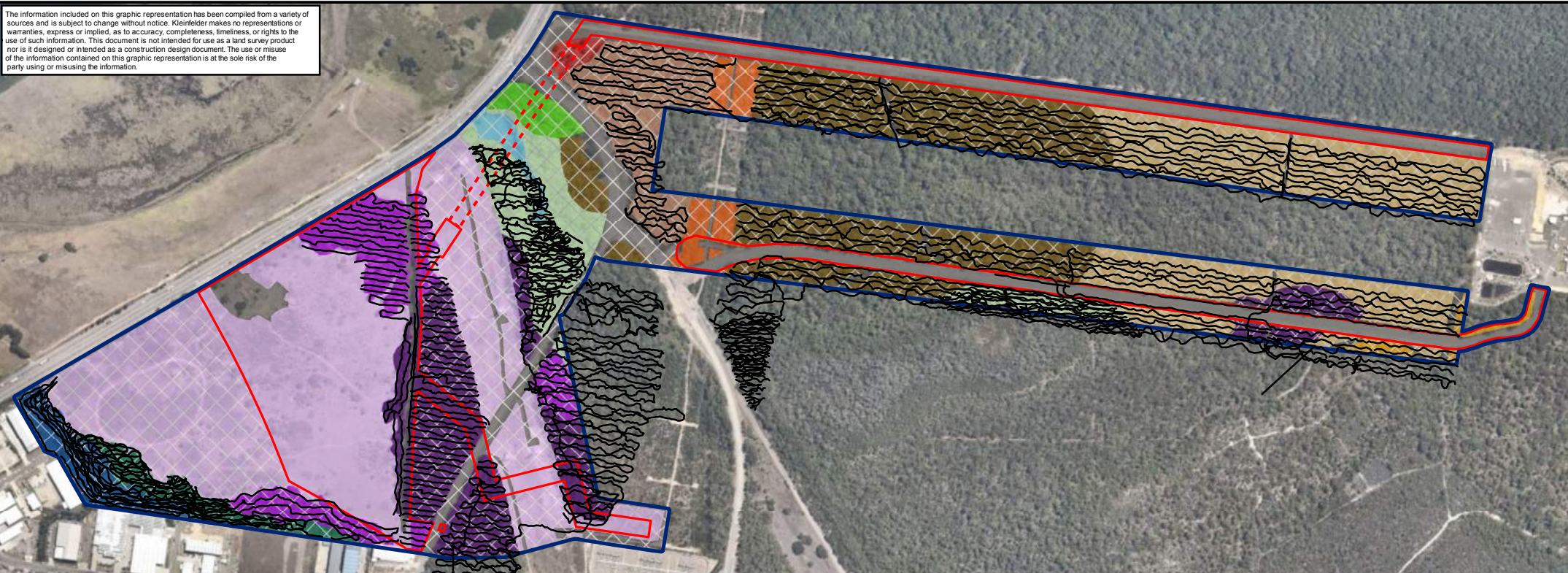
DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2019

Flora Survey Effort
28 November to 7 December 2018

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FIGURE:
9

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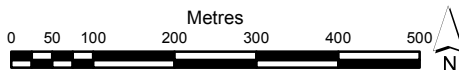
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- Cleared

Legend

- Targeted Threatened Flora Search Tracks (22 Jan to 1 Feb 2019)
- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)



PROJECT REFERENCE: 20191297
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DATA SOURCE:
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Flora Survey Effort
22 January to 1 February 2019

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FIGURE:

10

4.2.3 Candidate Threatened Fauna

The following candidate threatened fauna species were surveyed in the appropriate season, as per the BAM (**Table 9**). Surveys were undertaken across the Study Area by suitably qualified ecologists. As previously discussed, fauna surveys were conducted over a broader Study Area in order to assess indirect impacts and allow for project infrastructure design changes. Survey methodologies for each round of targeted surveys are shown on **Figure 12**.

Table 9: Survey of threatened fauna species

Scientific name	Common name	Survey Requirements	Survey Timing & Type
Amphibians			
<i>Crinia tinnula</i>	Wallum Froglet	All Year	March 2019 - Targeted waterbody surveys
<i>Litoria brevipalmata</i>	Green-thighed Frog	October to March	
<i>Uperoleia mahonyi</i>	Mahony's Toadlet	October to March	
<i>Litoria aurea</i>	Green and Golden Bell Frog	November to March	
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	July to November	November 2018 - Targeted veg community survey, call playback
<i>Mixophyes iteratus</i>	Giant Barred Frog	October to March	March 2019 - Targeted waterbody surveys
<i>Mixophyes balbus</i>	Stuttering Frog	September to March	
Birds			
<i>Haliaeetus leucogaster</i> (Breeding)	White-bellied Sea-Eagle	July to December	August and October 2018 – Nest survey
<i>Hieraaetus morphnoides</i> (Breeding)	Little Eagle	August to October	
<i>Lophoictinia isura</i> (Breeding)	Square-tailed Kite	September to January	
<i>Pandion cristatus</i> (Breeding)	Eastern Osprey	April to November	
Mammals			
<i>Myotis macropus</i>	Southern Myotis	November to March	October 2018 Anabat Survey
<i>Petaurus norfolcensis</i>	Squirrel Glider	All Year	October 2018 – Remote cameras, spotlighting
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	All Year	
<i>Phascolarctos cinereus</i>	Koala	All Year	Habitat assessment, vegetation mapping (assumed present)
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	October to December	October 2018 Searches for camps

4.2.3.1 Survey Methodology

The following sub-sections outline the methods for all fauna surveys conducted across the Study Area. A summary of the Fauna Survey Effort and Comparison Against the *Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft)* (DEC 2004) and *Flora and Fauna Survey Guidelines Version 4.2.* (LMCC 2012) is provided in **Appendix 3.**

Arboreal Mammals

Targeted surveys for the candidate threatened species (Squirrel Glider, Eastern Pygmy-possum and Brush-tailed Phascogale) were undertaken through installation of 16 Reconyx Hyperfire™ remote trigger cameras placed at heights of 3 m (8 cameras) and 1 m (8 cameras) (**Figure 12**). Cameras installed were active onsite for 25 nights during January and February 2019. Cameras were baited with an oats, peanut butter, treacle, vanilla essence and truffle oil mixture in a mesh canister, and the surrounding area (tree trunk) was sprayed with honey water. Images were analysed in-house to identify species captured on camera.

Spotlighting surveys were conducted on 11, 12 and 13 February 2019 using high-powered torches to search for all types of nocturnal fauna (**Figure 12**).

Koala

The CPKoM Guidelines for Koala Habitat Assessments were used to determine the impact that the Proposal will have on potential koala habitat and/or populations. The Koala Habitat Assessment is undertaken in four major parts:

- 1) **Preliminary Assessment** – refer to the Koala Habitat Planning Map of the Port Stephens LGA to determine mapped Koala Habitat and undertake an inspection of the site to determine whether it contains individuals of preferred Koala feed trees (**Table 10**) outside areas mapped as Preferred Koala Habitat.

Table 10: List of preferred Koala feed trees in the Port Stephens LGA

Scientific Name	Common Name
<i>Eucalyptus robusta</i>	Swamp Mahogany
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Eucalyptus parramattensis</i>	Earp's Gum

- 2) **Vegetation Mapping** – Vegetation mapping of the Study Area using aerial photography and detailed ground-truthing. Floristic and structural characteristics of each vegetation community was determined using both transect and quadrat-based survey methods.
- 3) **Koala Habitat Identification** – If the LGA-wide vegetation map produced by Port Stephens Council is inaccurate for the Study Area, a revised Koala Habitat Planning Map in accordance with the vegetation community definitions of the CKPoM must be produced. If it is identified that the Study Area contains either preferred or supplementary Koala habitat, Habitat Buffers or Habitat linking areas then proceed to Step 4.
- 4) **Assessment of Proposal** – At this point, a map needs to be produced showing information gathered in Steps 1, 2 and 3 and showing the proposed development. The appropriateness of the proposal is assessed using performance criteria from Appendix 4 of the CKPoM.

This assessment has been undertaken in **Section 7.2**.

Terrestrial Mammals

Twenty-five (25) Elliott A traps were placed on the ground, along four transects (100 traps in total) for a period of four days in January 2019 (**Figure 12**). Traps were baited with a mixture of rolled oats, honey, peanut butter and treacle. Traps were checked daily for terrestrial species for four nights.

In addition to nocturnal spotlighting, opportunistic daytime observations of the signs of recent terrestrial mammal activity such as diggings, droppings or scratch marks were noted.

Microchiropteran Bats

Anabat™ bat-call detectors were used passively to record the calls of passing Microchiropteran bats. Five Anabats™ were set up in five different locations at dusk and recording occurred for two nights at each location (**Figure 12**). Nocturnal searches of blossoming trees were also undertaken during spotlighting to detect Megachiropteran bats.

Birds

Visual and auditory bird surveys were conducted throughout the Study Area between 14 – 31 August 2018 (eight mornings). Surveys were conducted between 6 am – 11 am to increase detection of birds in the cooler parts of the day (when activity peaks) (Bibby *et al.* 2000). Species were identified visually with the aid of binoculars or aurally from call identification. The route of the bird census track is illustrated in **Figure 12**. Waterbird surveys were also

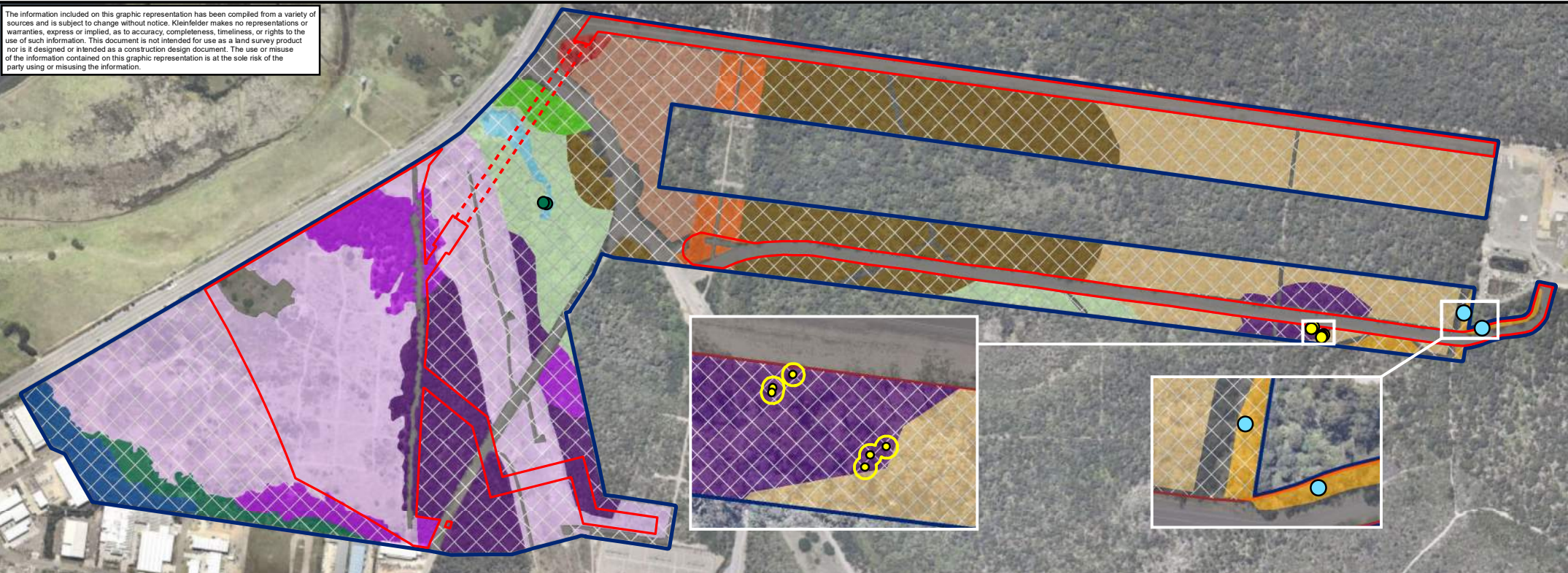
conducted at one waterbody within the Development Site (coastal freshwater wetland) on the mornings of 14 and 15 February 2019 for 30 minutes per survey.

Fauna call playback was conducted where the calls of large forest owls were broadcasted through a megaphone to attract individuals or to incite a response; therefore, allowing identification. Recorded calls of threatened species were played through a megaphone after dusk on the nights between the 20–23 and 28–31 August 2018 (totalling 8 nights) at two separate locations. After an initial listening period of 15 minutes, recorded calls of threatened species were broadcast for 5 minutes each, followed by 1-2 minutes of stationary spotlighting. Directly after the final broadcast, a quiet listening period of 5 minutes was conducted followed by the spotlighting survey.

Amphibians

Amphibian surveys were carried out at four areas within the Development Site over three nights (12, 14, 20 March 2019) (**Figure 12**). Nocturnal surveys involved quiet listening periods where species were identified through aural detection of species-specific calls. Emergent vegetation visual detection of animals with a spotlight or head torch. Adult frogs encountered were identified by visual confirmation or by their distinct advertisement calls. Tadpoles were identified using diagnostic features including mouthparts (tooth rows, jaw sheaths and papillae), pigmentation, body size, tail structure (musculature, fin depth, fin shape, tip shape), eye direction and spacing, pupil pigmentation, nare shape and spacing, spiracle height and direction, vent length and direction, and tadpole behaviour according to Anstis (2002).

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- Cleared

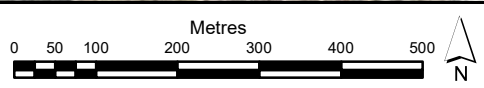
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- Cleared

Legend

- Maundia triglochinooides* Location (13 plants within Study Area (not impacted))
- Grevillea parviflora* Location (14 plants within Study Area (not impacted))
- Grevillea parviflora* Species Polygon (61m²)
- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)
- Eucalyptus parramattensis* subsp. *decadens* Location (3 plants within Development Site (impacted); 1 plant outside Development Site (not impacted))



PROJECT REFERENCE: 20191297
 DATE DRAWN: 29/10/2019 12:34 Version 1
 DRAWN BY: GJoyce
 DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2019

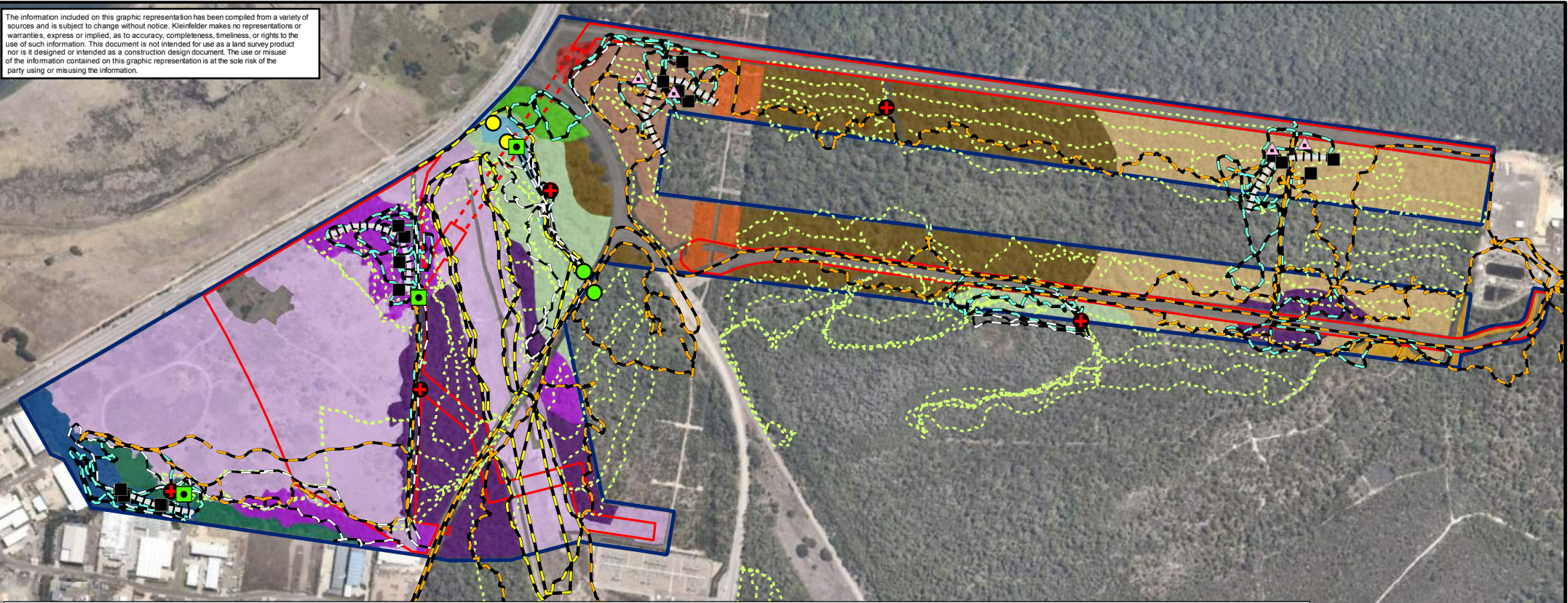
Threatened Flora Habitat

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FIGURE:

11

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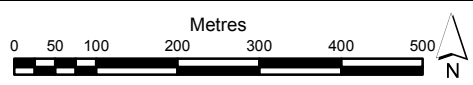


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- ▲ Pygmy Possum Nestbox
- Remote Camera
- ⊕ Anabat
- Call Playback (Frog)
- Frog Search
- Threatened Bird Census
- Habitat Feature Search
- |||| Trapping Transect
- Bird Census
- Threatened Bird Census
- Nocturnal Herp Search
- Spotlight Search

- Study Area
- Development Site
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FIGURE:

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4.2.3.2 Fauna Species Identified

A total of 45 species of fauna were detected within the Study Area during field surveys (**Appendix 1**). This includes 21 bird, 19 mammal, four amphibian and one reptile species. Five species detected within the Study Area are listed as vulnerable under the BC Act; Little Bentwing-bat (*Miniopterus australis*), Masked Owl (*Tyto novaehollandiae*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Grey-headed Flying Fox (*Pteropus poliocephalus*) and the Squirrel Glider (*Petaurus norfolkensis*). The Microchipteran bat species were detected via AnaBat™ ultrasonic recorder and subsequent call analysis. The Grey-headed Flying-fox was recorded during spotlighting surveys and the Squirrel Glider was identified from remote camera footage. The Masked Owl was recorded during call playback surveys.

The Little Bentwing-bat is a dual Species and Ecosystem Credit Species (species credit species for breeding habitat). The habitat constraint listed for this species in the Threatened Biodiversity Data Collection (habitat constraint: cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding) is not present within the Study Area (as outlined in **Section 4.1.3**). As such, this species was determined as unlikely to occur within the Development Site (for breeding habitat) and was ruled out as a candidate species.

The Masked Owl is a dual Species and Ecosystem Credit Species (species credit species for breeding habitat). The habitat constraint listed for this species in the Threatened Biodiversity Data Collection (habitat constraint: Hollow-bearing trees; Living or dead trees with hollows greater than 20 cm diameter) is present within the Development Site and wider Study Area (as outlined in **Section 4.1.3**). Targeted large forest owl surveys were conducted across the Study Area and included a thorough search of the Study Area marking the locations of all trees or dead stags containing large hollows with a GPS during August 2018 (see **Figure 5**). Recorded calls of threatened large forest owl species were also played through a megaphone after dusk on the nights between the 20–23 and 28–31 August 2018 (totalling 8 nights) at two separate locations. The Masked Owl responded to owl call playback during these surveys from two locations in the vicinity of the NGSF northern and southern access roads. A thorough search of these areas identified two trees which may represent potential breeding trees (**Figure 5**). These trees contained characteristic large hollows suitable for large forest owl breeding and several regurgitated pellets were found underneath. These pellets were analysed by an experienced Ecologist who concluded that some of the pellets were consistent with the *Tyto* genus. Other large pellets located were thought to belong to the Wedge-tailed Eagle due to analysis of prey contents and their shape/size. As such, these two trees were conservatively considered to represent breeding habitat for this species and a 100 m buffer was applied in

accordance with the BAM. The outer edge of one of these buffers extends into the Development Site, however, it clips an already cleared area of the southern access road to the NGSF. Offsetting of this area is not required under the BAM. Further assessment of this species is provided in **Section 4.3**.

The Eastern Freetail-bat is an ecosystem credit species and was recorded at one location (Anabat placed in the Smooth-barked Apple – Blackbutt forest) within the Study Area. Habitat for this species is offset through calculation of ecosystem credits for native vegetation removal within the Development Site.

No Grey-headed Flying-fox camps (breeding constraint) were identified during extensive searches of the Study Area. Therefore, this species was determined to not be a candidate species credit species.

The Squirrel Glider is a species credit species; there are no habitat constraints listed for this species in the Threatened Biodiversity Data Collection. General notes on the Squirrel Glider state that they require old large hollow-bearing trees with good connectivity throughout for movement. As this species was identified within vegetation along the northern access road and within the eastern areas of the Development Site (nearby the NGSF), and suitable foraging habitat (*Corymbia gummifera* and *Banksia serrata*) is present within the Development Site, the species was assessed as occurring within the Development Site (see **Section 4.3**).

In addition to the fauna species discussed above, the Koala, which is a dual Species/Ecosystem credit species, was assessed as occurring within the Development Site (due to Bionet Atlas records of the Koala occurring on and within 1 km of the Study Area and presence of preferred and supplementary Koala habitat). Therefore, the species was assumed to be present due to the habitat constraint; 'areas identified via surveys as important habitat' being confirmed through vegetation mapping.

4.3 IDENTIFIED THREATENED SPECIES

Step 5: Determine the area or count, and location of suitable habitat for species credit species & Step 6: Determine the habitat condition within the species polygon for species assessed by area

One species credit species, *Eucalyptus parramattensis* subsp. *decadens* (Earp's Gum) was recorded within the Development Site (three individuals) (**Figure 11**). These individuals form

part of a much larger population which occurs to the east and south of the NGSF within rehabilitation (post sandmining).

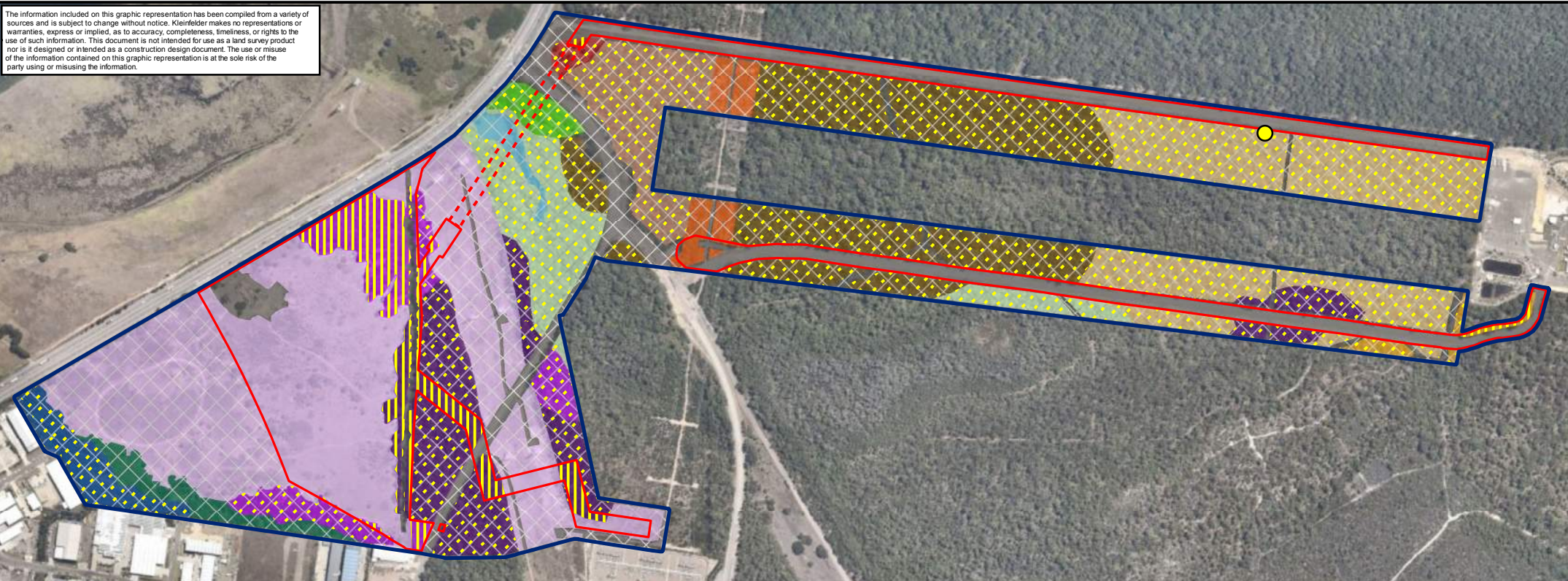
Two other species credit species, *Maundia triglochinooides* and *Grevillea parviflora* subsp. *parviflora* were recorded within the Study Area (**Figure 11**) but will not be directly impacted.

The Squirrel Glider was recorded within the Development Site along the southern edge of the northern gas pipeline, within the Smooth-barked apple-Blackbutt-Old Man Banksia forest (**Figure 13**) and is known to occur around the NGSF within nest boxes (Kleinfelder 2018). Similar habitat within the Development Site has therefore been assessed as suitable habitat for the species. The species polygon includes PCT 1590 – Zone 1 (Moderate_Good) and Zone 2 (Moderate_Good_EEC) and PCT 1646 – Zone 4 (Managed) and Zone 6 (Rehabilitation). The total area of Squirrel Glider habitat within the Development Site is approximately 4.48 ha.

The Masked Owl was recorded during call playback in an area between the northern and southern access roads to the NGSF within the Smooth-barked apple-Blackbutt-Old Man Banksia forest (**Figure 14**), and a pair was also subsequently located approximately 150 m south of the Study Area roosting in Melaleuca swamp. As discussed in **Section 4.2.3.2**, two potential large forest owl roost trees were identified in close proximity to the Study Area and 100 m buffers were applied (**Figure 14**). A small section of the outer buffer from the southernmost tree clips the Development Site but this occurs in an already cleared area (for the southern access road to the NGSF). The total area of Masked Owl habitat within the Development Site is determined to be zero, as cleared areas do not need to be offset under the BAM. Assessment of prescribed and indirect impacts on this species habitat has been undertaken in **Section 5.2**.

Preferred and Supplementary Koala Habitat has been mapped within the Development Site from two locations (**Figure 15**). The species polygon includes PCT 1646 – Zone 4 (Managed) and Zone 6 (Rehabilitation). The total area of Koala habitat within the Development Site is approximately 0.18 ha (0.05 ha of Preferred Koala Habitat and 0.13 ha of Supplementary Koala Habitat).

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Plant Community Type and Vegetation Zone within the Development Site

- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good) - **Zone 1**
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC) - **Zone 2**
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low) - **Zone 3**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed) - **Zone 4**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline) - **Zone 5**
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation) - **Zone 6**
- Cleared

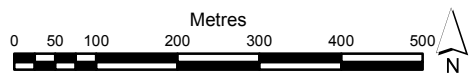
Plant Community Type outside Development Site

- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good)
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC)
- 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed)

- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate_Good)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Mesic variant)
- 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Red Gum variant)
- 1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (Moderate_Good)
- 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Moderate_Good)
- 1568: Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Moderate_Good)
- 1724: Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
- 1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
- Cleared

Legend

- Squirrel Glider Observation
- Squirrel Glider Habitat Within the Development Site
- Squirrel Glider Habitat Outside the Development Site
- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)



PROJECT REFERENCE: 20191297
 DATE DRAWN: 1/05/2019 10:33 Version 1
 DRAWN BY: GJoyce

DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2019

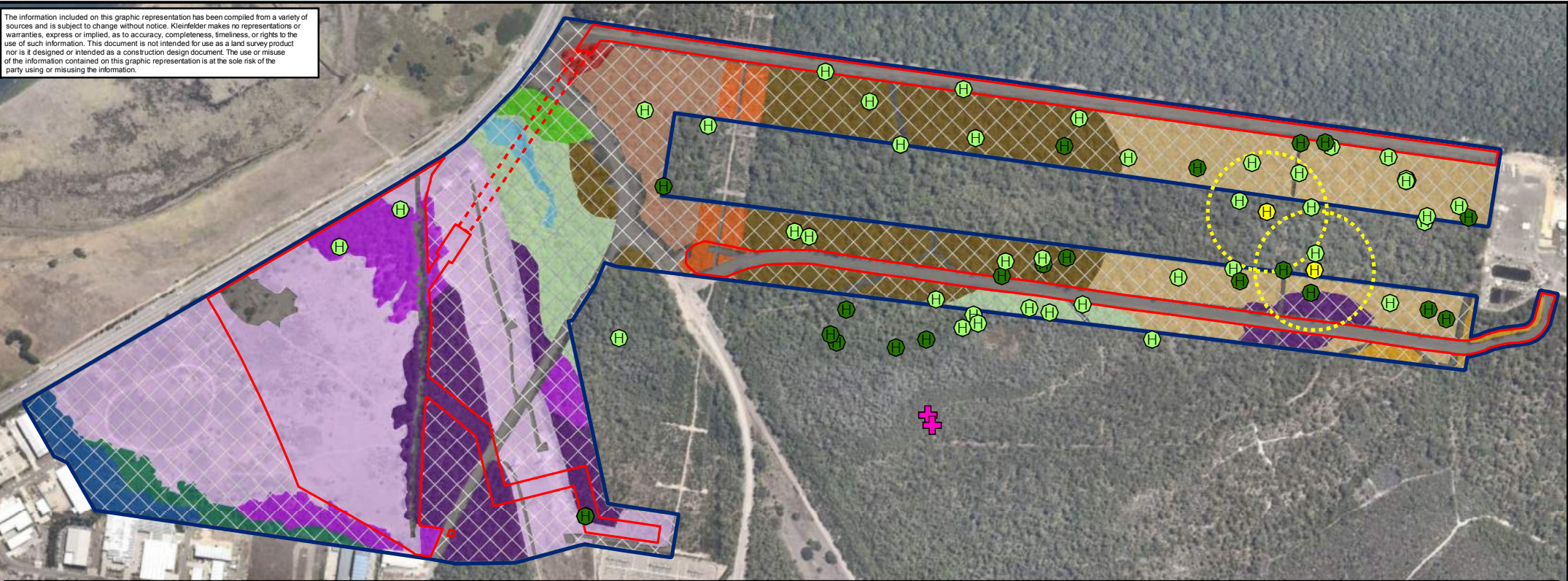
Squirrel Glider Habitat

Aurecon
 Biodiversity Development Assessment Report
 AGL Newcastle Power Station Project
 Tomago NSW

FIGURE:

13

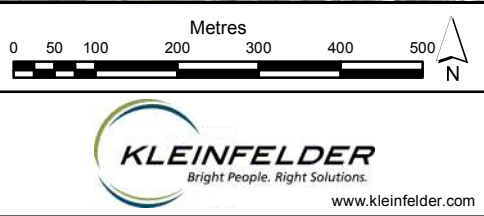
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Plant Community Type and Vegetation Zone within the Development Site	
1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good) - Zone 1	1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline)
1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC) - Zone 2	1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation)
1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low) - Zone 3	1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate_Good)
1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed) - Zone 4	1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Meric variant)
1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed Powerline) - Zone 5	1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Red Gum variant)
1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Rehabilitation) - Zone 6	1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (Moderate_Good)
Cleared	1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Moderate_Good)
	1568: Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast (Moderate_Good)
	1724: Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
	1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
	Cleared

Plant Community Type outside Development Site	
1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good)	
1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Moderate_Good_EEC)	
1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Low)	
1646: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Managed)	

Legend	
Study Area	Masked Owl Observation
Development Site	Potential Owl Roost Tree
HDD Pipe Alignment (No direct impact)	100m Buffer from Potential Roost Tree
	Hollow-bearing Tree with Large Hollows
	Dead Stag with Large Hollows

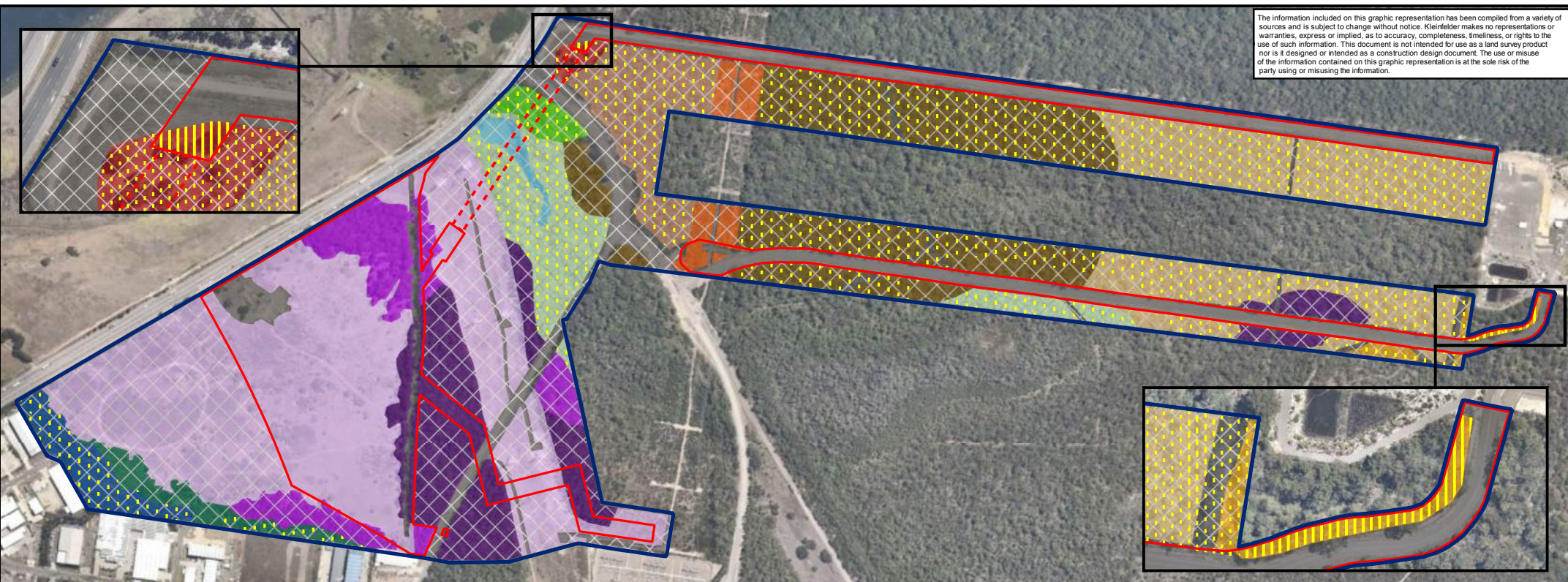


PROJECT REFERENCE: 20191297
DATE DRAWN: 1/05/2019 10:10 Version 1
DRAWN BY: GJoyce
DATA SOURCE: NSW DFSI - 2018 Nearmap - 2019

Masked Owl Habitat
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FIGURE:
14

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- Cleared

Plant Community Type outside Development Site

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- 1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate_Good)
- Cleared

Legend

- Koala Habitat Within the Development Site
- Koala Habitat Outside the Development Site
- Study Area
- Development Site
- HDD Pipe Alignment (No direct impact)

Metres

0 50 100 200 300 400 500

N

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PROJECT REFERENCE: 20191297

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DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2018
Nearmap - 2019

Koala Habitat

Aurecon
Biodiversity Development Assessment Report
AGL Newcastle Power Station Project
Tomago NSW

FIGURE:

15

5. AVOID AND MINIMISE IMPACTS ON BIODIVERSITY VALUES

5.1 AVOIDING AND MINIMISING IMPACTS DURING PROJECT PLANNING

5.1.1 Alternate Sites Considered

Please refer to **Section 1.4** and **Figure 3** for background on alternate sites considered as part of the site selection process. AGL, in consultation with Kleinfelder, has taken significant steps to avoid, minimise and mitigate impacts as per the process outlined below:

- Identification of biodiversity values through comprehensive biodiversity surveys across multiple sites within the Tomago area; and
- Consultation between the design team and project ecologists to consider the direct and indirect impacts of the Proposal, working through an iterative design process, with multiple iterations of the design footprint to achieve a feasible project with the least biodiversity impact.

5.1.2 Alternative Technologies Considered

The proposed power station would utilise either large reciprocating engines or aero-derivative gas turbine technology. For each technology there are multiple suppliers and products available and changing rapidly technology. An evaluation and tender process would be undertaken to ultimately choose the technology to be implemented. This evaluation would consider several factors, some of which include:

- Compliance with legislation, codes and standards.
- Performance characteristics such as thermal efficiency and output at different ambient conditions and loading, when fuelled by gas and/or diesel.
- Operational characteristics such as start-up times, usage rates of consumables such as water, oil and catalysts and auxiliary power consumption when off-line and in service.
- Capital, operating and maintenance costs

5.1.3 Avoid and Minimise Impacts on Prescribed Biodiversity Impacts

The following are prescribed impacts which need to be considered as per section 8.2 of the BAM.

Impact of development on the habitat of threatened species or ecological communities associated with significant geological features, human made structure or non-native vegetation

No significant geological features, rocky areas, or human made structures occur within the Study Area.

Within the Development Site there is predominantly exotic vegetation (in cleared areas) which contains marginal foraging habitat for the Masked Owl. Additionally, a small portion of the species polygon occurs across the southern access road. Construction and operation of the power station and associated infrastructure would temporarily cause indirect impacts on this species habitat through noise, dust, vibration, lighting and potentially sediment and nutrient runoff and weed invasion. Measures to address these potential impacts are recommended in **Section 5.3**.

Impacts of the development on the connectivity of different habitat which facilitates movement of threatened species

The NSW Government has identified several green corridors that run through the Lower Hunter Region (Department of Planning 2006). The Lower Hunter Regional Strategy recognises the importance of large vegetated areas being linked via habitat corridors at a landscape scale. The Development Site lies within a large wildlife corridor that extends from the Watagan Ranges in the south to Port Stephens in the North. This corridor is likely to provide a highly significant link between southern sandstone ranges and the coast heaths and wetlands of Port Stephens. Specifically, wildlife corridors enable a range of benefits to biodiversity such as access to critical resources, genetic exchange between individuals of the same species and dispersal of juveniles (Scoot, 2003).

On a local level, the Development Site is situated to the north of the industrial precinct of Tomago with Old Punt Road dissecting the middle of the site in a north/south bearing. There is limited connectivity south through the industrial estate; however, linear vegetation strips exist along a powerline easement connecting the site to riparian areas of the North Channel of the Hunter River. Another stretch of the Hunter River lies approximately 450 m to the north-west

of the Development Site separated by grazed marshlands and the Pacific Highway. Large areas of intact native vegetation extend from the northern and eastern boundaries of the Development Site. The areas provide linkage to Tilligerry State Conservation Area (4,689 ha) which extends north-east through the Tomago sand beds. Throughout these large connective habitats, there are some cleared easements and tracks/roads which are generally no wider than 25 m. These barriers are unlikely to fragment local fauna populations; however, Old Punt Road and Masonite Road are likely to restrict movement of less mobile species.

Where possible the proposed development would be positioned within areas of previously disturbed vegetation or cleared land. The removal of relatively narrow (30 m width) sections of PCT 1590 along the high voltage powerline easement to connect the proposed power station with the Transgrid switching station will be required.

The Proposal will not further exacerbate fragmentation of habitat for threatened fauna species recorded within the Study Area as most of the infrastructure will be located in already cleared areas. The removal of relatively narrow (30 m width) sections of PCT 1590 along the high voltage powerline easement to connect the proposed power station with the Transgrid switching station is unlikely to have any significant impact on either the Squirrel Glider or the Koala (as the Squirrel Glider was not recorded in this area during targeted surveys and this PCT was mapped as Marginal Koala Habitat and does not contain preferred Koala feed trees).

Impact of the development on movement of threatened species that maintains their life cycle

The Development Site is located within a much larger area of relatively contiguous native vegetation known to facilitate Squirrel Glider and Koala movement. However, as discussed above the relatively small areas of habitat to be removed (0.18 ha for the Koala and 4.48 ha for the Squirrel Glider) from the edges of much larger patches is unlikely to significantly impact the life cycle of local populations.

Impacts of the development on water quality, bodies and hydrological processes that sustain threatened species or ecological communities.

One ephemeral wetland occurs within the north-eastern portion of the Study Area. This is identified in the BOM Groundwater Dependent Ecosystem Atlas as a moderate potential Groundwater Dependent Ecosystems (GDE) featuring woodlands on coastal sand vegetation that rely on the availability of shallow groundwater. Direct impacts on the freshwater wetland within the Study Area will be completely avoided by using HDD to pass the gas pipeline underneath PCT 1071 occurring on the corner of the Pacific Highway and Old Punt Road. Of

the available pipeline construction methods, HDD will have the least environmental impact on vegetation and habitat as the bore and pipeline will pass below rather than directly impacting vegetation and soils. An HDD entry drill pad will be established in a previously disturbed area within the existing NGSF gas supply easement and the exit point will be between the TransGrid 132kV corridor and the proposed power station (see **Figure 2**).

Potential indirect impacts of the HDD process include leaks and spills from vehicles, plant and equipment, corrosion of plant or equipment, particulates from internal combustion engines, and dust from plant and vehicle movements. There is a potential for groundwater intersection and a potential for indirect impact from the inadvertent return of bentonite drilling slurry, or frac-out. Frac-out occurs when drilling slurry is released through underlying fractures into the surrounding strata and travels toward the surface. Drilling slurry may impact on aquatic flora and fauna, covering these with a fine layer of bentonite clay and reducing their viability. Frac-out will be managed under a contingency plan for the project.

With respect to potential impacts to areas outside the Development Site, there are no mapped watercourses within the Development Site or Study Area but there are two ephemeral drainage channels/paths which flow west toward the river under the Pacific Highway. In addition, depth to groundwater measured in the wells installed for project studies indicates the water table is close to the ground surface in some parts of the Proposal area (Aurecon 2019).

The Hunter River lies 450 m to the north-west of the Development Site and 1,800 m to the south. The closest Important Wetland (SEPP Coastal Wetland) is located 450 m to the north-west of the Development Site which borders the edge of the Hunter River while the Kooragang component of the Ramsar listed Hunter Estuary Wetlands is located about 2.5 km to the south of the Development Site at its closest point. These have been identified as potential or high potential GDE within the BOM Atlas.

Specialist groundwater studies have been undertaken as part of the EIS for the project and have included consideration of potential impact to GDE. The proposed pad for the power station is not anticipated to intersect the water table or alter groundwater levels and therefore would not impact on GDE in the area during construction (Aurecon 2019). Impact from the pipeline will be mitigated by the use of coarse-grained material (sand or gravel) around the pipeline that will facilitate the flow of groundwater around the pipe and mitigate adverse impact on the flow of shallow groundwater and potential adverse impacts on GDEs. In addition, during both construction and operation, stormwater will be managed via a bio-retention system that will capture and filter run-off so that operational stormwater discharges from the system are

likely to be of a superior quality compared to the existing background conditions (Aurecon 2019). By ensuring minimal change in recharge and discharge volumes and qualities during operations, there is not expected to be any measurable groundwater impact on the GDEs in the immediate vicinity of the proposal area.

Given the distance from the Development Site, and provided that standard avoidance, mitigation and management measures are implemented, the likelihood of impact on the wetlands and associated GDE is therefore generally considered to be low. However, given the presence of the Ramsar listed wetland, the proposed action was determined under section 75 of the EPBC Act to have a potentially significant impact on a listed wetland of international importance and has required assessment under the Act. This assessment is discussed further in **Section 7.1**.

Impact of wind turbine strikes on protected animals

Not applicable to the current application.

Impacts of vehicle strikes on threatened species or on animals that are part of a TEC

There is the potential for the Proposal to increase the impact of vehicle strikes on the Koala due to increased traffic accessing the power station site along Old Punt Road. To minimise the threat of motor vehicles to Koalas, a speed limit compatible with the Port Stephens CKPoM will be enforced and Koala traffic signs will be installed along the access route from Old Punt Road.

5.2 ASSESSMENT OF IMPACTS

5.2.1 Impacts on Native Vegetation and Habitat

5.2.1.1 Direct Impacts

The Proposal will impact on all native vegetation identified within the Development Site (totalling approximately 15.5 ha of native vegetation). Each vegetation zone equates to one management zone, and the future value of each attribute (composition, structure, and function) and the vegetation integrity score for all management zones will be zero.

5.2.1.2 Indirect Impacts

The Proposal has the potential for edge effects on the adjoining vegetation within the Study Area. Potential indirect impacts include:

- Increased weed invasion and potential spread or introduction of pathogens from the site to adjacent vegetation;
- Accidental incursions during clearing, including trampling of threatened flora species (*Grevillea parviflora* subsp. *parviflora* and *Eucalyptus parramattensis* subsp. *decadens* located adjacent to the Development Site);
- Reduced viability of adjoining habitats due to increased noise, dust or light spill; or
- Increase in rubbish dumping in adjoining habitats.

These potential indirect impacts may have an effect on the adjacent vegetation and habitat for threatened species associated along the southern edge of the power plant site and along the electrical transmission easement and gas pipeline route options. The northern pipeline route directly adjoins a Biobank Site which has been secured for conservation under a Biobank agreement (ID 173 – 105.1 ha). This site and other large areas of vegetation are owned by Hunter Water to the north of the northern access road to the NGSF. These indirect impacts may occur during the construction and operation phases of the Proposal; however, provided appropriate mitigation measures and management plans are enforced, it is unlikely to have a significant long-term effect on threatened species, ecological communities and their habitats.

5.2.2 Prescribed Impacts

The Proposal has the potential to impact on one prescribed impact, non-native vegetation for threatened species, through impacts on areas of Masked Owl foraging as described in **Section 5.1.3**.

5.3 MITIGATING AND MANAGING IMPACTS ON BIODIVERSITY VALUES

A site-specific Management Plan will be prepared prior to commencement of any clearing or construction works to ensure that impacts are minimised. This should include the measures outlined in **Table 11**.

Table 11: Summary of direct, prescribed and indirect impacts of the Proposal

Impact	Action and Outcome	Responsibility	Timing
Direct impact / prescribed impact			
Clearing of native vegetation	<ul style="list-style-type: none"> • Avoid and minimise clearing impacts to native vegetation where possible. • Clearly delineate the boundaries of the project footprint to prevent any unnecessary clearing beyond its extent. • Ensure vehicle and equipment parking areas and stockpile areas are identified and positioned to avoid areas containing ecological value. • Appropriate signage such as 'no go zone' or 'environmental protection area' should be installed. • Identify and communicate the location of any 'no go zones' in site inductions. 	Construction site manager	Prior to and during vegetation clearing
Removal of hollow-bearing trees / habitat trees, resulting in fauna injury and mortality	<ul style="list-style-type: none"> • Limit removal of trees to that required within the project footprint. • A pre-clearing protocol will be implemented during clearing works, as follows: <ul style="list-style-type: none"> ○ Pre-clearance surveys will be undertaken to determine if any inhabiting fauna are present; ○ A suitably qualified and trained fauna handler will be present during hollow-bearing tree clearing to rescue and relocate displaced fauna. • Appropriate exclusion fencing around trees and woodland that are to be retained within the Development Site should be erected, considering allowance for Tree Protection Zones in accordance with AS4970 (Standards Australia, 2009). 	Construction site manager and suitably qualified/trained fauna handler	Prior to and during tree clearing
Impacts to surface and groundwater quality and quantity due to sediment run-off and/or contaminant runoff into adjacent watercourses	<ul style="list-style-type: none"> • Source controls such as sediment fences, mulching and jute matting will be utilised where appropriate. • Site-based vehicles will carry spill kits. • A Soil Management Plan, including erosion and sediment control will be required with each stage of development as part of the CEMP in accordance with Managing Urban Stormwater: Soils and Construction (Landcom 2004) prior to commencement of construction. • A Groundwater Management Plan is to be included in the CEMP. • A Surface Water Management Plan is to be included in the CEMP. • Acid sulphate soils potentially occur within the Development Site therefore associated management actions may be required. • Limit the use of pesticides in the project footprint where possible to avoid contamination of nearby watercourses/wetland areas. 	Construction site manager	During vegetation clearing, construction and operation

Impact	Action and Outcome	Responsibility	Timing
Vehicle collision with fauna	<ul style="list-style-type: none"> Speed limits within the Development Site should be limited to 40 km/hr. This limit should be stated in the CEMP and be communicated in site inductions. 	Construction site manager	During construction and operation
Indirect Impact			
Transfer of weeds and pathogens to and from site	<ul style="list-style-type: none"> The fungal pathogens <i>Phytophthora cinnamomi</i> and Myrtle Rust (<i>Puccinia psidii</i>) are known to occur in the Port Stephens LGA however, it is unknown if they occur within the Development Site. These pathogens can have devastating impacts on native plant communities and inhabiting fauna if not properly managed. Appropriate wash down facilities will be available to clean vehicles and equipment prior to arrival on-site and prior to departure. Ensure soil and seed material is not transferred in accordance with measures outlined in the CEMP. Weed infestations within the construction footprint are to be identified and mapped prior to construction. A Plan of Management for the control of weeds is to be included in the CEMP. 	Construction site manager	During vegetation clearing and construction
Noise, vibration, lighting, waste and air pollution impacts to adjacent sensitive habitat areas	<ul style="list-style-type: none"> Increased human activity (from workers and traffic levels) directly adjacent to sensitive habitat areas may cause disturbance to flora and fauna species in adjoining habitat. Impacts from operational activities, such as disturbance to an animal's normal behaviour patterns due to noise, vibration, lighting or dust may cause areas of previously suitable habitat to become sub-optimal and may cause fauna species to vacate areas of previously suitable habitat. The CEMP will consider measures to mitigate impacts on flora and fauna from noise, vibration, waste, light and air pollution such as: <ul style="list-style-type: none"> Preparation of a waste and traffic management plan. Enforce 'carry-in, carry-out' policy regarding rubbish and waste materials generated on-site to avoid waste materials entering adjacent vegetation. Restriction of public access and associated impacts from domestic pets, waste dumping and damage to adjoining vegetation must be enforced pre, during and post construction. Fence sensitive areas to delineate 'no go' zones. Levels of lighting that will accompany the access road will be reduced to a minimal level to reduce any adverse effects upon the essential behavioural patterns of light-sensitive fauna. 	Construction site manager	During construction and operation

Impact	Action and Outcome	Responsibility	Timing
	<ul style="list-style-type: none"> ○ Lighting should comply with Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting. ○ Noise minimisation practices should be included in the CEMP in accordance with OEH recommendations. ○ Dust control measures will include covering loads where required; amending operations under excessive wind conditions including ceasing operations if required; use of water tankers as required, to control dust; rehabilitation through vegetation of surfaces to be left unsealed; and, truck wheel washes or other dust removal measures. 		

Environmental Management Framework

The Proposal would operate under the AGL Health, Safety and Environment Management Systems (HSEMS), which forms the basis for managing the environmental aspects of the construction and operation of the proposed power station. The contracting strategy for the construction of the power station would require the major contractors for these components of the Proposal to have and maintain systems that reflect the requirements of HSEMS.

Environmental management of the construction and operation of the power station would be in accordance with the conditions of approval determined through the approvals process and, as a minimum, to the HSEMS equivalent standards (provided by the construction contractors). A construction environmental management plan (CEMP) would be prepared and implemented during the Proposal’s construction phase. An operations EMP would be prepared and implemented during operations.

The requirements of the conditions of approval and relevant standards would be incorporated into both the construction and operations EMPs as appropriate. The EMPs would be written to clearly define objectives, issues and mitigation measures for each environmental aspect that may be impacted by the Proposal. The EMPs would also include detailed monitoring measures.

6. IMPACT SUMMARY

6.1 SERIOUS AND IRREVERSIBLE IMPACTS

No Serious and Irreversible Impacts (SAILs) were found to occur on the Development Site.

6.2 IDENTIFICATION OF IMPACTS REQUIRING OFFSETS

This section provides an assessment of the impacts requiring offsetting in accordance with Section 10.3 of the BAM (OEH, 2017).

6.2.1 Impacts on Native Vegetation

A summary of the impacts on native vegetation and the required ecosystem credit is provided in **Table 12**.

Table 12: Summary of ecosystem credit requirements

Vegetation Zone	Vegetation Zone Name	Area (ha)	Current Vegetation Integrity Score	Future Vegetation Integrity Score	Credits Required	BAM Case No
1	1590_Moderate_Good	2.4	60.9	0	55	00015291
2	1590_Mod_Good_EEC	1.9	68	0	65	00018030
3	1590_Low	10.8	23.7	0	96	00015291
4	1646_Managed	0.10	25.9	0	1	00015291
5	1646_Managed_Powerline	0.20	36.6	0	3	00015291
6	1646_Rehabilitation	0.10	77.1	0	4	00015291
Total Credit Requirement for PCT 1590					216	
Total Credit Requirement for PCT 1646					8	

The like-for-like Credit Report is provided in **Appendix 4**.

6.2.2 Impacts on Species Credit Species

A summary of the impacts on species credit species and the required species credits is provided in **Table 13**.

Table 13: Summary of species credit requirements

Vegetation Zone	Vegetation Zone Name	Area (ha) / Individual	Species Name	Biodiversity Risk Weighting	Credits Required	BAM Case No
1	1590_Moderate_Good	2.39	Squirrel Glider	2	73	00015291
2	1590_Mod_Good_EEC	1.91	Squirrel Glider	2	65	00018030
4	1646_Managed	0.05	Squirrel Glider	2	1	00015291
		0.05	Koala	2	1	00015291
6	1646_Rehabilitation	3	<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	2	6	00015291
		0.13	Squirrel Glider	2	5	00015291
		0.13	Koala	2	5	00015291
Total Credit Requirement for Squirrel Glider					144	
Total Credit Requirement for Koala					6	
Total Credit Requirement for <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>					6	

The like-for-like Credit Report is provided in **Appendix 4**.

6.3 IMPACTS NOT REQUIRING OFFSETS

Impacts on *Grevillea parviflora* subsp. *parviflora* and Masked Owl do not require offsets, as they occur outside the Development Site. Approximately 10 individuals of *Grevillea parviflora* subsp. *parviflora* are known to occur from the patch of Spotted Gum – Broad-leaved Mahogany – Red Ironbark Forest occurring within the southern gas pipeline investigation area. The potential for indirect impacts on this species and its habitat has been considered and addressed in **Section 5.3**.

The prescribed impact on marginal Masked Owl foraging habitat (non-native vegetation) has also been considered but does not require offsetting.

7. ASSESSMENT OF OTHER BIODIVERSITY LEGISLATION

7.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

Due to the occurrence of several EPBC-listed flora and fauna species in the immediate vicinity of the Development Site, a referral was made to the DoEE for approval. In general, the Proposal was not considered likely to have significant impact on MNES because the Proposal:

- Is not in the vicinity of any World Heritage areas.
- Is not associated with any Nuclear Actions.
- Is not located near any Commonwealth marine areas.
- Would avoid removal of any threatened ecological communities.
- Would minimise removal of any threatened flora species (using ground-based controls at the time of construction to avoid individual *Eucalyptus parramattensis* subsp. *decadens* wherever possible).
- Will only remove a small area of threatened fauna habitat which is not expected to significantly impact on threatened fauna populations in the locality or wider region.

However, in consideration of the significant impact criteria outlined in the *EPBC Act Policy Statement 1.1: Significant Impact Guidelines Matters of National Environmental Significance* (DoE, 2013), it has been determined that the Proposal has the potential to significantly impact on a wetland of international importance (a Ramsar wetland). This is due to the proximity of the project to the Kooragang component of the Hunter Estuary wetland (refer **Figure 16**) and the:

- potential for groundwater intersection;
- potential presence of contaminants in soils; and
- the likely presence of acid sulphate soils;

As a result of these factors, DoEE considered that the proposed action has the potential to significantly impact the physico-chemical status of the Hunter Estuary Wetlands Ramsar site and the habitat or lifecycle of native species dependent on the site. The project has therefore been deemed a controlled action under section 75 of the EPBC Act and requires assessment and approval under the Act before it can proceed.

The proposal has therefore been assessed for potential to impact on the wetland and the species that may utilise the wetland for breeding or foraging habitat. This has included consideration of several studies on surface water and hydrology, groundwater, soils and contamination. Assessment against the significant impact criteria for those species potentially utilising the wetland and potentially affected by the proposal is provided in **Appendix 5**.

The assessment concluded that the project is unlikely to have a significant impact on the wetland and the species utilising the wetland.

7.2 PORT STEPHENS CKPOM

A revised Koala habitat map in accordance with the CKPoM is provided in **Figure 17**.

Each section of the Performance Criteria contained within Appendix 4 “Performance Criteria for development applications” of the Port Stephen’s CKPoM is answered below. Proposed development activities must:

a) Minimise the removal or degradation of native vegetation within Preferred Koala Habitat or Habitat Buffers

The proposed power station site, electrical transmission corridor and pipeline easements have been located (as far as practicable) to minimise the removal or degradation of Preferred Koala Habitat or Habitat Buffers. The power station site and electrical transmission easement does not contain any Preferred Koala Habitat or Habitat Buffers. Removal of Preferred Koala Habitat will be almost completely avoided by using HDD underneath the Swamp Mahogany Forest occurring on the corner of the Pacific Highway and Old Punt Road. A very small area (0.05 ha) of Smooth-barked Apple – Blackbutt Forest (Red gum variant) occurring at the site of the HDD entrance yard which is already managed may need to be cleared. This was conservatively mapped as Preferred Koala Habitat due to the presence of *E. tereticornis* in the canopy (see **Plate 4**). A small area of Habitat Buffers also occurs within the Development Site; however, the majority of these buffers extend over cleared land (for powerline easements and roads).

b) Maximise the retention and minimise degradation of native vegetation within Supplementary Koala Habitat and Habitat Linking Areas

The retention of Supplementary Koala Habitat and Habitat Linkage Areas has been maximised with only 0.13 ha to be impacted within the Development Site. This has been achieved by

selecting proposed gas pipeline routes within already cleared easements. Post construction of the underground gas pipeline there will be no further impediment to Koala movement than already exists through the 25 m wide access roads cleared as part of the NGSF development. The 30 m wide corridor for the electrical transmission easement has been located in marginal Koala habitat and sited as much as possible along the edges of the existing high voltage powerline easement to reduce any potential for impeding movement of Koalas across the landscape.

c) Minimise the removal of any individuals of preferred Koala food trees, where they occur on a development site

The retention of preferred Koala food trees (*E. robusta*, *E. parramattensis* and *E. tereticornis*) has been maximised by the avoidance of preferred habitats where these species occur. Within the Study Area, 0.05 ha of Smooth-barked Apple - Blackbutt - Old Man Banksia (Red gum variant) habitat containing *E. tereticornis* lies within the development footprint; and, 0.13 ha of Smooth-barked Apple - Blackbutt - Old Man Banksia (Rehabilitation) habitat containing *E. parramattensis* lies within the development footprint. However, this habitat cannot be considered as preferred due to the low density of this species (<15%) in the total canopy cover. It has been assigned to the Supplementary Koala Habitat category.

d) Make provision, where appropriate, for restoration or rehabilitation of areas identified as Koala Habitat including Habitat Buffers and Habitat Linking Areas over Mainly Cleared Land. In instances where Council approves the removal of Koala habitat, and where circumstances permit, this is to include measures which result in 'net gain' of Koala habitat on the site and/or adjacent land

In accordance with the NSW BAM methodology, the Koala was assessed as a candidate species in the offset calculator tool. Removal of Koala habitat at the Development Site requires retirement of 6 credits which can be obtained from anywhere in NSW. However, it is noted from Port Stephens Council's response to the SEARs that Council would prefer that any offsetting requirements in accordance with the biodiversity offset scheme be secured within the local area, where possible. AGL is open to discussing offsetting options with council.

e) Make provision for long term management and protection of Koala habitat including both existing and restored habitat

The remaining Koala habitat within lands between the proposed power station site and the NGSF is predominantly owned by TAC (as part of their buffer lands). A large area of vegetation directly to the north of the northern access road to the NGSF is already conserved as a Biobank

site (owned by Hunter Water). Retention of this relatively contiguous patch of Koala habitat into the future is provided for by these land uses.

f) Not compromise the potential for safe movement of Koalas across the site

Any fencing required around proposed easements (not including fencing erected for safety of operation purposes) will have a Koala-friendly design, with a 20 cm gap at the bottom to allow the movement of Koalas and other terrestrial fauna.

g) Be restricted to identified envelopes which contain all buildings and infrastructure and fire fuel reduction zone. Generally, there will be no clearing on the site outside these envelopes

All activities will be restricted to within the existing development area.

h) Include measures to effectively minimise the threat posed to Koalas by dogs, motor vehicles and swimming pools by adopting minimum standards

The proposal does not pose a threat to Koalas through injury or death associated with dogs or swimming pools as these will not form part of any future features on the site. To minimise the threat of motor vehicles to Koalas, a speed limit compatible with the Port Stephens CKPoM will be enforced and Koala traffic signs will be installed along the access route from Old Punt Road.

7.2.1 Port Stephens Koala Occupancy

A Koala Occupancy and Monitoring Report to Port Stephens Council (Biolink, 2017), identified 5 Koala populations / hubs east of the Pacific Highway within the LGA. The Anna Bay – Soldiers Point hub was the only hub positively confirmed. The other likely hubs, based on survey data included Medowie, Tomago – Heatherbrae, southern edge of the Tilligerry Peninsula and along the western edge of the Grahamstown Water Reservoir.

The postulated Tomago – Heatherbrae hub includes the Newcastle Gas Storage Facility and extends to the north, north east and east of the facility. The mapped extent of the predicted hub does not extend to the west, towards the Gas Fired Power Station site.

The location of the power station site and electrical transmission easement does not contain any Preferred Koala Habitat or Habitat Buffers. In locating the power station, powerline

easement and use of existing easements, has used avoid and mitigate measures to reduce any impact on the koala habitat and the Tomago – Heatherbrae Koala Hub functionality.

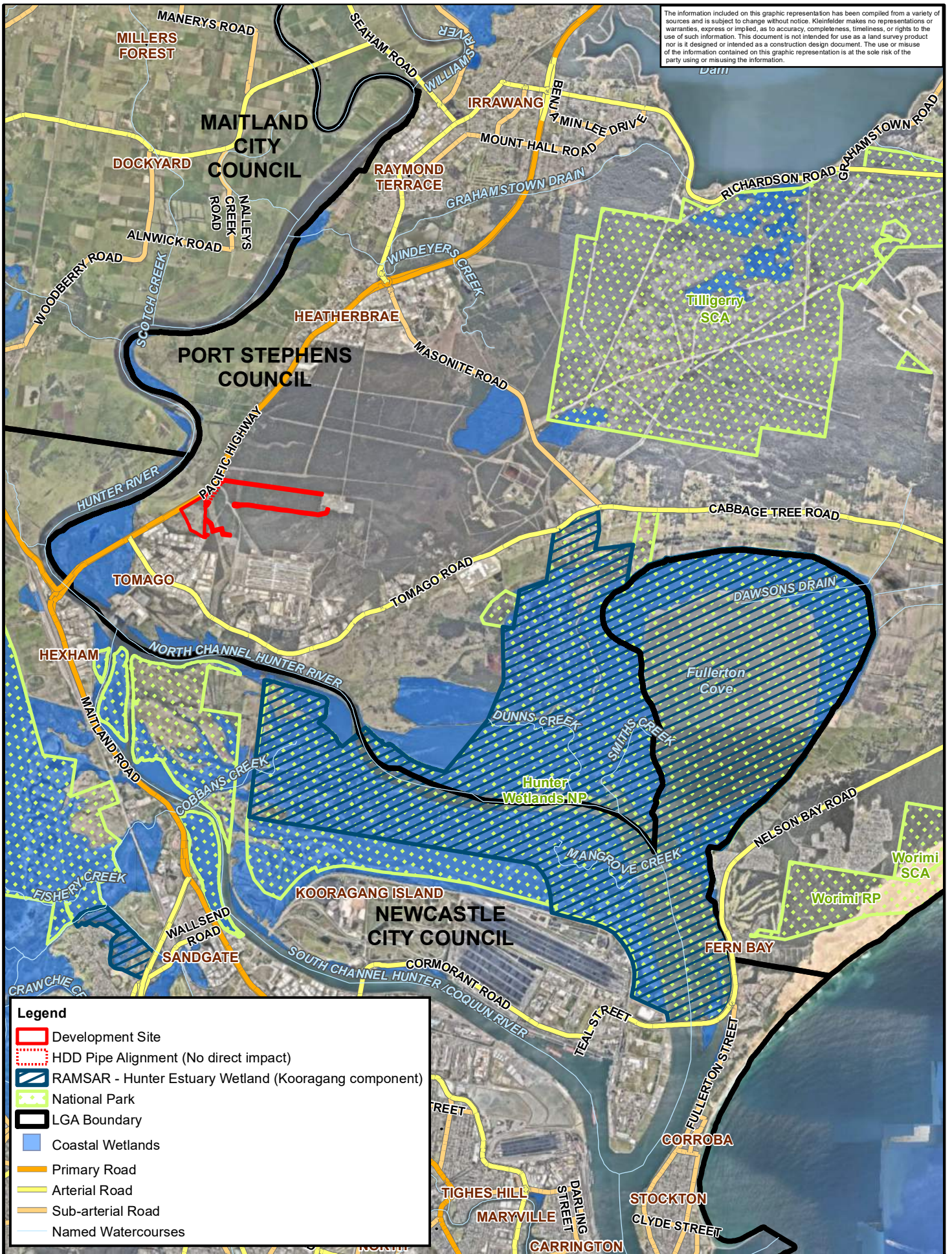
7.3 BIOSECURITY ACT 2015

Species which require control prior to and post construction of the power station and associated infrastructure to ensure they are not spread due to works, include the high threat species listed in **Table 14**.

Table 14:a Weed species requiring control within the Development Site

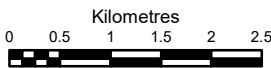
Family	Scientific Name	Common Name	Weeds of National Significance (WONS)	Priority weeds of the Hunter Region (Biosecurity Act)	High Threat Weeds (BAM)
Asteraceae	<i>Bidens pilosa</i>	Cobblers pegs	-	-	Y
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	Y	Y	Y
Oleaceae	<i>Ligustrum sinense</i>	Small-leaved Privet	-	-	Y
Poaceae	<i>Andropogon virginicus</i>	Whiskey Grass	-	-	Y
Poaceae	<i>Axonopus fissifolius</i>	Narrow-leaved Carpet Grass	-	-	Y
Poaceae	<i>Briza subaristata</i>	-	-	-	Y
Poaceae	<i>Chloris gayana</i>	Rhodes Grass	-	-	Y
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass	-	Y	Y
Poaceae	<i>Megathyrsus maximus</i>	Guinea Grass	-	-	Y
Poaceae	<i>Paspalum dilatatum</i>	Paspalum	-	-	Y
Rosaceae	<i>Rubus fruticosus</i> sp. agg.	Blackberry	Y	Y	Y
Verbenaceae	<i>Lantana camara</i>	Lantana	Y	Y	Y

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Legend

- Development Site
- HDD Pipe Alignment (No direct impact)
- RAMSAR - Hunter Estuary Wetland (Kooragang component)
- National Park
- LGA Boundary
- Coastal Wetlands
- Primary Road
- Arterial Road
- Sub-arterial Road
- Named Watercourses



PROJECT REFERENCE: 20191297
 DATE DRAWN: 29/10/2019 12:31 Version 1
 DRAWN BY: GJoyce
 DATA SOURCE:
 NSW DFSI - 2018
 Planning NSW - 2017
 Nearmap - 2018

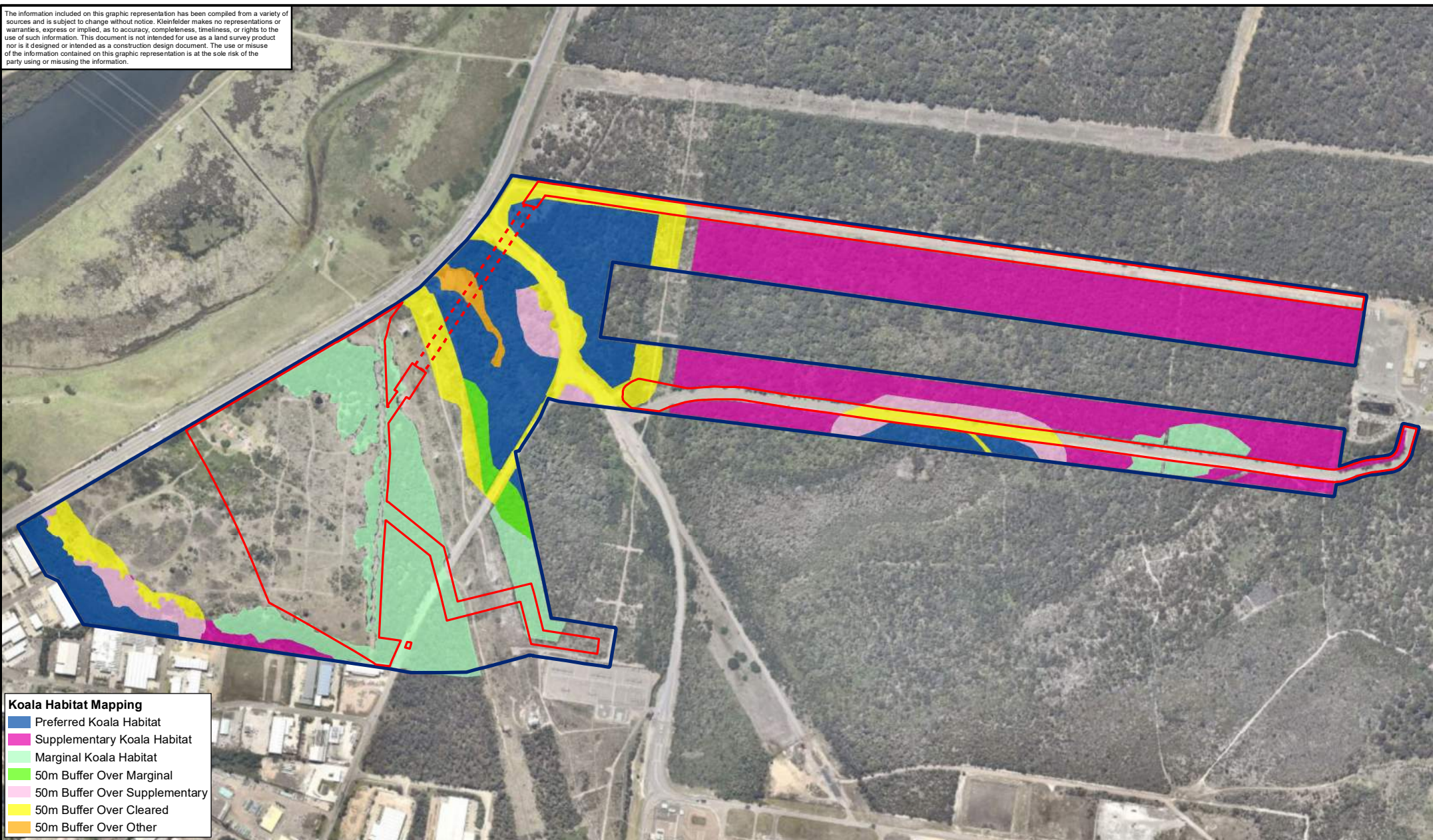
Location of Hunter Estuary Wetland (Kooragang component)

Aurecon
 EPBC Referral
 AGL Newcastle Power Station Project -
 Tomago NSW

FIGURE:
16

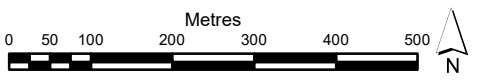


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- Koala Habitat Mapping**
- Preferred Koala Habitat
 - Supplementary Koala Habitat
 - Marginal Koala Habitat
 - 50m Buffer Over Marginal
 - 50m Buffer Over Supplementary
 - 50m Buffer Over Cleared
 - 50m Buffer Over Other

- Legend**
- Development Site
 - HDD Pipe Alignment (No direct impact)
 - Study Area



PROJECT REFERENCE: 20191297
 DATE DRAWN: 29/10/2019 12:29 Version 1
 DRAWN BY: GJoyce

DATA SOURCE:
 NSW DFSI - 2018
 Nearmap - 2018

Revised CKPoM Mapping

Aurecon
 Biodiversity Development Assessment Report
 AGL Newcastle Power Station Project
 Tomago NSW

FIGURE:

17

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APPENDIX 1. FLORA AND FAUNA SPECIES LISTS

Flora species list for the Development Site.

Family	Scientific Name	BAM Growth Form / High Threat Weeds	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12	
			C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab
Acanthaceae	<i>Brunoniella australis</i>	Forb (FG)							0.1	50	0.1	10							0.1	50					0.1	20
Anthericaceae	<i>Arthropodium milleflorum</i>	Forb (FG)							0.1	50	0.1	20														
Apiaceae	<i>Actinotus helianthi</i>	Forb (FG)	0.1	50																						
Apiaceae	<i>Centella asiatica</i>	Forb (FG)					0.5	100			0.1	50	0.1	500	0.1	500	0.1	100								
Apiaceae	<i>Hydrocotyle laxiflora</i>	Forb (FG)											0.1	20												
Apocynaceae	<i>Parsonsia straminea</i>	Other (OG)	0.1	20	0.1	5			0.1	1	1	2	0.1	1	20	20			10	10					3	10
Araliaceae	<i>Polyscias sambucifolia</i>	Shrub (SG)	0.1	20	1	50													0.2	2						
Asteraceae	<i>Ambrosia artemisiifolia</i>	Exotic											0.2	500			1	100								
Asteraceae	<i>Ambrosia confertiflora</i>	Exotic																			15	500				
Asteraceae	<i>Bidens pilosa</i>	High Threat			0.1	20							0.1	10			0.1	20								
Asteraceae	<i>Cassinia quinquefaria</i>	Shrub (SG)									0.5	1														
Asteraceae	<i>Conyza bonariensis</i>	Exotic					1	500																		
Asteraceae	<i>Conyza sumatrensis</i>	Exotic											0.1	20			0.1	10			0.1	20				
Asteraceae	<i>Hypochaeris radicata</i>	Exotic					0.5	500			0.1	10	0.1	50			0.2	100								
Asteraceae	<i>Lagenophora stipitata</i>	Forb (FG)									0.1	20														
Asteraceae	<i>Ozothamnus diosmifolius</i>	Shrub (SG)							0.2	10													0.1	5		
Asteraceae	<i>Senecio madagascariensis</i>	High Threat															0.1	20								
Bignoniaceae	<i>Pandorea pandorana</i>	Other (OG)	1	20																						
Casuarinaceae	<i>Allocasuarina littoralis</i>	Tree (TG)	10	5	2	20																				
Casuarinaceae	<i>Allocasuarina torulosa</i>	Tree (TG)			5	20																				
Commelinaceae	<i>Commelina cyanea</i>	Forb (FG)																	0.1	2						
Convolvulaceae	<i>Dichondra repens</i>	Forb (FG)																	0.1	20	0.1	100				
Convolvulaceae	<i>Polymeria calycina</i>	Other (OG)												0.1	50											
Cyperaceae	<i>Cyperus involucratus</i>	Exotic					0.1	1																		
Cyperaceae	<i>Cyperus</i> sp.	Grass & grasslike (GG)									0.1	10														
Cyperaceae	<i>Gahnia clarkei</i>	Grass & grasslike (GG)																			0.5	1	1	5		
Cyperaceae	<i>Lepidosperma laterale</i>	Grass & grasslike (GG)																	0.1	15			0.1	5	0.1	20
Cyperaceae	<i>Ptilothrix deusta</i>	Grass & grasslike (GG)																					2	50	2	50
Cyperaceae	<i>Schoenus ericetorum</i>	Grass & grasslike (GG)	0.1	5							0.1	10														
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Fern (EG)	5	100 0	0.1	10																				
Dilleniaceae	<i>Hibbertia empetrifolia</i> subsp. <i>empetrifolia</i>	Shrub (SG)																							0.1	10
Dilleniaceae	<i>Hibbertia pedunculata</i>	Shrub (SG)	0.1	5	0.1	5																				
Ericaceae	<i>Leucopogon leptospermoides</i>	Shrub (SG)	0.5	20																						
Ericaceae	<i>Monotoca elliptica</i>	Shrub (SG)	10	20	5	50																				

Family	Scientific Name	BAM Growth Form / High Threat Weeds	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12		
			C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	
Euphorbiaceae	<i>Ricinosarpus pinifolius</i>	Shrub (SG)	0.2	20																							
Fabaceae (Faboideae)	<i>Bossiaea heterophylla</i>	Shrub (SG)	0.1	10																							
Fabaceae (Faboideae)	<i>Daviesia ulicifolia</i> subsp. <i>ulicifolia</i>	Shrub (SG)	1	20							1	5												0.1	10		
Fabaceae (Faboideae)	<i>Desmodium rhytidophyllum</i>	Forb (FG)									0.1	1															
Fabaceae (Faboideae)	<i>Dillwynia retorta</i>	Shrub (SG)	1	50																			0.2	100	0.1	20	
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	Other (OG)									0.1	20															
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Other (OG)									0.1	10					0.1	10									
Fabaceae (Faboideae)	<i>Phyllota phyllicoides</i>	Shrub (SG)	0.2	15																							
Fabaceae (Faboideae)	<i>Pultenaea euchila</i>	Shrub (SG)									0.1	1											0.2	50	1	50	
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>	Shrub (SG)	0.5	10							1	20	10	50	1	1					1	1					
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	Shrub (SG)			0.2	1																					
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Shrub (SG)	2	5	5	50			0.1	2	0.1	5	5	20	10	20	0.1	1	0.1	2							
Fabaceae (Mimosoideae)	<i>Acacia suaveolens</i>	Shrub (SG)	1	50																							
Fabaceae (Mimosoideae)	<i>Acacia terminalis</i>	Shrub (SG)	0.1	1																							
Goodeniaceae	<i>Goodenia heterophylla</i> subsp. <i>eglandulosa</i>	Forb (FG)																					1	100	0.1	20	
Haloragaceae	<i>Gonocarpus micranthus</i>	Forb (FG)																					0.1	5			
Hypoxidaceae	<i>Hypoxis hygrometrica</i>	Forb (FG)									0.1	5	0.1	10	0.1	20											
Juncaceae	<i>Juncus usitatus</i>	Grass & grasslike (GG)									0.1	50					0.1	20	0.1	5							
Lentibulariaceae	<i>Utricularia dichotoma</i>	Forb (FG)	0.1	5																							
Lobeliaceae	<i>Pratia purpurascens</i>	Forb (FG)							0.1	50	0.1	20			0.1	20	0.1	20	0.1	20	0.1	20	0.1	10	0.1	10	
Lomandraceae	<i>Lomandra filiformis</i>	Grass & grasslike (GG)							0.1	50	0.1	10													0.1	50	
Lomandraceae	<i>Lomandra glauca</i>	Grass & grasslike (GG)	2	500																							
Lomandraceae	<i>Lomandra longifolia</i>	Grass & grasslike (GG)	0.2	20															0.1	1	5	50					
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Grass & grasslike (GG)							10	50	0.1	10			0.2	10	0.1	1	1	20			0.1	5	0.1	10	
Malvaceae	<i>Pavonia hastata</i>	Exotic																				0.2	50				
Malvaceae	<i>Sida rhombifolia</i>	Exotic									0.1	1									1	100					
Menispermaceae	<i>Stephania japonica</i>	Other (OG)			0.1	2																					
Myrtaceae	<i>Angophora costata</i>	Tree (TG)	1	1																							
Myrtaceae	<i>Callistemon linearis</i>	Shrub (SG)																					0.5	20	0.1	5	
Myrtaceae	<i>Corymbia gummifera</i>	Tree (TG)					15	1																			
Myrtaceae	<i>Corymbia maculata</i>	Tree (TG)							70	12	15	2								50	17				30	15	
Myrtaceae	<i>Eucalyptus fibrosa</i>	Tree (TG)																		5	2					35	15
Myrtaceae	<i>Eucalyptus paniculata</i> subsp. <i>paniculata</i>	Tree (TG)							5	2	35	15															
Myrtaceae	<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	Tree (TG)	2	3																							

Family	Scientific Name	BAM Growth Form / High Threat Weeds	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12		
			C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	
Myrtaceae	<i>Eucalyptus pilularis</i>	Tree (TG)	30	2																							
Myrtaceae	<i>Eucalyptus signata</i>	Tree (TG)	20	1																							
Myrtaceae	<i>Eucalyptus tereticornis</i>	Tree (TG)					20	3			2	1									3	1					
Myrtaceae	<i>Eucalyptus umbra</i>	Tree (TG)																	5	1			1	3	5	5	
Myrtaceae	<i>Leptospermum trinervium</i>	Shrub (SG)	5	5																							
Myrtaceae	<i>Melaleuca nodosa</i>	Shrub (SG)	0.5	1															40	30					10	10	
Myrtaceae	<i>Melaleuca quinquenervia</i>	Tree (TG)					2	2																			
Myrtaceae	<i>Melaleuca sieberi</i>	Shrub (SG)																					0.5	1	0.1	1	
Myrtaceae	<i>Melaleuca styphelioides</i>	Shrub (SG)																				1	1				
Oleaceae	<i>Ligustrum sinense</i>	High Threat																	0.2	2							
Oxalidaceae	<i>Oxalis perennans</i>	Forb (FG)					0.1	50			0.1	10															
Phormiaceae	<i>Dianella caerulea</i> var. <i>producta</i>	Forb (FG)	10	100	2	100			0.5	50	0.5	20	0.1	1					0.1	20			0.1	5	0.1	5	
Phormiaceae	<i>Dianella longifolia</i> var. <i>longifolia</i>	Forb (FG)													0.1	5							0.1	10	0.1	5	
Phyllanthaceae	<i>Breynia oblongifolia</i>	Shrub (SG)			1	50					1	20			0.2	2			0.5	20					0.1	20	
Phyllanthaceae	<i>Glochidion ferdinandi</i>	Tree (TG)	5	1	80	1000	0.1	3	0.1	10	1	5	0.5	1	1	5			0.2	20	1	1			0.1	10	
Phyllanthaceae	<i>Phyllanthus hirtellus</i>	Shrub (SG)																	0.1	1							
Pittosporaceae	<i>Billardiera scandens</i>	Other (OG)	1	20	0.1	5			1	20									0.1	1					0.1	5	
Pittosporaceae	<i>Bursaria spinosa</i>	Shrub (SG)																	5	50					5	5	
Pittosporaceae	<i>Pittosporum revolutum</i>	Shrub (SG)			0.1	20																					
Pittosporaceae	<i>Pittosporum undulatum</i>	Shrub (SG)			0.5	10			5	4					0.1	1			10	15							
Plantaginaceae	<i>Plantago lanceolata</i>	Exotic					0.1	5			0.1	10	0.1	100	0.1	20	0.2	500			0.1	50					
Poaceae	<i>Andropogon virginicus</i>	High Threat																1	10					30	100		
Poaceae	<i>Aristida vagans</i>	Grass & grasslike (GG)							0.1	50	0.1	10							0.1	5			2	50	2	100	
Poaceae	<i>Axonopus fissifolius</i>	High Threat					3	100			0.1	10			0.1	10											
Poaceae	<i>Briza maxima</i>	Exotic											0.1	100	0.1	20	0.1	50			0.1	100					
Poaceae	<i>Briza subaristata</i>	High Threat											0.1	100							1	50					
Poaceae	<i>Capillipedium spicigerum</i>	Grass & grasslike (GG)											5	200					5	50					0.1	5	
Poaceae	<i>Chloris gayana</i>	High Threat											5	500	0.5	10					1	50					
Poaceae	<i>Cymbopogon refractus</i>	Grass & grasslike (GG)									5	100									0.1	5					
Poaceae	<i>Cynodon dactylon</i>	Grass & grasslike (GG)	0.2	100			80	5000			0.1	50	20	1000	25	1000	60	1000			1	100					
Poaceae	<i>Dichelachne micrantha</i>	Grass & grasslike (GG)									0.5	50	0.1	50				0.1	50	0.2	10						
Poaceae	<i>Echinopogon ovatus</i>	Grass & grasslike (GG)							0.1	50	0.2	50											0.1	20			
Poaceae	<i>Entolasia marginata</i>	Grass & grasslike (GG)							0.1	20																	
Poaceae	<i>Entolasia stricta</i>	Grass & grasslike (GG)							40	500	0.5	20							25	1000			20	100	35	500	
Poaceae	<i>Eragrostis curvula</i>	High Threat			5	100																					
Poaceae	<i>Imperata cylindrica</i>	Grass & grasslike (GG)	5	100	0.2	50									20	1000			0.1	10							
Poaceae	<i>Megathyrsus maximus</i>	High Threat											5	500							20	500					
Poaceae	<i>Melinis repens</i>	Exotic			5	100																					
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Grass & grasslike (GG)			0.1	20			0.1	50			5	500			0.1	50	1	50							
Poaceae	<i>Oplismenus aemulus</i>	Grass & grasslike (GG)			1	100													0.2	50							

Family	Scientific Name	BAM Growth Form / High Threat Weeds	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10		Q11		Q12	
			C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab	C (%)	Ab
Poaceae	<i>Oplismenus imbecillis</i>	Grass & grasslike (GG)																	2	50						
Poaceae	<i>Panicum effusum</i>	Grass & grasslike (GG)																							0.1	10
Poaceae	<i>Panicum simile</i>	Grass & grasslike (GG)	0.1	20					0.1	20	5	100	0.1	10					0.1	20			15	100		
Poaceae	<i>Paspalidium distans</i>	Grass & grasslike (GG)									0.1	20	0.1	10	0.1	10			0.1	10			0.1	20		
Poaceae	<i>Paspalum dilatatum</i>	High Threat					0.1	50	0.1	20	5	100	45	100 0	1	20	30	500					0.1	20		
Poaceae	<i>Paspalum urvillei</i>	Exotic																	0.1	1	0.1	20	0.2	20		
Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>	Grass & grasslike (GG)																			0.2	20				
Poaceae	<i>Rytidosperma pallidum</i>	Grass & grasslike (GG)																	0.2	10			20	100	25	200
Poaceae	<i>Setaria pumila</i>	Exotic					5	500																		
Poaceae	<i>Setaria sphacelata</i>	Exotic										0.1	5	5	100	0.1	20					0.5	20	0.2	20	
Poaceae	<i>Stenotaphrum secundatum</i>	Exotic																			40	100 0				
Poaceae	<i>Themeda triandra</i>	Grass & grasslike (GG)							15	100						15	500			0.1	20	1	50		2	50
Proteaceae	<i>Grevillea robusta</i>	Tree (TG)														0.5	2									
Proteaceae	<i>Persoonia lanceolata</i>	Shrub (SG)	0.1	5																						
Proteaceae	<i>Persoonia levis</i>	Shrub (SG)	0.5	5																						
Proteaceae	<i>Persoonia linearis</i>	Shrub (SG)	0.1	5	0.2	3																				
Pteridaceae	<i>Cheilanthes sieberi</i>	Fern (EG)									0.5	50	0.2	100					0.1	50						
Ranunculaceae	<i>Clematis aristata</i>	Other (OG)			0.1	2																				
Rhamnaceae	<i>Alphitonia excelsa</i>	Tree (TG)			10	50													1	2	1	1				
Rosaceae	<i>Rubus fruticosus</i> sp. agg.	Exotic													20	50										
Rosaceae	<i>Rubus parvifolius</i>	Shrub (SG)																			10	100				
Rubiaceae	<i>Pomax umbellata</i>	Forb (FG)	0.1	100																						
Rubiaceae	<i>Richardia stellaris</i>	Exotic					0.1	10																		
Rutaceae	<i>Eriostemon australasius</i>	Shrub (SG)	0.5	20																						
Sapindaceae	<i>Dodonaea triquetra</i>	Shrub (SG)	0.2	10																						
Stackhousiaceae	<i>Stackhousia viminea</i>	Forb (FG)									0.1	10														
Thymelaeaceae	<i>Pimelea linifolia</i>	Shrub (SG)	0.1	10																						
Verbenaceae	<i>Lantana camara</i>	High Threat	5	5	20	50					1	5	1	5	1	10			25	50	1	1			1	5
Verbenaceae	<i>Verbena bonariensis</i>	Exotic											0.1	20			0.5	20			1	100				
Zamiaceae	<i>Macrozamia communis</i>	Other (OG)	0.1	5																						

C (%) = Percent Foliage Cover; Ab = Abundance rating

Fauna Species List

Scientific Name	Common Name	Status
Amphibians		
<i>Limnodynastes peronii</i>	Striped Marsh Frog	
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	
<i>Litoria latopalmata</i>	Broad-palmed Frog	
<i>Litoria tyleri</i>	Tyler's Tree Frog	
Birds		
<i>Acanthiza pusilla</i>	Brown Thornbill	
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	
<i>Caligavis chrysops</i>	Yellow-faced Honeyeater	
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	
<i>Corvus coronoides</i>	Australian Raven	
<i>Cracticus tibicen</i>	Australian Magpie	
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	
<i>Elanus axillaris</i>	Black-shouldered Kite	
<i>Gerygone mouki</i>	Brown Gerygone	
<i>Hirundo neoxena</i>	Welcome Swallow	
<i>Malurus cyaneus</i>	Superb Fairy-wren	
<i>Manorina melanocephala</i>	Noisy Miner	
<i>Meliphaga lewinii</i>	Lewin's Honeyeater	
<i>Milvus migrans</i>	Black Kite	
<i>Pardalotus punctatus</i>	Spotted Pardalote	
<i>Platycercus eximius</i>	Eastern Rosella	
<i>Rhipidura albiscapa</i>	Grey Fantail	
<i>Rhipidura leucophrys</i>	Willie Wagtail	
<i>Tyto alba</i>	Barn Owl	
<i>Tyto novaehollandiae</i>	Masked Owl	Vulnerable (BC Act)
<i>Zosterops lateralis</i>	Silvereye	
Mammals		
<i>Antechinus stuartii</i>	Brown Antechinus	
<i>Austronomus australis</i>	White-striped Freetail-bat	
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	
<i>Isodon macrourus</i>	Northern Brown Bandicoot	
<i>Miniopterus australis</i>	Little Bentwing-bat	Vulnerable (BC Act)
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	Vulnerable (BC Act)
<i>Mormopterus ridei</i>	-	
<i>Mus domesticus</i>	House Mouse	Introduced
<i>Nyctophilus sp.</i>	Long-eared Bat	
<i>Petaurus breviceps</i>	Sugar Glider	
<i>Petaurus norfolcensis</i>	Squirrel Glider	Vulnerable (BC Act)
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Vulnerable (BC Act) / Vulnerable (EPBC Act)

Scientific Name	Common Name	Status
<i>Rattus lutreolus</i>	Swamp Rat	
<i>Rattus rattus</i>	Black Rat	Introduced
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	
<i>Vespadelus vulturnus</i>	Little Forest Bat	
<i>Wallabia bicolor</i>	Swamp Wallaby	
Reptiles		
<i>Eulamprus quoyii</i>	Eastern Water Skink	

APPENDIX 2. THREATENED SPECIES DATABASE SEARCH

A list of threatened species, populations and ecological communities that have been reported or modelled to occur from within a five-kilometre radius of the Study Area was obtained from the following databases:

- NSW Office of Environment and Heritage (OEH) BioNet Atlas: (<http://www.bionet.nsw.gov.au/>); and
- Department of Environment and Energy (DoTEE) Protected Matters search tool: (www.environment.gov.au/erin/ert/epbc/index.html).

An assessment was then made of the likelihood of the threatened species, populations, and ecological communities reported or modelled to occur in the locality occurring within the Study Area or using the habitat within the Study Area as an essential part of a foraging range.

The table below summarises the likelihood of threatened species and EPBC Act listed migratory species occurring within the Study Area based on the habitat requirements of each species. A brief definition of the likelihood of occurrence criteria is provided below:

- Known – species identified within the site during surveys;
- High – species known from the area (OEH Wildlife Atlas records), suitable habitat (such as roosting and foraging habitat) present within the site;
- Moderate – species may be known from the area, potential habitat is present within the site;
- Low – species not known from the area and/or marginal habitat is present within the site; and
- Nil – habitat requirements not met for this species within the site.

An assessment of the likelihood of threatened species, populations and ecological communities occurring within the Study Area

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
Flora								
1.	<i>Angophora inopina</i>	V	V	-	PMST	Occurs most frequently in four main vegetation communities: (i) <i>Eucalyptus haemastoma</i> – <i>Corymbia gummifera</i> – <i>Angophora inopina</i> woodland/forest; (ii) <i>Hakea teretifolia</i> – <i>Banksia oblongifolia</i> wet heath; (iii) <i>Eucalyptus resinifera</i> – <i>Melaleuca sieberi</i> – <i>Angophora inopina</i> sedge woodland; (iv) <i>Eucalyptus capitellata</i> – <i>Corymbia gummifera</i> – <i>Angophora inopina</i> woodland/forest. Marginal habitat within Study Area. Targeted searches (flora transects) undertaken in January 2019 did not detect the species.	Low	No
2.	<i>Caladenia tessellata</i> Thick Lip Spider Orchid	E	V	-	PMST	In NSW this species is found sporadically on the coast from Swansea and extends onto the Tablelands further south. <i>Caladenia tessellata</i> is normally found on clay or sandy soils in grassy sclerophyll woodlands, although it has been recorded on stony soil. The species is now known with certainty from only two populations on the NSW Southern Tablelands. Unlikely to occur at the Development Site. Species not known from locality.	Nil	No
3.	<i>Commersonia prostrata</i> Dwarf Kerrawang	E	E	-	PMST	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (<i>Eucalyptus pauciflora</i>) Woodland and Ephemeral Wetland floor at Rowes Lagoon; Blue leaved Stringybark (<i>E. agglomerata</i>) Open Forest at Tallong; and in Brittle Gum (<i>E. mannifera</i>) Low Open Woodland at Penrose; Scribbly Gum (<i>E. haemostoma</i>)/ Swamp Mahogany (<i>E. robusta</i>) Ecotonal Forest at Tomago. Marginal habitat within Study Area. Species not detected during field surveys.	Low	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
4.	<i>Cryptostylis hunteriana</i> Leafless Tongue-orchid	V	V	-	PMST	In New South Wales the species occupies a variety of habitats. The larger populations typically occur in woodland dominated by Scribbly Gum (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>). The species grows most often on the flat plains close to the coast, favouring moist soils. Marginal habitat within Study Area. Species not detected during field surveys.	Low	No
5.	<i>Cynanchum elegans</i> White- flowered Wax Plant	E	E	1	OEH Atlas, PMST	Occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree <i>Leptospermum laevigatum</i> – Coastal Banksia <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; Forest Red Gum <i>Eucalyptus tereticornis</i> aligned open forest and woodland; Spotted Gum <i>Corymbia maculata</i> aligned open forest and woodland; and Bracelet Honey Myrtle <i>Melaleuca armillaris</i> scrub to open scrub. Marginal habitat within Study Area. Species not detected during field surveys.	Low	No
6.	<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	V	V	93	OEH Atlas, PMST	This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports <i>Eucalyptus robusta</i> (Swamp mahogany), <i>E. tereticornis</i> (Forest Red Gum), <i>E. gummifera</i> (Sydney Bloodwood) as well as <i>Melaleuca</i> (Paperbark) species. Species detected during field surveys from woodland rehabilitation. Previously recorded on and within 1 km of the Study Area.	Known	Yes
7.	<i>Euphrasia arguta</i>	CE	CE	1	OEH Atlas	Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'. No suitable habitat within the Study Area.	Nil	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
8.	<i>Grevillea parviflora</i> subsp. <i>parviflora</i> Small-flower Grevillea	V	V	2	OEH Atlas, PMST	The species occurs in heath and shrubby woodland, in sandy or lightly clay soils usually over thin shales. Suitable habitat within Study Area, no individuals identified within Development Site.	Known	Yes
9.	<i>Lindernia alsinoides</i> Noah's False Chickweed	E	-	1	OEH Atlas	Grows in swamp forests and wetlands along coastal and hinterland creeks Suitable habitat within Study Area, no individuals identified within Development Site.	Low	-
10.	<i>Maundia triglochinosoides</i> -	V	-	1	OEH Atlas	Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Unsuitable habitat within the Development Site. Small population known from freshwater wetland which will be avoided by HDD.	Known	-
11.	<i>Melaleuca biconvexa</i> Biconvex Paperbark	V	V	-	PMST	The species is most commonly found in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects, along freshwater watercourses and in association with <i>Eucalyptus saligna</i> (Sydney Bluegum) or <i>Eucalyptus robusta</i> (Swamp Mahogany). Potential habitat within Study Area. Species not detected during field surveys.	Low	No
12.	<i>Persicaria elatior</i> Tall Knotweed	V	V	-	PMST	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. Unsuitable habitat within the Development Site. Species not detected during field surveys.	Low	No
13.	<i>Phaius australis</i> Lesser Swamp-orchid	E	E	-	PMST	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas. Unlikely to occur at the Development Site. Species not known from locality.	Nil	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
14.	<i>Prasophyllum sp. Wybong</i>	-	CE	-	PMST	A perennial orchid, appearing as a single leaf over winter and spring. Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to occur in open eucalypt woodland and grassland. Outside known distribution of the species. Some potential habitat present. Not recorded during targeted threatened flora searches across the Study Area.	Low	No
15.	<i>Rutidosis heterogama</i>	V	V	-	PMST	Grows in heath on sandy soils and moist areas in open forest and has been recorded along disturbed roadsides. Marginal habitat within Study Area. Not recorded during targeted threatened flora searches across the Study Area.	Low	No
16.	<i>Syzygium paniculatum</i>	E	V	-	PMST	Small to medium sized rainforest tree growing to 8 m tall. The bark is flaky and the leaves are shiny, dark-green above and paler underneath growing to 10 cm long. Plants produce white flower-clusters at the end of each branch, between November and February. Occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. No suitable habitat within Study Area.	Nil	No
17.	<i>Tetraloche juncea</i> Black-eyed Susan	V	V	-	PMST	Grows in sandy, occasionally swampy heath and in dry sclerophyll forest; chiefly in coastal districts from Bulahdelah to Lake Macquarie. Suitable habitat, no individuals identified (surveys conducted in flowering period).	Low	No
18.	<i>Zannichellia palustris</i>	E	-	2	OEH Atlas	Grows in fresh or slightly saline stationary or slowly flowing water. Flowers during warmer months. No suitable habitat within the Development Site. Not recorded during targeted threatened flora searches across the Study Area.	Low	-

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
Threatened Ecological Communities								
1.	<i>Central Hunter Valley eucalypt forest and woodland</i>	-	CE	-	PMST	<p>The ecological community is a eucalypt woodland/ open forest. It occurs in the Hunter River catchment (including the Goulburn Valley)—commonly known as the Hunter Valley, or Hunter Region—in north-eastern New South Wales.</p> <p>The ecological community is mainly in the Central Hunter Valley—in the Muswellbrook, Singleton and Cessnock Local Government Areas.</p> <p>This TEC does not occur within the Study Area.</p>	Nil	No
2.	<i>Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community</i>	-	E	-	PMST	<p>Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees.</p> <p>A total of 1.4 ha of the Coastal Swamp Oak Forest EEC (a regenerating patch) was mapped within the Study Area, occurring along the power station site's southern boundary. It does not form part of the Development Site.</p>	Known	Yes
3.	<i>Subtropical and Temperate Coastal Saltmarsh</i>	-	V	-	PMST	<p>The community is largely restricted to the intertidal zone of the subtropical and temperate coasts of Australia. Substrates of intertidal saltmarsh are Quaternary or recent alluvium and are saline to hypersaline depending on the extent of inundation and tidal flushing.</p> <p>Unsuitable habitat within the Study Area. Community does not occur within Study Area.</p>	Nil	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
4.	<i>Lowland Rainforest of Subtropical Australia</i> (CEEC – EPBC);	E	CE	-	PMST	The Lowland Rainforest of Subtropical Australia ecological community primarily occurs from Maryborough in Queensland to the Clarence River (near Grafton) in New South Wales (NSW). The ecological community also includes isolated areas between the Clarence River and Hunter River such as the Bellinger and Hastings Valleys. Unsuitable habitat within the Study Area. Community does not occur within Study Area.	Nil	No
Amphibians								
1.	<i>Crinia tinnula</i> Wallum Froglet	V	-	7	OEH Atlas	Found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgeland and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. Possible – marginal habitat in Freshwater Wetland within Study Area. Targeted searches undertaken in March 2019 did not detect the species.	Low	-
2.	<i>Heleioporus australiacus</i> Giant Burrowing Frog	V	V	-	PMST	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water. Not recorded to date on or within 5 km of Study Area. Unlikely to occur within Study Area.	Nil	No
3.	<i>Litoria aurea</i> Green and Golden Bell Frog	E	V	3414	OEH Atlas, PMST	Prefers open water bodies, fringed by reeds and other aquatic vegetation for breeding and foraging purposes. Needs fallen logs and debris for shelter and overwintering purposes. Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Possible – marginal habitat in Freshwater Wetland within Study Area. Targeted searches undertaken in March 2019 did not detect the species.	Low	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
4.	<i>Uperoleia mahonyi</i>	E	-	3	OEH Atlas	Commonly associated with acid paperbark swamps, Mahony's Toadlet also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species. Possible – marginal habitat in Freshwater Wetland within Study Area. Targeted searches undertaken in March 2019 did not detect the species.	Low	-
Birds								
1.	<i>Anthochaera phrygia</i> Regent Honeyeater	CE	CE	-	PMST	Mostly recorded in box-ironbark eucalypt associations. At times of food shortage, the species also uses other woodland types and wet lowland coastal forest dominated by Swamp Mahogany or Spotted Gum. Recorded from Hunter Region Botanic Gardens in August 2018. May occur in Swamp Mahogany – Paperbark Forest, Spotted Gum – Ironbark Forest or Coastal Sand Apple – Blackbutt Forest communities within Study Area.	Low	Yes
2.	<i>Anseranas semipalmata</i> Magpie Goose	V	-	4	OEH Atlas	Is widespread throughout coastal northern and eastern Australia. It can be seen from Fitzroy River, Western Australia, through northern Australia to Rockhampton, Queensland, and has been extending its range into coastal New South Wales to the Clarence River and further south. Marginal foraging habitat within Study Area. No suitable habitat within Development Site.	Low	-
3.	<i>Artamus cyanopterus cyanopterus</i> Dusky Woodswallow	V	-	1	OEH Atlas	Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland. Marginal foraging habitat within the Study Area.	Low	-

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
4.	<i>Botaurus poiciloptilus</i> Australasian Bittern	E	E	8	PMST	Occurs in reeds and marshes in terrestrial freshwater wetlands and, occasionally estuarine habitats. Nests in stands of <i>Phragmites</i> , <i>Typha</i> , and rushes (<i>Juncus</i> , <i>Baumea</i> spp.). Marginal habitat within Study Area. Very small areas of freshwater wetland present within Study Area were dry at time of survey.	Low	No
5.	<i>Calidris canutus</i> Red Knot	-	E, M	3	OEH Atlas, PMST	Mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts. Occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans but rarely use freshwater swamps. Unsuitable habitat within the Study Area.	Nil	No
6.	<i>Calidris ferruginea</i> Curlew Sandpiper	E	CE, M	6	OEH Atlas, PMST	Generally occupies littoral and estuarine habitats including intertidal mudflats of sheltered coasts where it forages in or at the edge of shallow water. May also occur in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. Unsuitable habitat within the Study Area.	Nil	No
7.	<i>Calidris tenuirostris</i> Great Knot	V	CE	2	PMST	Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Unsuitable habitat within the Study Area.	Nil	No
8.	<i>Calyptorhynchus lathamii</i> Glossy Black Cockatoo	V	-	2	OEH Atlas	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Feeds almost exclusively on the seeds of several species of she-oak (particularly Black She-oak, Forest She-oak, or Drooping She-oak). Dependent on large hollow-bearing eucalypts for nest sites. Low suitability of habitat due to very small amount of Casuarina and Allocasuarina species within the Development Site.	Low	-

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
9.	<i>Charadrius leschenaultii</i> Greater sand Plover	V	V	2	OEH Atlas, PMST	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. Unsuitable habitat within the Study Area.	Nil	No
10.	<i>Charadrius mongolus</i> Lesser Sand Plover	V	E	3	OEH Atlas, PMST	Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Unsuitable habitat within the Study Area.	Nil	No
11.	<i>Circus assimilis</i> Spotted Harrier	V	-	1	OEH Atlas	Occurs in grassy open woodland including <i>Acacia</i> and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands Marginal foraging habitat within the Study Area.	Low	-
12.	<i>Daphoenositta chrysoptera</i> Varied Sittella	V	-	6	OEH Atlas	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and <i>Acacia</i> woodland. Marginal foraging habitat within the Study Area. Development Site lacks shrub and groundlayer structure.	Low	-
13.	<i>Dasyornis brachypterus</i> Eastern Bristlebird	E	E	-	PMST	Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone. Habitat and location is unsuitable for this species. No records within locality.	Nil	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
14.	<i>Ephippiorhynchus asiaticus</i> Black-necked Stork	E	-	12	OEH Atlas	Black-necked Storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. Marginal foraging habitat within the Study Area.	Low	-
15.	<i>Epthianura albifrons</i> White-fronted Chat	V	-	26	OEH Atlas	Gregarious species usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Unsuitable habitat within the Study Area.	Low	-
16.	<i>Erythrorichis radiatus</i> Red Goshawk	CE	V	-	PMST	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers. Marginal habitat within the Study Area. Outside known distribution of the species.	Nil	No
17.	<i>Falco subniger</i> Black Falcon	V	-	1	OEH Atlas	Sparsely distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population. Marginal habitat within the Study Area.	Low	-
18.	<i>Glossopsitta pusilla</i> Little Lorikeet	V	-	7	OEH Atlas	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in <i>Angophora</i> , <i>Melaleuca</i> and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Potential foraging habitat within Study Area.	High	-

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		TSC Act	EPBC Act					
19.	<i>Grantiella picta</i> Painted Honeyeater	V	V	-	PMST	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. The primary food source for this bird is the fruit and flowers of mistletoes in the genus <i>Amyema</i> , though it will also take some nectar and insects. No suitable habitat due to lack of mistletoes and suitable tree species. No records in locality.	Low	No
20.	<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	V	M	53	OEH Atlas	Inhabits coastal areas including offshore islands and hunts over estuaries and waterways. Unsuitable foraging habitat within the Study Area. One large stick nest found within Study Area was confirmed to belong to a Wedge-tailed Eagle (but the nest was known to previously be occupied by this species).	High	Yes
21.	<i>Hieraaetus morphnoides</i> Little Eagle	V	-	2	OEH Atlas	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Potential habitat for this species within Study Area. No stick nests characteristic of this species were observed within Study Area.	Low	-
22.	<i>Ixobrychus flavicollis</i> Black Bittern	V	-	1	OEH Atlas	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Marginal habitat (semi-vegetated waterbodies) within the Study Area. Only one record from the locality.	Low	-
23.	<i>Lathamus discolor</i> Swift Parrot	CE	CE	-	PMST	This migratory species has been recorded on the mainland from a variety of habitat types including dry and wet sclerophyll forest, forested wetlands, coastal swamp forests and heathlands. Potential foraging habitat across the Study Area in forest and woodland communities. Species not identified during field surveys.	Moderate	Yes

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
24.	<i>Limicola falcinellus</i> Broad-billed Sandpiper	V	-	10	OEH Atlas	Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches. Unsuitable habitat within the Study Area.	Nil	No
25.	<i>Limosa lapponica baueri</i> Bar-tailed Godwit	-	V	-	PMST	It is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms. Unsuitable habitat within the Study Area.	Nil	No
26.	<i>Limosa lapponica menzbieri</i>	-	CE	-	PMST	The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. In Tasmania, the bar-tailed godwit has mostly been recorded on the south-east coast. No suitable habitat within Study Area.	Nil	No
27.	<i>Limosa limosa</i> Black-tailed Godwit	V	M	10	OEH Atlas, PMST	Inhabits intertidal mudflats, rarely far from the coast. No suitable habitat within Study Area.	Nil	No
28.	<i>Lophoictinia isura</i> Square-tailed Kite	V	-	2	OEH Atlas	It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Potential habitat for this species within Study Area. No stick nests characteristic of this species were observed within Study Area.	Low	-

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		TSC Act	EPBC Act					
29.	<i>Neophema pulchella</i> Turquoise Parrot	V	-	1	OEH Atlas	Inhabits fringes of eucalypt woodlands, often adjacent to clearings, ridges and farmland creeks. Typically forages on the ground under trees. Distributed from southern Queensland to northern Victoria, extending from the coast to the western slopes of the Great Dividing Range. Nesting occurs from December to August in tree hollows. Marginal foraging habitat within the Study Area. Development Site lacks shrub and groundlayer structure.	Low	-
30.	<i>Ninox strenua</i> Powerful Owl	V	-	4	OEH Atlas	The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunt in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine, Black She-oak, Blackwood, Rough-barked Apple, Cherry Ballart and a number of eucalypt species. 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. Marginal foraging and roosting habitat within the Development Site.	Moderate	-
31.	<i>Numenius madagascariensis</i> Eastern Curlew	-	CE, M	22	OEH Atlas, PMST	Generally, occupies coastal lakes, inlets, bays and estuarine habitats mainly in intertidal mudflats and sometimes saltmarsh of sheltered coasts. No suitable habitat within the Study Area.	Nil	No
32.	<i>Pandion cristatus</i> Eastern Osprey	V	-	8	OEH Atlas	Found mostly in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. Unsuitable foraging habitat within the Study Area. No stick nests characteristic of this species were observed within Study Area.	Low	-

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
33.	<i>Petroica boodang</i> Scarlet Robin	V	-	1	OEH Atlas	In NSW, it occurs from the coast to the inland slopes. The species lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. The species habitat usually contains abundant logs and fallen timber. Marginal foraging habitat within the Study Area. Development Site lacks shrub and groundlayer structure.	Low	-
34.	<i>Pomatostomus temporalis temporalis</i> Grey-crowned Babbler (eastern subspecies)	V	-	2	OEH Atlas	Inhabits Box-Gum woodlands on slopes, and Box-Cypress pine and Open-Box woodlands when on Alluvial plains. Distribution along most of the eastern side of Australia, particularly the western slopes of the Great Dividing Range. Marginal foraging habitat within the Study Area. Development Site lacks shrub and groundlayer structure.	Low	-
35.	<i>Ptilinopus magnificus</i> Wompoo Fruit-Dove	V	-	1	OEH Atlas	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. Unsuitable habitat within the Study Area.	Low	-
36.	<i>Rostratula australis</i> Australian Painted-snipe	E	E	2	OEH Atlas, PMST	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Marginal habitat (semi-vegetated waterbodies) within the Study Area. Targeted waterbird surveys did not detect the species.	Low	No
37.	<i>Sternula albifrons</i> Little Tern	E	M	1	OEH Atlas	Almost exclusively coastal, preferring sheltered environments but may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Unsuitable habitat within the Study Area.	Nil	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
38.	<i>Stictonetta naevosa</i> Freckled Duck	V	-	5	OEH Atlas	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Unsuitable habitat within the Study Area.	Nil	-
39.	<i>Tyto longimembris</i> Eastern Grass Owl	V	-	20	OEH Atlas	Eastern Grass Owls are 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. Marginal foraging habitat within the Study Area. Not detected during spotlighting surveys.	Low	-
40.	<i>Tyto novaehollandiae</i> Masked Owl	V	-	2	OEH Atlas	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Suitable foraging and breeding habitat within the Study Area. A pair were recorded just outside Study Area boundary and regurgitated pellets were found under several trees.	Known	-
41.	<i>Xenus cinereus</i> Terek Sandpiper	V	M	4	OEH Atlas	In Australia, has been recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools. Unsuitable habitat within the Study Area.	Nil	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
Mammals								
1.	<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	-	PMST	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Found in well-timbered areas containing gullies. No suitable habitat within the Study Area. No records in locality.	Nil	No
2.	<i>Dasyurus maculatus</i> Spotted-tailed Quoll	V	E	-	PMST	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Low habitat suitability within the Development Site due to lack of ground and shrub layer structure.	Low	No
3.	<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle	V	-	19	OEH Atlas,	Prefers moist habitats, with trees taller than 20 m and generally roosts in tree hollows. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Marginal roosting and foraging habitat available within Study Area.	Moderate	-
4.	<i>Miniopterus australis</i> Little Bentwing-bat	V	-	51	OEH Atlas	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. Detected within the Study Area. Marginal roosting and foraging habitat available within Development Site.	Known	-
5.	<i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat	V	-	18	OEH Atlas	Forages in forested habitats. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Marginal foraging habitat available within the Development Site.	Known	-

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
6.	<i>Mormopterus norfolkensis</i> Eastern Freetail-bat	V	-	61	OEH Atlas	Inhabits dry sclerophyll forest and woodland, where it hunts for insects above the canopy or within clearings at forest edges. This species normally roosts in tree hollows or under loose bark on a variety of tree species. Detected within the Study Area. Marginal roosting and foraging habitat available within the Development Site.	Known	-
7.	<i>Myotis macropus</i> Southern Myotis	V	-	30	OEH Atlas	Generally roost close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. Typically occurs in vegetated areas. Marginal roosting habitat within Study Area. Foraging habitat within locality.	Moderate	-
8.	<i>Petauroides Volans</i> Greater Glider	-	V	-	PMST	Open woodland and tall remnant forests where there is suitable eucalypt trees. Rests in hollow trees during the day and feeds at night. Presence and density of Greater Gliders is related to soil fertility, eucalypt tree species, disturbance history and density of suitable tree hollows Low habitat suitability within the Study Area.	Low	No
9.	<i>Petaurus norfolcensis</i> Squirrel Glider	V	-	16	OEH Atlas	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. Prefers mixed species stands with a shrub or Acacia midstorey. Requires abundant tree hollows for refuge and nest sites. Recorded within the Study Area.	Known	-
10.	<i>Phascogale tapoatafa</i> Brush-tailed Phascogale	V	-	2	OEH Atlas	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. Potential habitat within woodland and forest communities within Study Area. Targeted remote camera surveys and spotlighting did not detect the species.	Low	-

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
11.	<i>Phascolarctos cinereus</i> Koala	V	V	278	OEH Atlas, PMST	Found in a variety of forest types with suitable feed tree species. Feeds on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Potential habitat due to the presence of Koala feed trees. Presence has been assumed due to past records within Study Area.	Known	Yes
12.	<i>Potorous tridactylus tridactylus</i> Long-nosed Potoroo (SE Mainland Population)	V	V	-	PMST	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. Low habitat suitability within the Study Area.	Nil	No
13.	<i>Pseudomys novaehollandiae</i> New Holland Mouse	-	V	17	OEH Atlas, PMST	Inhabits open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. Low habitat suitability within the Development Site. Targeted trapping surveys did not detect the species.	Low	No
14.	<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	22	OEH Atlas, PMST	Occurs across a wide range of habitat types along the eastern seaboard of Australia, depending on food availability. Fruit from myrtaceous trees and rainforest trees form the major components of their diet. Potential foraging habitat within forest and woodland communities within Study Area. No roost sites present.	Known	Yes
15.	<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat	V	-	3	OEH Atlas,	Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Roosts in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Marginal roosting and foraging habitat available within Study Area.	Moderate	-

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
16.	<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat	V	-	22	OEH Atlas	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Marginal roosting and foraging habitat available within Study Area.	Moderate	-
17.	<i>Vespadelus troughtoni</i> Eastern Cave Bat	V	-	7	OEH Atlas	A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest. Marginal foraging habitat available within the Study Area. The Development Site does not occur near cliffs or rocky overhangs.	Low	-
Fish								
1.	<i>Epinephelus daemeli</i> Black Rockcod	-	V	0	PMST	Usually found in caves, gutters and beneath bommies on rocky reefs, from near shore environments to depths of at least 50 m. Small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores in estuaries. No suitable habitat within the Study Area.	Nil	No
Migratory Species								
1.	<i>Actitis hypoleucos</i> Common Sandpiper	-	M	8	OEH Atlas, PMST	Prefers rocky creeks, channels, dams, mangrove-lined inlets. Forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. Low habitat suitability within the Study Area.	Low	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
2.	<i>Arenaria interpres</i> Ruddy Turnstone	-	M	-	PMST	The Ruddy Turnstone is found singly or in small groups along the coastline and only occasionally inland. They are mainly found on exposed rocks or reefs, often with shallow pools, and on beaches. In the north, they are found in a wider range of habitats, including mudflats Unsuitable habitat within the Study Area.	Nil	No
3.	<i>Ardea ibis</i> Cattle Egret	-	M	42	OEH Atlas	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. Low habitat suitability within the Study Area.	Low	No
4.	<i>Calidris acuminata</i> Sharp-tailed Sandpiper	-	M	35	OEH Atlas, PMST	The Sharp-tailed Sandpiper prefers the grassy edges of shallow inland freshwater wetlands. It is also found around sewage farms, flooded fields, mudflats, mangroves, rocky shores and beaches. Its breeding habitat in Siberia is the peat-hummock and lichen tundra of the high Arctic. Low habitat suitability within the Study Area.	Low	No
5.	<i>Calidris canutus</i> Red Knot	-	E, M	3	OEH Atlas, PMST	Mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts. Occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans but rarely use freshwater swamps. Low habitat suitability within the Study Area.	Low	No
6.	<i>Calidris ferruginea</i> Curlew Sandpiper	-	CE, M	6	OEH Atlas, PMST	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. Low habitat suitability within the Study Area.	Low	No
7.	<i>Calidris melanotos</i> Pectoral Sandpiper	-	M	9	OEH Atlas, PMST	Inhabits shallow fresh to saline wetlands. Usually found in coastal or near coastal habitat. Prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation. Forages in shallow water or soft mud at the edge of wetlands Low habitat suitability within the Study Area.	Low	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
8.	<i>Calidris minuta</i> Little Stint	-	M	1	OEH Atlas	Found in fresh and brackish wetland habitats. Occurs locally in flocks; elsewhere singles travel with flocks of other waders. Low habitat suitability within the Study Area.	Low	No
9.	<i>Calidris ruficollis</i> Red-necked Stint	-	M	8	OEH Atlas, PMST	Inhabits a variety of fresh and saltwater habitats in coastal and inland areas. Mostly forages on bare wet mud on intertidal mudflats or sandflats, or in very shallow water; mostly in areas with a film of surface water and mostly close to edge of water. Low habitat suitability within the Study Area.	Low	No
10.	<i>Calidris tenuirostris</i> Great Knot	-	CE, M	2	OEH Atlas, PMST	Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Unsuitable habitat within the Study Area.	Nil	No
11.	<i>Charadrius bicinctus</i> Double-banded Plover	-	M	-	PMST	The Double-banded Plover is found on coastal beaches, mudflats, sewage farms, riverbanks, fields, dunes, upland tussock grasses and shingle. Unsuitable habitat within the Study Area.	Nil	No
12.	<i>Charadrius leschenaultii</i> Greater Sand Plover	V	V, M	2	OEH Atlas, PMST	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. Unsuitable habitat within the Study Area.	Nil	No
13.	<i>Charadrius mongolus</i> Lesser Sand Plover	-	E, M	3	OEH Atlas, PMST	Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Unsuitable habitat within the Study Area.	Nil	No
14.	<i>Cuculus optatus</i> Oriental Cuckoo	-	M	-	OEH Atlas, PMST	Occurs at rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves. Low habitat suitability within the Study Area.	Low	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
15.	<i>Gallinago hardwickii</i> Latham's Snipe	-	M	4	OEH Atlas, PMST	Often recorded in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. Possible – some small wetlands present in Study Area. Targeted searches undertaken in January 2019 did not detect the species. All waterbodies were almost completely dry at time of survey.	Low	No
16.	<i>Gallinago megala</i> Swinhoe's Snipe	-	M	-	PMST	Breeding habitat: forest glades and meadows. Non-breeding habitat: shallow freshwater wetlands of various kinds including paddy fields and sewage farms, with bare mud or shallow water for feeding, with nearby vegetation cover. Low habitat suitability within the Study Area. Not known from locality.	Low	No
17.	<i>Gallinago stenura</i> Pin-tailed snipe	-	M	-	PMST	Birds in their non-breeding range use a variety of wetlands, often with common snipe, but may be found also in drier habitats than their relative. They nest in a well-hidden location on the ground. Low habitat suitability within the Study Area. Not known from locality.	Low	No
18.	<i>Hirundapus caudacutus</i> White-throated Needletail	-	M	1	OEH Atlas, PMST	Forages in high open spaces over varied habitat types although probably recorded most often above wooded or partly wooded areas, including open forest and rainforest, and may also fly between trees or in clearings. May occur in airspace over the Study Area.	Low – Moderate	Yes
19.	<i>Limicola falcinellus</i> Broad-billed Sandpiper	V	M	10	OEH Atlas	Inhabits sheltered coastal estuaries, lagoons with soft intertidal mudflats, muddy coastal creeks, swamps, sewage ponds. No suitable habitat within Study Area.	Nil	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
20.	<i>Limosa lapponica</i> Bar-tailed Godwit	-	M	6	OEH Atlas, PMST	Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Forages at low to mid tide in shallow water or along the water's edge on sandy substrates on intertidal flats, banks and beaches or on soft mud substrates. No suitable habitat within the Study Area.	Nil	No
21.	<i>Limosa limosa</i> Black-tailed Godwit	V	M	10	OEH Atlas, PMST	Inhabits intertidal mudflats, rarely far from the coast. No suitable habitat within Study Area.	Nil	No
22.	<i>Monarcha melanopsis</i> Black-faced Monarch	-	M	-	PMST	Found in rainforests, moist eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Suitable habitat within forest and woodland communities within Study Area.	Moderate	Yes
23.	<i>Monarcha trivirgatus</i> Spectacled Monarch	-	M	-	PMST	Inhabits the understorey of mountain/ lowland rainforests, thickly wooded gullies and waterside vegetation including mangroves. No suitable habitat within the Study Area. No records from locality.	Low	No
24.	<i>Motacilla flava</i> Yellow Wagtail	-	M	-	PMST	Found in a variety of habitats including short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns. No suitable habitat within the Study Area. No records from locality.	Nil	No
25.	<i>Myiagra cyanoleuca</i> Satin Flycatcher	-	M	-	PMST	Found in tall forests, preferring wetter habitats such as heavily forested gullies. Marginal habitat within the Study Area. No records from locality.	Low	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
26.	<i>Numenius madagascariensis</i> Eastern Curlew	-	CE, M	22	OEH Atlas, PMST	It generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Possible – some small wetlands present in Study Area. Targeted searches undertaken in January 2019 did not detect the species. All waterbodies were almost completely dry at time of survey.	Low	No
27.	<i>Numenius minutus</i> Little Curlew	-	M	1	OEH Atlas, PMST	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. Marginal habitat within Study Area. Targeted searches undertaken in January 2019 did not detect the species. All waterbodies were almost completely dry at the time of survey.	Low	No
28.	<i>Numenius phaeopus</i> Whimbrel	-	M	6	OEH Atlas, PMST	Prefers intertidal mud and sandflats but also known to inhabit harbours, lagoons, estuaries often with mangroves but also open unvegetated mudflats. No suitable habitat within the Study Area.	Nil	No
29.	<i>Pandion cristatus</i> Eastern Osprey	-	M	8	OEH Atlas, PMST	Ospreys are found on the coast and in terrestrial wetlands of tropical and temperate Australia and offshore islands, occasionally ranging inland along rivers, though mainly in the north of the country. May fly over the Study Area to nearby coastal foraging habitat. No potential nest trees were observed.	Low	No
30.	<i>Philomachus pugnax</i> Ruff	-	M	1	PMST	Prefers muddy margins of freshwater and brackish swamps and lakes. Marginal habitat within the Study Area.	Low	No
31.	<i>Plegadis falcinellus</i> Glossy Ibis	-	M	8	OEH Atlas	Requires shallow water and mudflats, so is found in well-vegetated wetlands, floodplains, mangroves and ricefields. Marginal habitat within the Study Area.	Low	No

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Assessment Required (EPBC)?
		TSC Act	EPBC Act					
32.	<i>Pluvialis fulva</i> Pacific Golden Plover	-	M	15	OEH Atlas, PMST	Intertidal sand and mudflats, coastal saltmarshes, rocky shores. No suitable habitat within the Study Area.	Nil	No
33.	<i>Pluvialis squatarola</i> Grey Plover	-	M	6	OEH Atlas, PMST	Occurs 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. No suitable habitat within the Study Area.	Nil	No
34.	<i>Rhipidura rufifrons</i> Rufous Fantail	-	M	1	PMST	Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. Suitable habitat within forest and woodland communities within Study Area.	Moderate	Yes
35.	<i>Tringa brevipes</i> Grey-tailed Tattler	-	M	1	OEH Atlas, PMST	Usually seen in small flocks on sheltered coasts with reefs and rock platforms or with intertidal mudflats. Also in intertidal rocky, coral or stony reefs, platforms and islets that are exposed at high tide, also shores of rock, shingle, gravel and shells and on intertidal mudflats in embayments, estuaries and coastal lagoons, especially those fringed with mangroves. No suitable habitat within the Study Area.	Nil	No
36.	<i>Tringa nebularia</i> Common Greenshank	-	M	24	OEH Atlas, PMST	Found both on the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops. Low habitat suitability within the Study Area.	Low	No
37.	<i>Tringa stagnatilis</i> Marsh Sandpiper	-	M	10	OEH Atlas, PMST	Inhabits coastal and inland fresh or saltwater wetlands, avoiding intertidal mudflats unless protected. Low habitat suitability within the Study Area.	Low	No
38.	<i>Xenus cinereus</i> Terek Sandpiper	V	M	4	OEH Atlas, PMST	Inhabits coastal mudflats in sheltered estuaries and lagoons as well as sandbars, reefs, coastal swamps and salt fields. No suitable habitat within Study Area.	Nil	No

* Legal Status: V = Vulnerable, E = Endangered, CE = Critically Endangered under TSC Act and EPBC Act; M = Migratory under EPBC Act. # Source: OEH Atlas = Atlas of NSW Wildlife (OEH), PMST = Protected Matter Search Tool (Australian Government).

APPENDIX 3. FAUNA SURVEY EFFORT WITHIN THE STUDY AREA

Fauna trapping effort within the Study Area

Fauna Transect	Trap type	No.	Nights/ Days	Total nights/days
PCT 1235: Swamp Oak swamp forest / PCT 1724 Broad-leaved Paperbark – Swamp Oak – Saw Sedge swamp forest				
	Elliott A	25	4	100
	Elliott B arboreal	-	-	-
	Anabat	1	2	2
	Remote Cameras (3m)	2	25	50
	Remote Cameras (1m)	2	25	50
PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark				
	Elliott A	25	4	100
	Elliott B arboreal	-	-	-
	Anabat	1	2	2
	Remote Cameras (3m)	2	25	50
	Remote Cameras (1m)	2	25	50
PCT 1646: Smooth-barked Apple - Blackbutt - Old Man Banksia - Red Gum variant				
	Elliott A	25	4	100
	Elliott B arboreal	-	-	-
	Anabat	1	2	2
	Remote Cameras (3m)	2	25	50
	Remote Cameras (1m)	2	25	50

Fauna Transect	Trap type	No.	Nights/ Days	Total nights/days
	Pygmy Possum Nest Box	2	25	50
PCT 1646: Smooth-barked Apple – Blackbutt – Old Man Banksia				
	Elliott A	25	4	100
	Elliott B arboreal	-	-	-
	Anabat	1	2	2
	Remote Cameras (3m)	2	25	50
	Remote Cameras (1m)	2	25	50
	Pygmy Possum Nest Box	2	25	50

Comparison of fauna survey effort (excluding trapping) against DECCW guidelines

Method	Completed	DECCW requirement	Comment
Bird surveys	Area search throughout the site completed on eight separate mornings totalling 20 hours	No specific methodology detailed – however, states that the Loyn 2ha/20 min area search is an accepted methodology per stratification unit	Meets minimum DECCW and LMCC guidelines
Owl call playback	8 nights of owl call playback at 2 separate locations (total 16 nights late August)	At least 5 visits for the Powerful Owl and up to 8 visits for the Masked Owl	Meets minimum DECCW guidelines
Anabat recording	Anabat units were placed at 5 locations over 2 full nights (February)	Two devices used for the entire night (min 4 hrs) starting at dusk for 2 nights	Meets minimum DECCW and LMCC guidelines
Spotlighting	8 hrs in total for all formations (February 2019)	2 hrs across each stratification unit	Meets minimum DECCW and LMCC guidelines
Amphibian surveys	Nocturnal surveys over 3 nights 2hrs each night in February focused in coastal freshwater wetlands, Swamp Mahogany and Swamp oak forest	Combination of diurnal and nocturnal census (listening for calls, spotlighting, call recording and habitat searches). Day habitat search – 1 hr per stratification unit Nocturnal search – 30 mins on 2 separate nights per stratification unit	Meets minimum DECCW and LMCC guidelines *Opportunistic records of all amphibian and reptile species detected in spotlighting surveys of all formations were noted
Reptile surveys	8 hrs in total for all formations (February 2019)	Combination of active diurnal searches and spotlighting on foot. Diurnal – 30 minute search on two separate days. Nocturnal – 30 minute search on two separate nights	Meets minimum DECCW and LMCC guidelines *Opportunistic records of all reptile species detected in spotlighting surveys of all formations were noted

Number and location of each fauna survey method (excluding trapping) conducted during the survey period

Vegetation Community	Anabat	Owl call playback	Spotlighting	Bird	Frog	Reptile
PCT 1568: Blackbutt - Turpentine - Sydney Blue Gum mesic River-flat Eucalypt Forest on Coastal Floodplain EEC		8 nights	1 hr (1 night)		1 hr (1 night)	
PCT 1071: Coastal Freshwater Wetlands - Freshwater Wetlands on Coastal Floodplain EEC	2 nights			2 mornings	3hrs (3 nights)	
Cleared				2 mornings		
PCT 1071: Smooth-barked Apple - Blackbutt - Old Man Banksia	2 nights	8 nights	6 hrs (3 nights)	3 mornings		6 hrs (3 nights)
PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark	2 nights		2 hrs (2 nights)	2 mornings		2 hrs (2 nights)
PCT 1725: Swamp Mahogany - Broad-leaved Paperbark - Swamp Forest - Swamp Sclerophyll Forest on Coastal Floodplains EEC	2 nights		1hr (1 night)	1 morning	2hrs (3 nights)	1hr (1 night)
PCT 1235: Swamp Oak Swamp Forest (Swamp Oak Floodplain Forest EEC – BC Act/Coastal Swamp Oak Forest EEC – EPBC Act	2 nights		2hr (2 nights)	1 morning	1.5hrs (3 nights)	2hr (2 nights)
PCT 1724: Broad-leaved paperbark – Swamp Oak (Swamp Sclerophyll Forest EEC – BC Act)			2hr (2 nights)	1 morning		2hr (2 nights)
Total no. of locations	5	2	6	8	4	5

APPENDIX 4. LIKE-FOR-LIKE BIODIVERSITY CREDIT REPORT



BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00012104/BAAS17039/19/00015291	Tomago Gas Fired Power Plant	17/10/2019
Assessor Name	Assessor Number	BAM Data version *
Samara Schulz	BAAS17039	16
Proponent Names	Report Created	BAM Case Status
AGL MACQUARIE PTY LIMITED	29/10/2019	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	29/10/2019

Potential Serious and Irreversible Impacts

Nil

Nil

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

BAM Biodiversity Credit Report (Like for like)

Predicted Threatened Species Not On Site

Name
Grantiella picta / Painted Honeyeater

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
1590-Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Not a TEC	13.2	151.00
1646-Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Not a TEC	0.4	8.00

1590-Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Like-for-like credit retirement options			
	Class	Trading group	HBT	IBRA region
	Hunter-Macleay Dry Sclerophyll Forests This includes PCT's: 715, 904, 922, 1178, 1215, 1588, 1589, 1590, 1591, 1592, 1593, 1600, 1601, 1602, 1608, 1612, 1626, 1748	Hunter-Macleay Dry Sclerophyll Forests - < 50% cleared group (including Tier 7 or higher).	Yes	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.



BAM Biodiversity Credit Report (Like for like)

1590-Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest				
1646-Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Like-for-like credit retirement options			
	Class	Trading group	HBT	IBRA region
	Coastal Dune Dry Sclerophyll Forests This includes PCT's: 685, 776, 1074, 1135, 1184, 1618, 1637, 1646, 1647, 1648, 1775	Coastal Dune Dry Sclerophyll Forests - < 50% cleared group (including Tier 7 or higher).	Yes	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Area	Credits
Eucalyptus parramattensis subsp. decadens / Eucalyptus parramattensis subsp. decadens	3.0	6.00
Petaurus norfolcensis / Squirrel Glider	2.6	79.00
Phascolarctos cinereus / Koala	0.2	6.00
Tyto novaehollandiae / Masked Owl	0.0	0.00



BAM Biodiversity Credit Report (Like for like)

Eucalyptus parramattensis subsp. decadens/ Eucalyptus parramattensis subsp. decadens	1646_Rehabilitation	Like-for-like credit retirement options	
		Spp	IBRA region
		Eucalyptus parramattensis subsp. decadens/ Eucalyptus parramattensis subsp. decadens	Any in NSW
Petaurus norfolcensis/ Squirrel Glider	1590_Moderate_Good	Like-for-like credit retirement options	
		Spp	IBRA region
		Petaurus norfolcensis/ Squirrel Glider	Any in NSW
	1646_Managed	Like-for-like credit retirement options	
		Spp	IBRA region
		Petaurus norfolcensis/ Squirrel Glider	Any in NSW
1646_Rehabilitation	Like-for-like credit retirement options		
	Spp	IBRA region	



BAM Biodiversity Credit Report (Like for like)

		Petaurus norfolcensis/Squirrel Glider	Any in NSW
Phascolarctos cinereus/ Koala	1646_Managed	Like-for-like credit retirement options	
		Spp	IBRA region
		Phascolarctos cinereus/Koala	Any in NSW
	1646_Rehabilitation	Like-for-like credit retirement options	
		Spp	IBRA region
		Phascolarctos cinereus/Koala	Any in NSW
Tyto novaehollandiae/ Masked Owl	1590_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW

BAM Biodiversity Credit Report (Like for like)

Tyto novaehollandiae/ Masked Owl	1590_Low		
	1590_Moderate_Good	Like-for-like credit retirement options	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	1646_Managed	Like-for-like credit retirement options	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	1646_Managed_Powerline	Like-for-like credit retirement options	
Spp		IBRA region	
Tyto novaehollandiae/Masked Owl		Any in NSW	



BAM Biodiversity Credit Report (Like for like)

Tyto novaehollandiae/ Masked Owl	1646_Rehabilitation	Like-for-like credit retirement options	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW



BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00012104/BAAS17039/19/00018030	Tomago Gas Fired Power Plant - 2	17/10/2019
Assessor Name	Assessor Number	BAM Data version *
		16
Proponent Names	Report Created	BAM Case Status
AGL MACQUARIE PTY LIMITED	29/10/2019	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	29/10/2019

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Nil

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

Name
Grantiella picta / Painted Honeyeater
Phascolarctos cinereus / Koala

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
1590-Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions	1.9	65.00

1590-Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Like-for-like credit retirement options			
	Name of offset trading group	Trading group	HBT	IBRA region
	Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions This includes PCT's: 1590, 1592, 1593, 1600, 1602	-	Yes	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

1590-Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest

Species Credit Summary

Species	Area	Credits
Petaurus norfolcensis / Squirrel Glider	1.9	65.00
Phascolarctos cinereus / Koala	0.0	0.00

Petaurus norfolcensis / Squirrel Glider	1590_Mod_Good_EE C	Like-for-like credit retirement options	
		Spp	IBRA region
		Petaurus norfolcensis /Squirrel Glider	Any in NSW
Phascolarctos cinereus / Koala	1590_Mod_Good_EE C	Like-for-like credit retirement options	
		Spp	IBRA region
		Phascolarctos cinereus /Koala	Any in NSW

APPENDIX 5. EPBC ASSESSMENT

Background

AGL proposes to develop a power station at 1940 Pacific Highway, Tomago, NSW (**Figure 16**). The proposal involves the construction and operation of a dual fuel (gas/diesel) fired power station and associated infrastructure including gas supply and electricity transmission connections (refer to **Section 1.4** of this report).

The project was referred to the Commonwealth Department of the Environment and Energy (EPBC 2019/8425) who determined on 15 August 2019 that the project is a controlled action under section 75 of the EPBC Act due to the potential to significantly impact on a wetland of international importance (a Ramsar wetland). This is due to the proximity of the project to the Kooragang component of the Hunter Estuary wetland and the:

- potential for groundwater intersection;
- potential presence of contaminants in soils; and
- the likely presence of acid sulphate soils.

Scope of Assessment

The Commonwealth Government provided its environmental assessment requirements (EARs) for the project on 11 September. Key risks from the Commonwealth perspective include:

- the risk of groundwater contamination from the site impacting on the Hunter Estuary Wetlands;
- the ground water connectivity to the Hunter Estuary Wetlands Ramsar site; and
- the likely impacts on the Hunter Estuary Wetlands Ramsar site if groundwater contamination occurs.

As a result, under item 3 of the EARs, the DoEE considered that the proposed action has the potential to significantly impact:

- the physico-chemical status of the Hunter Estuary Wetlands Ramsar site; and
- the habitat or lifecycle of native species dependent on the Hunter Estuary Wetlands Ramsar site

The EARs included a number of requirements for inclusion in an Environmental Impact Statement to be prepared for the project. Those considered most directly relevant to the assessment of potential impacts to biodiversity within the wetlands have been itemised below.

Other items contained within the EARs are covered by separate soil, surface and groundwater water assessments undertaken for the project (refer below).

No	DoEE assessment requirement
10	The EIS must identify and describe the location, extent and ecological characteristic of the Ramsar wetland that may be impacted by all stages of the proposed action.
12	A description and quantification of habitat (including suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival of species), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advices, conservation advices and recovery plans and threat abatement plans.
13	Maps displaying the above information in paragraphs 11 and 12, overlaid with the anticipated impacts from the proposed action
14	[extract only] an assessment of the relevant impacts ¹ of the action on the matters protected by the controlling provisions ...
15	[extract only] information on proposed avoidance and mitigation measures to manage the relevant impacts ...
17	For each of the relevant matters likely to be impacted by the action the EIS must provide reference to, and consideration of, relevant Commonwealth guidelines and policy statements including any: <ul style="list-style-type: none"> i. management plan for Ramsar wetland; and ii. any strategic assessment
20	Further information is required to determine the extent of the impacts of the proposed action on: <ul style="list-style-type: none"> i. habitat, such as saltmarsh and mangroves or native species such as Green and Golden Bell Frog or Migratory Shorebirds, that are dependent on the Hunter Estuary Wetlands Ramsar site, which could be impacted indirectly if water quality (through both groundwater and surface water contamination) is affected as a result of the proposed action; and ii. wetland species indirectly impacted as a result of noise during construction or the ongoing operation of the power plant.
21	a description of the controls and measures that will be put in place to manage impacts from the proposed action of the habitat and lifecycles of the native species dependent on the Ramsar site.

1. Relevant impacts are those impacts likely to significantly impact on any matter protected under the EPBC Act.

Reference document and guidelines

In preparing this assessment, consideration has been given to a number of guidelines and information sources including the following documents:

- DoE. 2013. *Matters of National Environmental Significance Significant impact guidelines 1.1*. Prepared by the Department of Environment, Canberra, Commonwealth of Australia.
- DoE. 2015. Draft referral guidelines for 14 migratory bird species listed under the EPBC Act.
- DoEE. 2017. *EPBC Act Policy Statement 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*. Prepared by the Department of the Environment and Energy, Canberra, Commonwealth of Australia
- Brereton, R., and Taylor-Wood, E., 2010, *Ecological Character Description of the Kooragang Component of the Hunter Estuary Wetlands Ramsar Site*. Report to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC), Canberra.
- NPWS. 1998. *Kooragang Nature Reserve and Hexham Swamp Nature Reserve Plan of Management*. NSW National Parks and Wildlife Service, August 1998.

Hunter Estuary wetlands

The Hunter Estuary wetlands are comprised of two parts: the Kooragang component and the Shortland Wetlands (Hunter Wetlands Centre). The Kooragang component is closest to the development site and is located about 2.5 km south and east of the proposed Development Site at its closest point (refer **Figure 16**).

The Kooragang component covers an area of close to 3000 ha and is comprised of the bed of Fullerton Cove, the northern part of Kooragang Island (including the Kooragang Dykes) and

the eastern section of the Tomago Wetlands (an area of former wetlands converted to grazing land by drains and levees which lie to the west of Fullerton Cove). The Ramsar site also includes the fringing mangroves and islands within Fullerton Cove and part of the North Arm, as well as Stockton Sandspit and the Kooragang Dykes.

The wetlands have been listed because they meet three of the Ramsar criteria (Brereton and Taylor-Wood, 2010):

- Criterion 2: Kooragang component has records of one wetland bird species (Australasian Bittern *Botoaurus poiciloptilus*) listed as Endangered under the EPBC Act and a frog species (Green and Golden Bell Frog *Litoria aurea*) listed as vulnerable under the EPBC Act and IUCN red list
- Criterion 4: Kooragang component is an important foraging and roosting site for migratory shorebirds and supports waterbirds at critical stages in their life cycles including breeding, migration stop-over, roosting and drought refuge
- Criterion 6: the Kooragang component regularly supports >1% of the East Asian Australasian Flyway population of Eastern Curlew (*Numenius madagascariensis*) and more than 1% of the Australian population of Red-necked Avocets (*Recurvirostra novaehollandiae*)

The vegetation communities within the listed area are predominantly wetland types including mangrove forests, saltmarsh and brackish swamps. Vegetation associations within the site are largely determined by the frequency and periodicity of tidal inundation as well as salinity. Saltmarshes are confined to those areas periodically tidally inundated and which are hypersaline. Mangroves fringe the tidal mudflats of Fullerton Cove and are found in areas which are inundated more frequently and have salinities close to full seawater (e.g. margins of Kooragang Island).

Limited information is available on changes in tidal range and the impact on mangrove expansion, saltmarsh decline and changes in the distribution of intertidal mudflats. Similarly, limited information is available on groundwater flows into an out of the estuary. However, large influxes of freshwater into the estuary can cause great variability in salinity, which after rain has a very significant effect. Groundwater fluxes are also influenced by tidal movement (Brereton and Taylor-Wood, 2010):

The critical ecosystem components that describe the ecological character of the Kooragang component at the time of listing were determined to be (Brereton and Taylor-Wood, 2010):

- waterbirds, particularly migratory shorebirds
- the Green and Golden Bell Frog (*Litoria aurea*), a nationally listed threatened species
- *Sarcocornia* saltmarsh which supports migratory shorebirds
- intertidal mudflats which provide foraging habitat for migratory shorebirds
- hydrology (tidal regime and freshwater inflows) which is a major influence on the distribution and extent of saltmarsh and mangroves

Migratory shorebirds are present for up to eight months of the year between September and April in the Hunter Estuary Ramsar. At the time of listing, a maximum of 6800 migratory waders were recorded within the Hunter Estuary Wetlands (Brereton and Taylor-Wood, 2010). This includes 112 species of water birds and 45 species of migratory birds listed under international agreements. Important bird habitats at the site include:

- saltmarsh ponds (important roosting and foraging habitat for shorebirds)
- tidal mudflats and sand flats (important foraging habitat for shorebirds)

- Stockton Sandspit (important roosting habitat for shorebirds)
- Kooragang Dykes (important roosting and foraging habitat for shorebirds)

The Fullerton Cove area within the Kooragang component has been identified as the most important foraging area for the majority of the migratory shorebirds in the Hunter Estuary (Herbert 2007). Stockton Sandspit and the Kooragang Dykes are also important roosting and foraging areas for migratory shorebirds.

Threats to habitat within the wetlands include changes in the freshwater/saltwater balance due to drainage works and industrial development. For example, changes in the tidal range and to the freshwater/saltwater balance in recent years have resulted in an expansion of mangroves and a decrease in saltmarsh, an important foraging and roosting habitat for migratory shorebirds (Brereton and Taylor-Wood, 2010). This has been linked to the decline in migratory shorebirds within the Kooragang component. Sedimentation, much of it due to deforestation and overgrazing in the upper catchment, is also leading to vegetation changes in the estuary although.

A plan of management has been prepared that includes the Kooragang area (NPWS 1998). The objectives of the plan are primarily to protect and where necessary improve the ecological condition of the wetlands so as to maintain and promote the numbers and diversity of migratory birds and waterfowl. Strategies to achieve these objectives include enhancing areas of the reserve used as roost sites, feeding grounds and flyways, promoting appropriate management practices undertaken by neighbours which protect the wetland and emphasising within the local community the importance of management programs relating to the control of fire, weed and feral animals. Several rehabilitation programs have been proposed.

Importance of Hunter Estuary Wetlands

Of importance to the assessment of impacts upon migratory species is whether habitat is 'important habitat'. The wetlands are considered to provide important habitat for:

- Australasian Bittern *Botoaurus poeciloptilus* - considered to be a breeding resident in the Hunter Estuary as there are extensive areas of habitat available and it has been recorded in all months
- Green and Golden Bell Frog *Litoria aurea* - breeding populations have been recorded in ponds on Kooragang Island (Hamer et. al 2002) (although there is no recent information on Green and Golden Bell Frog breeding events within the Ramsar site).
- migratory shorebirds (important foraging and roosting site) and waterbirds (provides support at critical stages in their life cycles including breeding, migration stop-over, roosting and drought refuge) including
 - Eastern Curlew (*Numenius madagascariensis*) - regularly supports >1% of the East Asian Australasian Flyway population and
 - Red-necked Avocets (*Recurvirostra novaehollandiae*) - regularly supports more than 1% of the Australian population
- Estuary Stingray (*Dasyatis fluviorum*), listed as Vulnerable on the IUCN Red List (Version 2009.1), and which inhabits mangrove fringed rivers and estuaries has been recorded from the Hunter Estuary (Ruello 1976, Gibbs et al. 1999).

Impacts on non-breeding habitat for migratory species which reduces birds' ability to forage effectively can force some individuals to travel further to find feeding and roosting sites. This could potentially cause an impact on their migration should they not have the ability to rest and replenish their condition prior to their onward migration.

Site and context

A full description of the proposal is described in Section 1.4 of this document. A brief description is supplied below to provide background for the assessment contained in this document.

The Development Site is located approximately five kilometres south-west of Raymond Terrace and about two kilometres north-east of Hexham. The Hunter River flows in a southwest direction approximately 450 m north-west of the site before turning east and passing about 2 km to the south of the site towards Fullerton Cove and then turning in a southerly direction towards the Port of Newcastle. The Kooragang component of the Hunter Estuary Wetland is located approximately 2 km south of the site at its closest point with the Fullerton Cove boundary located about 5 km to the east.

Land use surrounding the Development Site is mixed with the Tomago industrial area located to the south, between the Development Site and the river, the Newcastle Gas Storage Facility (NGSF) to the east, and large areas of intact native vegetation to the north and east. Major industrial sites in the area to the south include the Tomago aluminium smelter, a Shipyard and the Tomago Sandbeds water treatment works. Another major industrial area occurs on the southern side of Kooragang Island a further 4 km to the south-east.

The footprint of the proposed development is provided in **Figure 1** and works described in **Section 1.4**. It is noted that no primary habitat will be cleared as a result of the proposal. In addition, it is not proposed to extract any groundwater for construction or operational use. The Proposal would source potable water from municipal supply. The Proposal is therefore not expected to impact on any adjacent licensed water users or existing groundwater infrastructure.

Project assessments

A number of assessments have been undertaken on surface water and hydrology, groundwater, soils and contamination to assess the potential for impact during both the construction and operational phases. These have included the following:

	Title	Objective
Aurecon. 2019	Surface Water and Hydrology Specialist Study (Addresses the potential hydrological and surface water quality impacts associated with the construction and operation of the Proposal
Aurecon. 2019	Groundwater Specialist Study	Address potential groundwater impacts associated with the construction and operation of the Proposal
Aurecon. 2019	Newcastle Power Station, Soils and Contamination Specialist Study	Assessment of the construction and operational impacts on soil, land capability and geotechnical stability of the site and surrounds. The assessment included a review of contaminated materials and acid sulfate soils on site and potential risks to human health and the receiving environment. Activities included a detailed sampling program including soil, sediment, surface water and groundwater sampling.

Full details of the assessments can be found in the EIS for the project (Aurecon, 2019). In summary, these have noted the following:

- The site of the Power Station is located on a topographic high point located approximately central to the site with a fall to the north-east and south-west either side of the high point to two ephemeral drainage lines (Drainage Paths 1 and 2). These head in a westerly direction under the Pacific Highway towards the Hunter River.
- The landscape around the Development Site is relatively flat with slope gradients <5%. The soils are known to be deep and well drained on ridges but poorly drained in swales.
- The tidal limit of the river is 40 km upstream of the Proposal area, and regular flushing on incoming tides creates a relatively stable saline environment of around 35 ppt.
- On the acid sulfate soil (ASS) Probability Map in the Port Stephens LEP, the development footprint is classified as Class 3 (southern area - consent required for works more than 1 m below ground surface or where the water table is likely to be lowered more than 1m below the natural ground surface) and Class 4 (central and eastern area - consent required for works more than 2 m below the natural ground surface or where the water table is likely to be lowered more than 2 m below the natural ground surface). Development of the site would therefore be undertaken with reference to an Acid Sulfate Management Plan.
- Soil testing across the power station footprint has indicated that near surface soils down to a depth of 1.0 m BGL have negligible potential to generate ASS, whilst potential acid sulphate soils are present below 2 m BGL, and deeper soils have a high potential to contain ASS
- The Proposal area is within the Hunter Valley alluvial aquifer formation, which is made up of clays, silts, sands and gravels, with highly permeable materials at the base of the alluvial deposit. The water table is generally very responsive to flooding and rainfall.
- Groundwater measured in monitoring wells installed during the studies indicates that the water table is close to the ground surface in some parts of the Proposal area, which is unsurprising for a floodplain and high hazard flood storage area. The majority of groundwater was encountered just above the bedrock surface and conditions were considered to be confining and the alluvium to be a low effective permeability aquifer. Given low hydraulic conductivity of 0.1m/day, and hydraulic gradient ranging from 1.4×10^{-2} to 1.3×10^{-2} , the study suggested a seepage velocity of around 2m per annum is indicated at the power station site, which is a low rate of migration of groundwater (Aurecon 2019)
- Groundwater may be intercepted during excavation and trenching due to the shallow water table – there is a higher potential of encountering groundwater along the proposed gas pipelines compared to gas power station site due to the lower topography. (Conceptual project plans indicate excavation for the pipelines would be undertaken to approximately 2-3m below the ground surface, to accommodate an approximately 42” pipe. Installation of the pipeline will require boring pits and associated tunneling HDD where it crosses existing services or roads, whilst the remainder of the pipeline route will be trenched).
- Due to the low permeability of the clay dominated alluvial soils, it is not expected that shallow excavations would encounter significant inflow or create an enduring impact on regional groundwater level.
- Mapping of regional groundwater levels in the area (Woolley et al, 1995) indicate that groundwater in the area of the Proposal flows to the north-northwest towards the Hunter River. This is supported by on-site studies in which a groundwater mound was interpreted from the monitoring wells with a radial flow from the proposed power station site towards the Hunter River and the lowlands flanking the site (Aurecon 2019). Ongoing studies for the nearby NGSF groundwater and surface water monitoring program also indicates groundwater flow in the vicinity of the NGSF was generally to the north-west (GHD, 2019). This was consistent with previous monitoring at the NGSF including during baseline and

construction period monitoring. Groundwater in the Proposal area is therefore not expected to flow towards the Kooragang component of the wetlands of the Nature Reserve (including Fullerton Cove or the Hunter Estuary Wetlands).

- The primary potential operational impact to surface water and hydrology relates to changes in storm water runoff discharge patterns, mostly as a result of surfacing reducing infiltration and increasing storm water runoff from the site. It is anticipated that around 30% of the power station area would become impervious. Given the relative size of the Proposal area and the development footprint compared to the total catchment area of the Hunter River (around 22,000 km²), it is expected that there would be negligible impact on the hydraulic behaviour of the Hunter River. In addition, flood modeling indicates that the development would not have any effect on the pattern of flood flows or on flood levels or on flood velocity outside the property area.
- Previous investigations at the site have indicated chemicals of potential concern may be present in soil, groundwater, surface water and sediments on the site. These were mostly associated with dumped waste, unknown stockpiled soil material and septic tanks and can be adequately managed by appropriate controls during construction. Preventing surface water contamination is considered the key to preventing impacts to groundwater.
- During the operational phase of the Proposal, there is a potential for minor spills and incidents that have the ability to contaminate soil with fuel, oil and chemicals. A control plan would be implemented that would capture any potential run-off from site (to be consolidated into the OEMP). This would also include reporting requirements including notification of NSW EPA in the event of any significant chemical spills.
- Potential impacts on groundwater systems can be mitigated by implementing several specified management plans and operational procedures. By implementing these plans a Neutral or Beneficial Effect (NorBE) on the receiving groundwater quality can be demonstrated.

These studies have been used to inform the impact assessment documented below.

Measures to minimise potential risks were also included in the studies. Without management measures in place, construction activities have the potential to cause surface water contamination, and runoff may cause impacts on downstream aquatic ecosystems including the Hunter River and the connected Hunter Estuary Wetlands Ramsar sites. Surface water contamination could also impact groundwater if not properly controlled.

The studies therefore also considered appropriate management measures such as investigation into the feasibility of using sediment basin during the construction phase to collect potential sediment in stormwater. Management plans are to be put in place to ensure that the development of the Proposal does not affect the water quantities, water qualities or associated ecosystems recognised under the North Coast Fractured and Porous Rock Groundwater Sources Water Sharing Plan.

In general, studies found the following:

- Care would be taken not to dewater shallow groundwater where possible, to prevent oxidation of previously un-oxidised ASS in situ for trenches, drainage lines and shallow excavations. The likelihood of an impact on the Ramsar wetland (Kooragang Nature Reserve) is minor given the distance (greater than 2.5 km) and so long as the recommended avoidance, mitigation, and management measures are implemented.
- Land contamination risks for the Proposal are not considered to be significant based on the assessment of desktop information and previous reports available and would be avoided, mitigated and managed during construction and operation of the proposal by implementing mitigation measures recommended in the reports.

- Potential impacts to wetlands via contaminated or sediment laden site storm water can be adequately managed by installation of a system of formalized drains and water storage or treatment systems. A contaminated/dirty storm water drains system can be established to capture runoff during construction as well as operation from roads, carpark, bunds, workshop and service areas and other hardstand areas via a ‘pit and pipe’ system. Stormwater would then be passed through a bioretention system made up of selectively vegetated areas with enhanced filter media to slowly filter stormwater runoff whilst physical and bio-chemical processes help break down and remove common stormwater contaminants.
- An assessment of pollutant loads and concentrations for total suspended solids, total phosphorous and total nitrogen was completed as part of a surface water quality assessment for the project (Aurecon, 2019). The assessment concluded that operational stormwater discharges from the bioretention system was likely to be of a superior quality compared to the existing background conditions. Together with the implementation of a site-specific Soil and Water Management Plan and Groundwater Management Plan for the Proposal, and a suite of control measures recommended in the EIS, a Neutral or Beneficial Effect (NorBE) on the receiving groundwater quality can be demonstrated. The likelihood of the Proposal impacting on the Kooragang Component of the Hunter Estuary Wetland is therefore considered to be low.

Mitigation measures are further discussed at the end of this document.

Nature and extent of likely impact

Ramsar listed wetland

Approval is required for an action occurring within or outside a declared Ramsar wetland if the action has, will have, or is likely to have a significant impact on the ecological character of the Ramsar wetland.

An assessment of potential impact of the project with respect to the significant impact criteria contained within the Significant Impact Guidelines (DoEE, 2013) and the potential for impacts on the wetlands is provided below.

<p style="text-align: center;">Criterion</p> <p style="text-align: center;">An action is likely to have a significant impact if there is the</p>	<p style="text-align: center;">Assessment of nature and extent of impacts</p>
<p>Possibility that the action will result in areas of the wetland being destroyed or substantially modified</p>	<p>Unlikely.</p> <p>The proposed Development Site is located 2.5 km from the boundary of the wetland – no works will occur within the boundary or near the boundary of the wetlands. No direct impacts on the wetland during construction or operation is therefore expected.</p>
<p>Possibility that the action will result in a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland</p>	<p>Unlikely.</p> <p>The distance of the site from the wetland is expected to reduce any potential for impact on the wetlands. In addition:</p> <ul style="list-style-type: none"> • It is not proposed to extract any groundwater for construction or operational use. • Due to the low permeability of the clay dominated alluvial soils, it is not expected that shallow excavations would encounter significant inflow or

Criterion An action is likely to have a significant impact if there is the	Assessment of nature and extent of impacts
	<p>create an enduring impact on regional groundwater level.</p> <ul style="list-style-type: none"> • The gas pipeline is likely to be installed below the water table but no significant adverse impact on the flow of shallow groundwater is expected. • Changes to surface water and hydrology as a result of changes in stormwater runoff discharge patterns is expected to be minor. This includes as a result of changes in stormwater behavior due to changes in impervious surfaces (about 30% of the power station area). Given the relative size of the development footprint compared to the total catchment area of the Hunter River (around 22,000 km²), it is expected that there would be negligible impact on the hydraulic behaviour of the Hunter River and associated wetlands. In addition, flood modeling indicates that the development would not have any effect on the pattern of flood flows or on flood levels or on flood velocity outside the property area. <p>Based on the surface and groundwater assessment work completed for the project, impacts on the hydrological regime of the wetland is therefore considered unlikely.</p>
<p>Possibility that the action will result in the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected</p>	<p>Unlikely.</p> <p>The proposed Development Site is located 2.5 km from the boundary of the wetland – no works will occur within the boundary or near the boundary of the wetlands. No direct impacts on the habitat or lifecycle of native species during construction or operation is therefore expected.</p> <p>Potential indirect impacts on habitat or life cycle of native species dependent upon the wetland are considered to largely fall into two areas:</p> <ul style="list-style-type: none"> • Hydrology - unlikely. <p>There is expected to be negligible impact on the hydraulic behaviour of the Hunter River and associated wetlands as a result of the project.</p> <p>Impacts to surface water during both construction and operation can be controlled by implementation of a bioretention system to reduce any potential contaminants</p> <p>Groundwater flow in the vicinity of the Proposal is generally north-northwest towards the Hunter River. Groundwater in the Proposal area is therefore not expected to flow towards the Kooragang component of the wetlands. Any potential impacts on groundwater systems beneath the site can be mitigated by implementing several specified management plans and operational procedures. By implementing these plans a Neutral or Beneficial Effect (NorBE) on the receiving groundwater quality can be demonstrated.</p> <p>There are therefore expected to be no significant impacts to habitat of native species dependent upon the wetland.</p>

<p style="text-align: center;">Criterion</p> <p style="text-align: center;">An action is likely to have a significant impact if there is the</p>	<p style="text-align: center;">Assessment of nature and extent of impacts</p>
	<ul style="list-style-type: none"> • Noise – unlikely. Projects may potentially impact upon water bird using the wetlands through noise from haul trucks during construction and from potential increased traffic. However, during construction, it is proposed that oversized or heavy items would be transported along the Pacific Highway and Old Punt Road thereby avoiding impacts that may arise from use of Tomago Road. Noise minimisation practices will be included in the CEMP in accordance with OEH recommendations. Noise at the site during construction is not expected to impact species utilising the wetlands due to the distance from the site as well as the intervening developments. These are expected to act as buffers sufficient to attenuate levels to a level that is minor or insignificant in comparison to ambient levels. Noise levels during operation are therefore expected to be no more than (similar or less than) levels from other industrial premises in the area. The distance and the existing industrial operations between the Ramsar site and the Proposal would mean the Proposal would not be audible from the Ramsar site during construction or operation. The habitat or lifecycle of native species dependent upon the wetland is therefore not expected to be seriously affected.
<p>Possibility that the action will result in a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health,</p>	<p>Unlikely. The likelihood of impact on the Hunter Estuary Wetlands is considered to be minor given the distance and as long as the recommended avoidance, mitigation and management measures are implemented. Studies undertaken during the project indicate that:</p> <ul style="list-style-type: none"> • Potential impacts to storm water can be managed by installation of a system of drains and water retention systems. Stormwater can then be passed through a bioretention system to slowly filter stormwater runoff. The assessment concluded that operational stormwater discharges from the bioretention system was likely to be of a superior quality compared to the existing background conditions. • Impacts to hydrology of the area are expected to be minimal and therefore impacts to salinity are considered unlikely. • Groundwater in the area of the Proposal flows to the north-northwest towards the Hunter River. Groundwater in the Proposal area is therefore not expected to flow towards the Kooragang component of the wetlands of the Nature Reserve (including Fullerton Cove or the Hunter Estuary Wetlands).

<p style="text-align: center;">Criterion</p> <p style="text-align: center;">An action is likely to have a significant impact if there is the</p>	<p style="text-align: center;">Assessment of nature and extent of impacts</p>
	<ul style="list-style-type: none"> • Care would be taken not to dewater shallow groundwater where possible, to prevent oxidation of ASS that may be encountered in shallow excavations. The likelihood of an impact on the Kooragang wetland is minor given the distance (greater than 2.5 km) and so long as the recommended avoidance, mitigation, and management measures are implemented. • Land contamination risks for the Proposal are not considered to be significant and can be avoided, mitigated and managed during construction and operation of the proposal by implementation of appropriate mitigation measures. • Preventing surface water contamination is considered the key to preventing impacts to groundwater. The risk of impacts during both construction and operation, such as a hydrocarbon spill, will be mitigated by measures specified in an OEMP and CEMP. The proposed stormwater management system will also act as a secondary defense system to capture any potential run-off from site • Any potential impacts on groundwater systems can be mitigated by implementing several specified management plans and operational procedures. By implementing these plans a Neutral or Beneficial Effect (NorBE) on the receiving groundwater quality can be demonstrated. <p>No substantial impacts to water quality of the wetland are therefore expected.</p>
<p>Possibility that the action will result in an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland</p>	<p>Unlikely.</p> <p>The proposed Development Site is located 2.5 km from the boundary of the wetland and is of sufficient distance from the wetland such that impacts are unlikely.</p> <p>The risk of introduction or dispersal of an invasive species or disease will be managed through prevention and control measures implemented under a Construction Environment Management Plan for the project. These measures will ensure soil and seed material is not transferred and will be applied on site during construction and operation.</p> <p>Weed infestations within the construction footprint are to be identified and mapped prior to construction and standard hygiene processes will include inspections of equipment prior to arrival on site. Appropriate wash down facilities will be available to clean vehicles and equipment prior to arrival on-site and prior to departure.</p> <p>Given the proposed mitigation measures, it is therefore considered unlikely that the project will result in the introduction or dispersal of an invasive species.</p>

It is noted that the NGSF located to the east of the proposed site of the Power Station has been operational since it was constructed by AGL between 2012 to 2015.

- The Environmental Assessment for the project (Coffey Environments, 2011), which also included trenching for pipelines and exposure of potential acid sulfate soils, determined that the likelihood of the NGSF impacting surface waters in the Ramsar wetland areas of Kooragang Nature Reserve and Wetlands Centre Australia was low due to their distance from the proposal construction and operational phase activities, the planned surface runoff control measures, high groundwater infiltration rates and flat topography of the site.
- During construction of the NGSF, any dewatering that was required was undertaken in accordance with a site-specific Dewatering Procedure. This included water accumulated in trenches or excavations, stormwater in the sediment basin/s, and rainwater collected in sumps, bunds and pits. Water quality parameters including pH and turbidity were tested prior to discharge to surface or groundwater, which was undertaken in compliance with a signed Dewatering Permit and the Soil and Water Management Standard. Where water could not be treated to adequate discharge criteria, untreated water was contained and transported off site by a licenced contractor and disposed of to a licensed facility.

No ground water contamination was recorded during construction and no significant impact to the wetlands has been recorded during construction or operation of the NGSF.

It is therefore concluded that the development of the proposed power station and associated infrastructure is unlikely to have a significant impact on the ecological character of the Hunter Estuary Wetlands.

Migratory Fauna species

Given the significance of the Hunter Estuary wetlands to migratory species, consideration has also been given to the potential impact, if any, of the project on migratory species that may use the wetlands as habitat.

An assessment of potential impact of the project with respect to the significant impact criteria contained within the Significant Impact Guidelines (DoEE, 2013) and the potential for impacts on migratory fauna species is provided below.

Criterion An action is likely to have a significant impact if there is the	Assessment of nature and extent of impacts
Possibility that the action will substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Unlikely. Construction - the action does not include works that will occur within the boundary of the wetlands: all works are located about 2.5 km to the north-west of the Ramsar boundary at its closest point. No important habitat will therefore be cleared as part of the proposal and no impact to fire regimes or nutrient cycles is expected. Studies for the project have also indicated that there will be no impact to hydrological cycles. While some vegetation clearance will occur, areas of ground disturbance will be focused in areas that have been previously disturbed on the north side of an existing industrial area. These are not connected to habitat in the wetland area and no fragmentation of habitat associated with the wetland will occur. It is therefore considered highly unlikely that the project will result in permanent or major impacts to important habitat for a migratory species.
Possibility that the action will result in an invasive species that is harmful to the migratory species	Unlikely

Criterion An action is likely to have a significant impact if there is the	Assessment of nature and extent of impacts
<p>becoming established in an area of important habitat for the migratory species</p>	<p>The proposed Development Site is located 2.5 km from the boundary of the wetland and is of sufficient distance from the wetland such that impacts are unlikely.</p> <p>The risk of introduction or dispersal of an invasive species or disease will be managed through prevention and control measures implemented under a Construction Environment Management Plan for the project. These measures will ensure soil and seed material is not transferred and will be applied on site during construction and operation.</p> <p>Weed infestations within the construction footprint are to be identified and mapped prior to construction and standard hygiene processes will include inspections of equipment prior to arrival on site. Appropriate wash down facilities will be available to clean vehicles and equipment prior to arrival on-site and prior to departure.</p> <p>Given the proposed mitigation measures, it is therefore considered unlikely that the project will result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.</p>
<p>Possibility that the action will seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.</p>	<p>Unlikely</p> <p>The location of the activity means that it is considered extremely unlikely that the activity will seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species. The development suite is located at least 2.5 km from the wetland at its closest point and about 5 km from Fullerton Cove which is considered to be the most important foraging area for the majority of the migratory shorebirds in the Hunter Estuary (Herbert 2007).</p> <p>Projects may potentially impact upon water birds using the wetlands through noise from haul trucks during construction and from potential increased traffic. However, during construction, it is proposed that oversized or heavy items would be transported along the Pacific Highway and Old Punt Road thereby avoiding impacts that may arise from use of Tomago Road. Noise minimisation practices will be included in the CEMP in accordance with OEH recommendations.</p> <p>Noise levels during operation are expected to be no more than (similar or less than) levels from other industrial premises in the area. The distance and the existing industrial operations between the Ramsar site and the Proposal would mean the Proposal would not be audible from the Ramsar site during construction or operation. It is therefore considered unlikely that the Proposal will seriously disrupt the lifecycle of a migratory species utilising the wetlands.</p>

Mitigation of impacts and residual impacts

The impact assessment has been used to help identify control and mitigation measures to be implemented during project construction and operation so as to avoid or mitigate impacts. These are fully discussed in the individual studies prepared by Aurecon and will be included in a CEMP for the project. They include:

- Soil and Water Management Plan to include but not limited to an Erosion and Sediment Control Plan, a Stormwater management strategy, a Dewatering procedure and an Acid Sulfate Soil Management Plan.

- Groundwater Management Plan (GMP) to describe best practice control measures to reduce the risk of contamination of shallow groundwater or alteration of groundwater flows due to drawdown effects.
- Flood Preparedness Plan to enable to enable flood preparedness procedures to be implemented ahead of potential flooding events, and site-shut down to be undertaken when required, to minimize harm to persons, plant and the environment. Notably, this plan would focus on the risk of spreading contaminants (such as sediment, hydrocarbons or chemicals) in floodwaters. Control actions would include filling excavations, completing erosion and sediment controls, removing hazardous materials and waste from the site, and sealing tanks and containers to prevent overflows. In addition to the plan, an environmental risk assessment should be completed prior to commencing excavation or trenching work in the event of a flood warning, to minimise unnecessary additional exposure.
- Operational Environmental Management Plan (OEMP) to include spill related mitigation such as spill containment protocols, stormwater capture strategy, treatment requirements, maintenance requirements of relevant infrastructure.

These management measure have been recommended in order to reduce risk to water, catchment values and hydrology. Key measures relating to MNES largely concern the management of construction impacts and are briefly summarised below:

- Scheduling construction works to avoid wet seasons and heavy rainfall, where possible.
- Minimization of the area of exposed and unstable ground surface during construction.
- Locating stockpiles, sediment basins, bunds and vehicle wash-downs away from drainage lines.
- Installation of sediment controls including sediment traps, contour berms and energy dissipaters.
- Locating cleared vegetation at high points away from watercourses with upgradient water diverted to avoid entering stockpile.
- Stormwater capture strategy including construction of sediment basins to manage stormwater runoff during construction and operation. Modeling to determine requirements during both the construction and operation phase has noted the similarity in size and location requirements for both phases allowing for re-use or modification of proposed basins from the construction phase into permanent basins. The basins will be constructed and operated in compliance with IECA and Landcom guidelines.
- Establishing dirty water drains to direct site runoff to the sediment retention basin system.
- Steps to minimize groundwater dewatering (potentially oxidizing unoxidized ASS).
- Acid sulfate management plan including protocol to minimize the disturbance and exposure of ASS and an emergency protocol where acidic runoff is generated.
- Procedure to minimize risk of drilling waste (in the form of drilling fluids and hydraulic stimulation fluids) contaminating watercourses during drilling, completion, hydraulic stimulation and workover activities.
- Use of dedicated refueling areas and spill controls together with appropriate fuel liquid and storage and handling in accordance with Australian Standards.
- Inclusion of contingency approaches in all plans in the unlikely event of an incident. This includes fuel spill protocols including provision of spill kits and training of personnel.

Monitoring of management measures will be undertaken during the project in order to assess the effectiveness of mitigation. This will include:

- Monitoring of baseline surface water and groundwater data prior to construction to understand natural wetting and during cycles. This includes preconstruction surface water quality monitoring to create a baseline dataset to be used for comparison during construction and operations at the two culverts crossing Pacific Highway (Drainage Path 1 and 2).
- Water quality monitoring to ensure operational mitigation measures are effective and contamination levels within the drainage system and at discharge locations do not exceed relevant trigger values (being ANZECC trigger values or using baseline water quality data to derive trigger values). Pre-construction baseline monitoring of water quality parameters would be undertaken to form a dataset which could be used for comparison during construction and operational monitoring programs.

Sufficient controls are therefore considered to be in place to ensure impact to surface water and ground water is minimised. As a result, no significant impact on the Ramsar wetlands is expected.

Conclusion

The project has been assessed against the significant impact criteria for impacts to the wetland and those species potentially utilising the wetland and potentially affected by the proposal. With implementation of the controls identified in the EIS, it is expected that there will be no measurable residual impact from the construction or operation of the Proposal on the local or regional groundwater aquifers with regards to quantities or quality.

The assessment has therefore concluded that the project is unlikely to have a significant impact on the wetland and the species utilising the wetland.

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APPENDIX 6. STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Adam Blundell	BEnvSc (Hons)	Principal Ecologist	Report review
Daniel O'Brien	BEnvSc & Mgt (Hons) / PhD (in progress)	Senior Ecologist	Report review
David Russell	BSc Accredited BAM Assessor	Senior Ecologist	Flora Surveys & BAM Calculator
Elise Connolly	Dip Cons Lnd Mgmt, Adv Dip Env Mgmt	Ecologist (Botanist)	Flora Surveys, PCT allocation & report writing
Gayle Joyce	BSc Forestry (Hons)	GIS Specialist	GSI data management and Figure preparation
Kristy Peters	BParkMgt (Hons Ecology)	Senior Ecologist	Fauna surveys and report writing
Luke O'Brien	BEnvSc&Mgt	Ecologist	Fauna surveys
Nigel Fisher	BSc (Hons) PhD	Senior Soil Microecologist	Flora surveys
Samara Schulz	BEnvSc & Mgt (Hons) Accredited BAM Assessor	Senior Ecologist	Flora Surveys & report review
Yann Buissiere	BEnvSc & Mgt	Ecologist (Botanist)	Flora Surveys

APPENDIX 7. LICENSING

Kleinfelder employees involved in the current study are licensed or approved under the *Biodiversity Conservation Act 2016* (License Number: SL100730, Expiry: 31 March 2020) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.