



238-258 Captain Cook Drive, Kurnell
Biodiversity Development Assessment Report

FINAL REPORT

Prepared for DEVKON

22 February 2018

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Glossary

BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
Biosecurity Act	NSW <i>Biosecurity Act 2015</i>
DEE	Commonwealth Department of the Environment and Energy
DCDB	Land and Property Information(LPI) digital cadastral database
DPE	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
DTDB	Digital topographic databases
Ecosystem credit species	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development.
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
HBT	Hollow-bearing Tree
Impact area	The footprint of the proposed development
LEP	Local Environment Plan
Locality	Area located within 10 kilometres radius from the study area
LPI	NSW Land and Property Information
Matters of NES	Matters of National Environmental Significance protected by a provision of Part 3 of the EPBC Act
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
RoTAP	Rare or Threatened Australian Plant
SEARs	Secretary's Environmental Assessment Requirements
SEPP 71	NSW State Environmental Planning Policy No. 71 – Coastal Protection
SSD	State Significant Development
Study area	238-258 Captain Cook Drive, Kurnell (Lot 2 DP1088703 and Lot 1 DP225973), the broader area in which the impact area is located.
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>
VIS	NSW Vegetation Information System
WM Act	NSW <i>Water Management Act 2000</i>

Summary

Devkon proposes to develop land at 238-258 Captain Cook Drive, Kurnell (hereafter referred to as 'study area') (Figure 1) as a commercial industrial site. The development will involve the construction of two warehouse storage areas, hardstands and the associated roads, parking, drainage, infrastructure and landscaping. The proposed development does not include the demolition of any structures, which has been approved under a prior DA.

Due to the scale of the proposed development, the project will be assessed under Part 4 Division 4.1 Section 89C of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as a State Significant Development (SSD). As such, the assessment is to proceed in accordance with the NSW Biodiversity assessment Method (BAM) (OEH 2017).

Field investigation, undertaken in accordance with the BAM, recorded 6.6 hectares of native vegetation within the study area, representing three threatened ecological communities.

Avoidance of native vegetation, threatened ecological communities and threatened species habitat have been undertaken to restrict impacts to 1.2 hectares of non-threatened and degraded coastal heath vegetation at the rear of the site.

No threatened species, or high quality habitats, were recorded within the study area, and the vegetation integrity score, of the vegetation to be impacted was calculated as 5.8. As such, in accordance with Section 10.3 of the BAM, offsets are not required to be secured for the proposed development.

Stage 1 – Biodiversity assessment

1 Introduction

Biosis Pty Ltd was commissioned by Devkon to undertake a biodiversity assessment of a proposed industrial re-development at 238-258 Captain Cook Drive, Kurnell, NSW.

The purpose of this assessment was to apply the NSW Biodiversity Assessment Method (BAM [OEH 2017a]) to the proposed development, and provide Devkon with a Biodiversity Development Assessment Report (BDAR). The BDAR is to be submitted to the NSW Department of Planning and Environment as the approval authority, as part of a Development Application (DA) for proposed development.

1.1 Project background

Devkon proposes to develop land at 238-258 Captain Cook Drive, Kurnell (hereafter referred to as 'study area') (Figure 1) as a commercial industrial site. The development will involve the construction of two warehouse storage areas, hardstands and the associated roads, parking, drainage, infrastructure and landscaping. The proposed development does not include the demolition of any structures, which has been approved under a prior DA.

Due to the scale of the proposed development, the project will be assessed under Part 4 Division 4.1 Section 89C of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as a State Significant Development (SSD).

Biosis was previously engaged by Kerry Lowe to prepare a flora and fauna assessment report (Biosis 2015a) and Vegetation Management Plan (Biosis 2015b) to support a DA for a proposed subdivision at the study area. Since that time, the project has changed proponents, redesigned and increased in total value.

In addition, recent changes to NSW biodiversity legislation have resulted in a change to the SSD project assessment and reporting process, requiring updated biodiversity assessments and potential offset of project impacts. The NSW *Biodiversity Conservation Act 2017* (BC Act) requires that all SSD apply the BAM and the Biodiversity Offsets Scheme (BOS) to assess and offset the impacts of developments to biodiversity. As part of this DA, a BDAR is required to be submitted to the approval authority.

1.2 Purpose of this assessment

This BDAR will:

- Address the BAM and the BOS.
- Identify how the proponent proposes to avoid and minimise impacts to biodiversity.
- Identify any potential impact that could be characterised as serious and irreversible.
- Describe the offset obligations required to compensate for any unavoidable biodiversity impacts resulting from the proposed development.

All biodiversity assessments have been undertaken in accordance with the BAM, and this BDAR has been prepared and reviewed by Accredited Assessor Rebecca Dwyer (BAAS17067).

1.3 The study area

The study area is located at 238-258 Captain Cook Drive, Kurnell, NSW within the Sutherland Shire Local Government Area (LGA) and the Greater Sydney Local Land Services Region, it is located approximately 2

kilometres west of the township of Kurnell, and approximately 20 kilometres south of the Sydney CBD. The site comprises of Lot 2 DP1088703 and Lot 1 DP225973, covers a total area of 17.2 hectares and is currently Zoned 4 (a) – General Industrial Zone, pursuant to State Environmental Planning Policy (SEPP) (Kurnell Peninsula) 1989 (Kurnell SEPP). Towra Point Nature Reserve is located to the north of the site, across Captain Cook Drive.

The impact area is located within the study area and is defined as the total area of disturbance, encompassing the development footprint (Figure 1). The development footprint includes the final development (operational) footprint and all areas that could be disturbed during construction (eg plant laydown and access tracks), and are expected to be rehabilitated during the operational phase of the project.

The site contains demolished industrial buildings and rubble, cleared land, scattered landscape plantings and native and exotic vegetation (Figure 1). There is a mapped watercourse running south to north, close to and parallel to the western boundary of the site. There is also a small man made pond in the south west of the site. The site is relatively flat, however the central portion has been subject to historical industrial development, which has disturbed soil profiles and likely introduced foreign fill and enriched topsoil (Biosis 2015a).

1.4 Sources of information

Sources of information used in the assessment included relevant databases, spatial data, literature and previous site reports.

In order to provide a context for the study area, records of flora and fauna from within 10 kilometres (the 'locality') were collated from the following databases and were reviewed:

- Commonwealth Department of the Environment and Energy (DEE) Protected Matters Search Tool for matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- NSW Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife, for species, populations and ecological communities listed under the *Biodiversity Conservation Act 2017* (BC Act).
- PlantNET (The Royal Botanic Gardens and Domain Trust).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2015.
- Other sources of biodiversity information relevant to the study area were sourced from:
 - The NSW Plant Community Types, as held within the BioNet Vegetation Classification database (OEH 2017).
 - Relevant vegetation mapping, including *The Native Vegetation of the Sydney Metropolitan Area* (OEH 2016).

The following reports were also reviewed and relied on to provide additional information:

- Biosis (2015a) 238-258 Captain Cook Drive, Kurnell – Flora and Fauna Assessment, prepared for Kerry Lowe by Biosis Pty Ltd.
- Biosis (2015b) 238-258 Captain Cook Drive, Kurnell, Vegetation Management Plan, prepared for Kerry Lowe by Biosis Pty Ltd.

Mapping was conducted using hand-held (uncorrected) GPS units (GDA94), mobile tablet computers running Collector for ArcGIS™ and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 5 metres) and dependent on the limitations of aerial photo rectification and registration.

Basemap data was obtained from LPI 1:25,000 digital topographic databases (DTDB), with cadastral data obtained from LPI digital cadastral database (DCDB)

The following spatial datasets were utilised during the development of this report:


- Mitchell Landscapes Version 3.0.
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- Directory of Important Wetlands (DIWA).
- NSW Soil and Land Information System (SALIS).

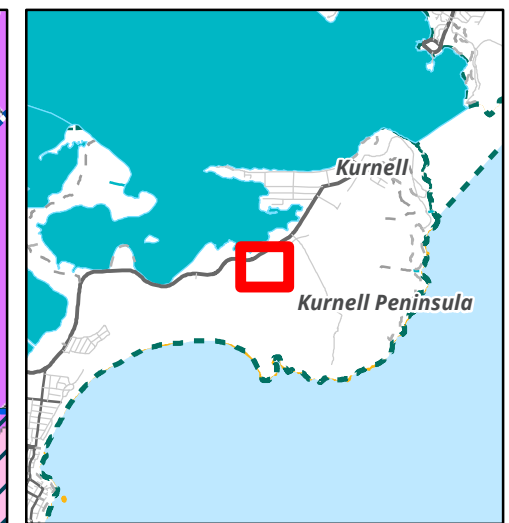
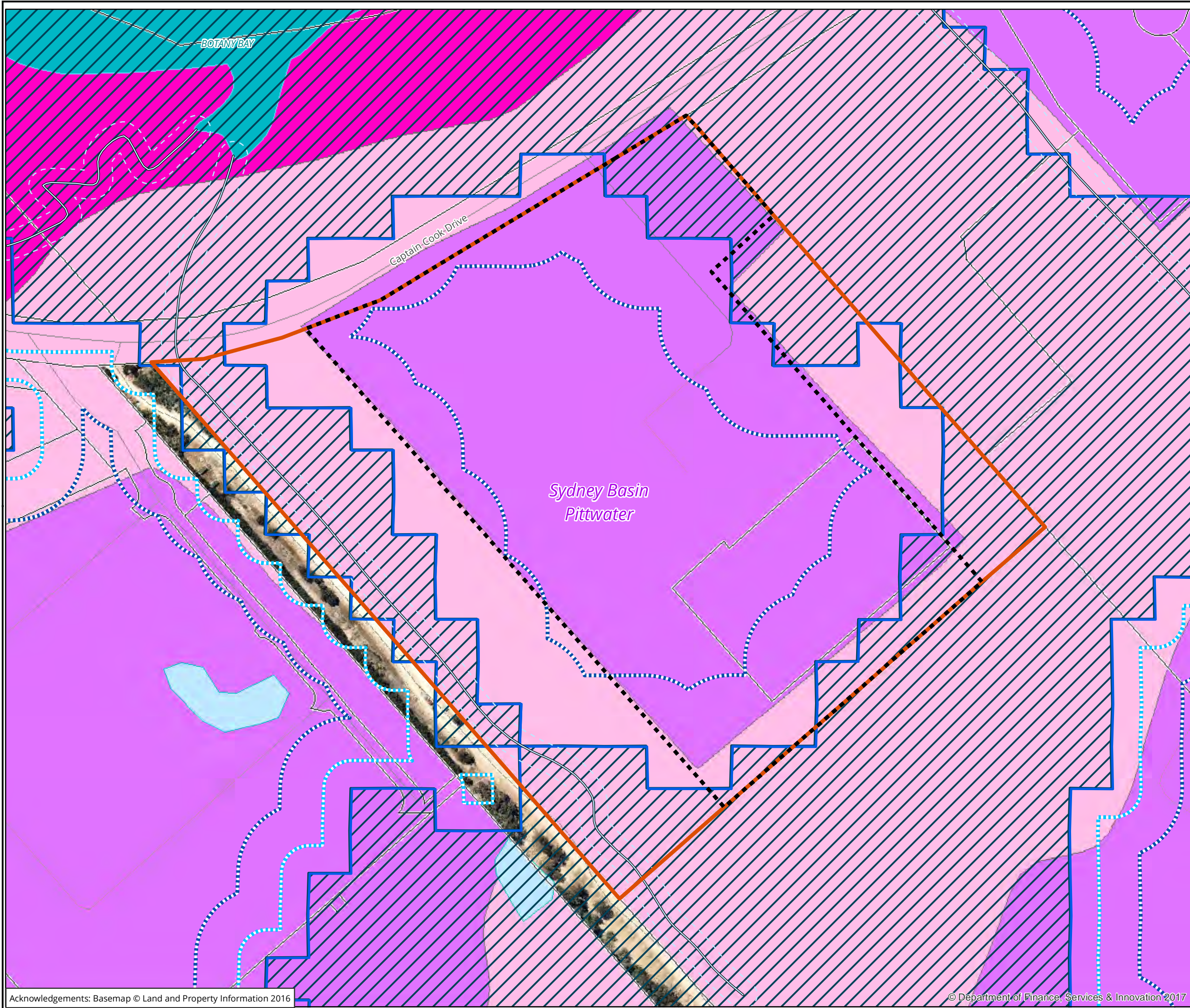
Mapping has been produced using a Geographic Information System (GIS). The following maps and data have been provided:

- Digital mapping with aerial photography showing 1:1000 or finer.
- Site map as described in subsection 4.2.1.1 of the BAM.
- Location Map as described in subsection 4.2.1.2 of the BAM.
- Landscape map with features including 1500 metre buffer, as described in section 4.2.1.3 of the BAM.

1.5 Legislative requirements

The project has been assessed against relevant biodiversity legislation and government policy, including:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Environmental Planning and Assessment Act 1979*
- *Biodiversity Conservation Act 2017*
- *Fisheries Management Act 1994*
- *Biosecurity Act 2015*
- State Environmental Planning Policy (Kurnell Peninsula) 1989 (Kurnell SEPP)
- **SEPP 71 Coastal Protection.** 
- Sutherland Shire Council Local Environmental Plan 2015 (SLEP 2015).



- Legend**
- Study
 - Impact
 - Strahler stream order**
 - 1st
 - Stream order buffer**
 - 1st
 - Local wetlands
 - Directory of Important Wetlands of Australia (DIWA)
 - Local Wetlands
 - DIWA wetland
 - Acid sulfate soils**
 - Class 1
 - Class 2
 - Class 3
 - Class 4
 - Class 5

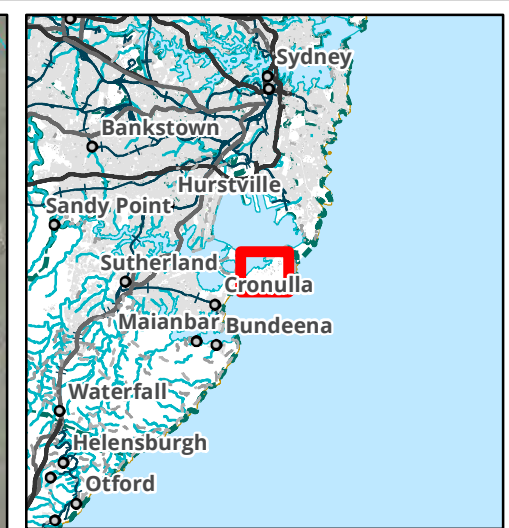
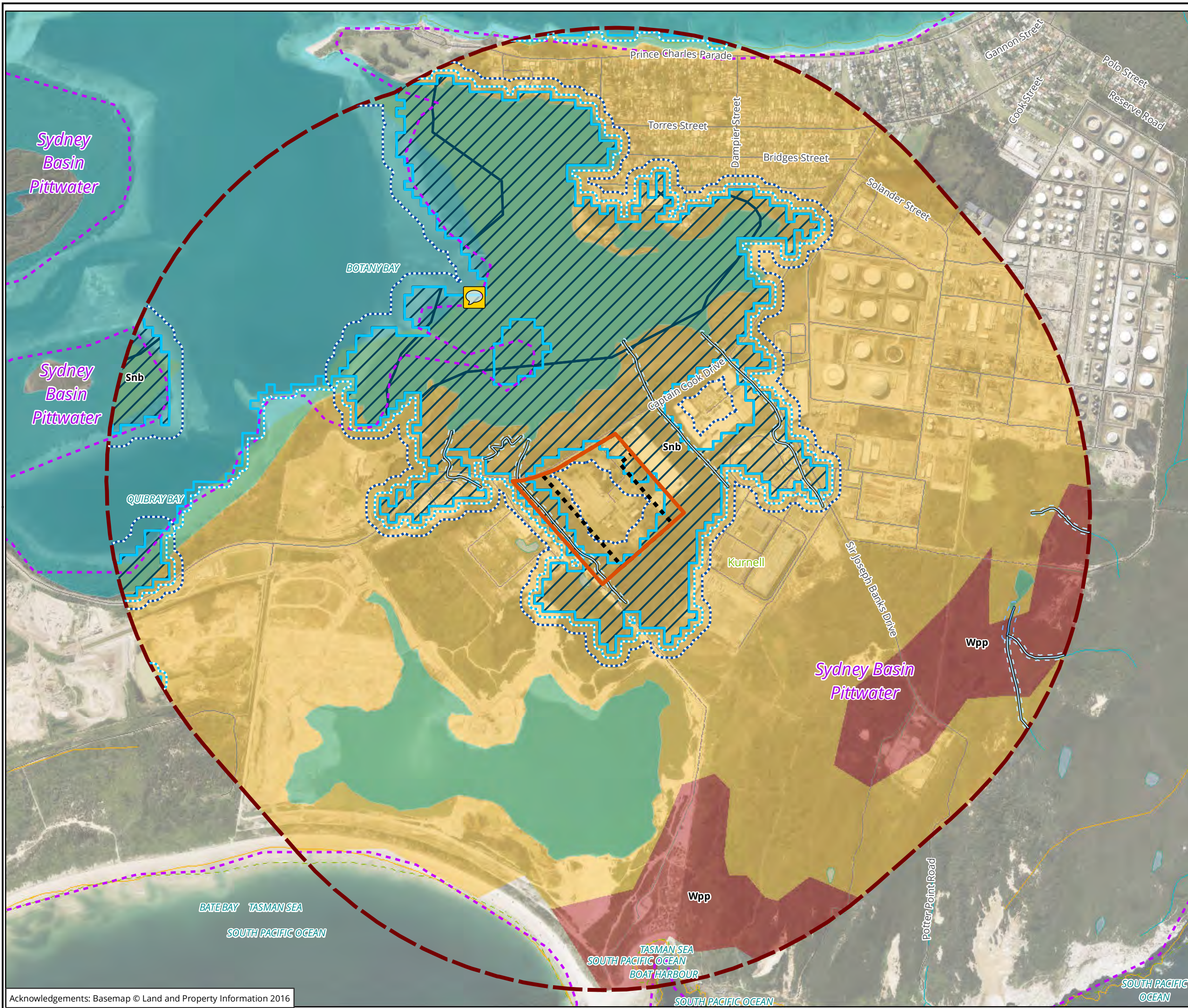
Figure 1: Site map

0 25 50 75 100 125
Metres

Scale: 1:2,500 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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- Legend**
- Study area
 - Impact area
 - Study area 1500m buffer
 - IBRA Sub-region
 - Local wetlands
 - Directory of Important Wetlands of Australia (DIWA)
- Wetland buffers**
- Local Wetlands
 - DIWA wetland
- Stream order**
- 1st
 - 2nd
- Stream order buffers**
- 1st order
 - 2nd order
- Mitchell landscape v3**
- Snb, Sydney - Newcastle Barriers and Beaches
 - Wpp, Woronora Plateau

Figure 2: Location map

0 120 240 360 480 600
Metres

Scale: 1:13,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Acknowledgements: Basemap © Land and Property Information 2016

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2 Landscape Context

This chapter describes the landscape and site context of the study area, describing the landscape features present within the study area and within a 1500 metre buffer to the site, as required by the BAM (OEH 2017a).

2.1 Landscape features

2.1.1 Bioregions

The study area occurs within the Sydney Basin IBRA bioregion and the Pittwater IBRA subregion. The Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of approximately 3,624,008 hectares. It occupies about 4.53 per cent of NSW and is one of two bioregions contained wholly within the state. The bioregion extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee. The bioregion is bordered to the north by the North Coast and Brigalow Belt South bioregions, to the south by the South East Corner Bioregion and to the west by the South Eastern Highlands and South Western Slopes bioregions. The Sydney Basin Bioregion is one of the most species diverse in Australia. This is a result of the variety of rock types, topography and climates in the bioregion (OEH 2016).

2.1.2 Mitchell Landscape

The study area occurs within the Sydney Basin Coastal Barriers *Sydney-Newcastle Barriers and Beaches* Mitchell Landscape. This landscape occurs as quaternary coastal sediments on long recurved quartz sand beaches between rocky headlands backed by sand dunes and intermittently closed and open lagoons. It has a general elevation of between zero to 30 meters with local relief of ten meters. Cliff top dunes may be found as high as 90 meters above sea level. There is a distinct zonation of vegetation and increasing soil development from the beach to the inland dunes. At the beach Spinifex *Spinifex hirsutus*, Spiky Mat-rush *Lomandra longifolia*, Coast Wattle *Acacia longifolia* ssp. *sophorae* and Coast Tea-tree *Leptospermum laevigatum* colonise the frontal dune. Coast Banksia *Banksia integrifolia* and Old Man Banksia *Banksia serrata* are found on the second dunes and these merge with more complex forest containing Blackbutt *Eucalyptus pilularis*, Red Bloodwood *Corymbia gummifera*, Grass trees *Xanthorrhoea* sp. and numerous understorey shrubs on deep sands that have an organic rich A horizon, a bleached A2 horizon and the initial development of weak iron or organic pans in the sandy subsoil. Freshwater sedge swamps are found in larger areas of sand. In the lagoons salinity varies depending on tidal flushing and they are often surrounded by Broad-leaved Tea-tree *Melaleuca quinquenervia* and Swamp Oak *Casuarina glauca*. Water margins are occupied by *Juncus* sp. and Common Reed *Phragmites australis* in fresh water areas. Grey mangrove *Avicennia marina* may occur in some tidal inlets (Mitchell 2002).

2.1.3 Soil

The study area is within the Wollongong / Port Hacking 1:100k soil landscape (Hazelton and Tille 1990). The majority of the study area is mapped as Disturbed Terrain. A small section in the south west of the site is mapped as the Kurnell Aeolian soil landscape. The surface geology of the study area is mapped as medium to fine grained marine sand with podsols. There is a small area in the south western section of the site that is mapped as having a lithology of peat, sandy peat and mud (Hazelton and Tille 1990), which corresponds to the area of Kurnell Aeolian landscape.

2.1.4 Native vegetation extent

Vegetation within the study area and within the 1500 meter buffer area was assessed using aerial photographic interpretation, field survey results and existing vegetation mapping. Table 1 provides the list of Plant Community

Types (PCTs) identified from existing vegetation mapping, and the current assessment, as occurring within the study area and within the 1500 meter buffer. Conservation status of the communities is also provided.

Table 1 PCTs mapped within the study area and buffer

Location	PCT – (mapped OEH 2016 or Biosis 2018)	TEC Listing	
		BC Act	EPBC Act
Study area	659: Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion.	Bangalay Sand Forest	-
Study area	1795: Coastal Flats Swamp Mahogany Forest	Swamp Sclerophyll Forest	-
Study area	1232: Swamp Oak-Prickly Tea-tree-Swamp Paperbark Swamp Forest on Coastal Floodplains, Sydney Basin and South East Corner	Swamp Oak Floodplain Forest	-
Study area	772: Coast Banksia-Coast Wattle Dune Scrub, Sydney Basin and South East Corner	-	-
Study area	1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	-	-
Study area, buffer	Planted natives and exotics	-	-
Study area, buffer	Weeds and exotics >90%	-	-
Buffer	1231: Swamp Mahogany Swamp Sclerophyll Forest on Coastal Lowlands of the Sydney Basin and South East Corner	-	-
Buffer	1236: Swamp Paperbark-Swamp Oak Tall Shrubland on Estuarine Flats, Sydney Basin and South East Corner	Swamp Oak Floodplain Forest	-
Buffer	661: Bangalay - Smooth-barked Apple - Swamp Mahogany low open forest of southern Sydney, Sydney Basin Bioregion	Kurnell Dune Forest	-
Buffer	1808: Estuarine Reedland	Swamp Oak Floodplain Forest	-
Buffer	781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	Sydney Freshwater Wetlands (part), Freshwater Wetlands on Coastal Floodplains (part)	-
Buffer	1775: Coastal Sand Apple-Bloodwood Forest	-	-
Buffer	1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	Swamp Oak Floodplain Forest	-

Location	PCT – (mapped OEH 2016 or Biosis 2018)	TEC Listing	
		BC Act	EPBC Act
Buffer	1126: Saltmarsh in Estuaries of the Sydney Basin and South East Corner	Coastal Saltmarsh	Coastal Saltmarsh
Buffer	920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner	Coastal Saltmarsh	Coastal Saltmarsh
Buffer	1793: Coastal Sand Bangalay Forest	Bangalay Sand Forest	-
Buffer	1061: Old-man Banksia-She-oak-Red Bloodwood Heathland on Coastal Sands, Southern Sydney Basin	Eastern Suburbs Banksia Scrub	Eastern Suburbs Banksia Scrub

2.1.5 Cleared areas

Cleared areas within the study area and buffer area include roads, sand dunes, car parks, existing development, waterbodies (natural and man-made) and vacant land lots.

2.1.6 Differences between mapped vegetation extent and aerial imagery

There were no significant differences between the mapped vegetation extent and that visible on the aerial imagery.

2.1.7 Rivers and streams

The study area is located within the Greater Sydney Local Land Services Region and the Port Jackson / Georges River catchment. The closest river-mouth is the Georges River located approximately 6 kilometres to the north-west of the study area. The closest major waterbody is Botany Bay, located approximately 200 meters to the north of the site.

There is one first order tributary that has its origin in the study area, located adjacent the western boundary. The tributary runs parallel to the site boundary from south to north, where it exits the site at Captain Cook Drive, before entering the Towra Point Nature Reserve (Figure 1).

There are no Key Fish Habitats as mapped by the NSW Department of Primary Industry (DPI) within the study area. However Botany Bay, approximately 200 meters to the north of the site, is mapped as Key Fish Habitat (DPI 2013)

2.1.8 Wetlands

The vegetated outer parts of the study area, and impact area, are mapped as part of the Towra Point Estuarine Wetland (Figures 1 and 2), which is included in the Directory of Important Wetlands of Australia (DoIW 2004). The Towra Point Estuarine Wetland is 1161 hectares in area and was listed on the DoIW for the following reasons:

- It is a good example of a wetland type occurring within a biogeographic region in Australia.
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.
- The wetland supports 1% or more of the national populations of any native plant or animal taxa.
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level.
- The wetland is of outstanding historical or cultural significance.

The study area lies to the south and is in close proximity (approximately 250 meters) to the Ramsar wetland Towra Point Nature Reserve. Ramsar wetlands are representative, rare or unique wetlands, or are important for conserving biological diversity. They are included on the List of Wetlands of International Importance developed under the Ramsar convention. The Towra Point Nature Reserve was listed for the following reasons:

- Criterion 2: It supports three species listed as threatened under the EPBC Act; Magenta Lilly Pilly *Syzygium paniculatum*, Green and Golden Bell Frog *Litoria aurea* and Grey-headed Flying-fox *Pteropus poliocephalus*. Towra Point also supports 23 threatened species and five endangered ecological communities listed under the BC Act and 34 species listed under three international migratory bird agreements (JAMBA, CAMBA and ROKAMBA).
- Criterion 3: It is an important area for maintaining the biodiversity of the Sydney region. Seagrass beds, in conjunction with its mangrove and saltmarsh communities, provide critical shelter and food for juvenile fish and crustaceans. It is also recognised as one of the four most important migratory wading bird sites in NSW and Towra Spit Island was named the second most important breeding area in NSW for the Little Tern *Sterna albifrons*. 34 species of migratory birds listed under international agreements (JAMBA, CAMBA and ROKAMBA) have been recorded at Towra Point Nature Reserve. The Brown Honeyeater *Lichmera indistincta*, Mangrove Gerygone *Gerygone levigaster* and Wallum Froglet *Crinia tinnula* are at the southern extent of their distribution at Towra Point.
- Criterion 4: Species of fish such as Common Silver Biddy *Gerres ovatus*, Yellow Bream *Acanthospagrus australis* and Flat-tail Mullet *Liza argentea* are found in high numbers at Towra Point and use the mangrove habitats exclusively during the vulnerable juvenile stage of their life cycle. Juvenile Luderick *Girella tricuspidata* also prefer the mangroves after an initial stage in the adjacent seagrass beds. Due to loss of habitat along their migratory route, Towra Point Nature Reserve is critical for migratory shorebirds protected under the international agreements, JAMBA, CAMBA and ROKAMBA. The birds roost in saltmarsh within the Ramsar site and feed in the intertidal zone along the shoreline of Botany Bay to replenish their fat reserves before embarking on a long northward migration.
- Criterion 8: Towra Point is a significant habitat and food source for at least 60 species of fish of which 25 are of economic significance. Fish utilise the saltmarsh, mangroves and seagrass habitats at and adjacent to Towra Point Nature Reserve for food, protection and as a nursery habitat during the early stages in their life cycle. The use of saltmarsh areas by fish and birds allows nutrient cycling and energy transfer and demonstrates the ecological connectivity of the area. The tidal regime in Botany Bay supports the food web at Towra Point by exporting crab and crustacean larvae from saltmarsh to intertidal and subtidal areas, and by transporting detritus from seagrass meadows to intertidal and supratidal areas.

2.1.9 Connectivity features

Habitats within the study area are primarily those associated with coastal sclerophyll forests. For highly mobile fauna species and seed/pollen dispersal of some flora species, habitats within the study area are connected to the vegetation of Towra Point Nature Reserve to the north. The strongest habitat connectivity links for fauna and flora are to the south of the study area, where vegetation of the site adjoins the vegetation buffer of the desalination plant. Further to the south this area of native vegetation links to a cleared area that has the potential to provide a habitat linkage to a larger remnant of native vegetation on Crown land to the south, and further to the south and east to Botany Bay National Park (Figures 2 and 3).

On a smaller scale and for species more restricted in mobility and dispersal ability, vegetation and habitats located along the western boundary are fragmented from Towra Point Nature Reserve to the north by Captain Cook Drive, with canopy species being separated by at least 25 meters. To the south there is potential for connectivity through the freehold land to vegetation of the Crown land parcels and into the Botany Bay National Park (Figures 2 and 3).

Potential habitat for frogs and other species reliant on waterbodies and watercourses occurs as a small constructed wetland in the south west portion of the study area, and within the small tributary that runs south to north along the western boundary. These habitats are isolated by more than 50 meters to other areas of potential breeding habitat on adjacent lots. Vegetation to the south and east of the study area could provide for dispersal and shelter habitats between potential breeding habitats within the local area.

2.1.10 Areas of geological significance

There were no recorded karst, caves, crevices, cliffs or other areas of geological significance within the study area or within the 1500 meter buffer area surrounding the study area.

2.1.11 Biodiversity Values Map

There are no areas of outstanding biodiversity or Biodiversity Values mapped within the study area.

2.1.12 Soil hazard features

Vegetated parts of the study area are mapped as being Class 3 Acid Sulfate Soils. Cleared parts of the site are mapped as Class 4 Acid Sulfate Soils (SLEP 2015) (Figure 1). Within the broader landscape and within the 1500 meter buffer Acid Sulfate Soils have been mapped within all Classes (SLEP 2015) (Figure 1).

For Class 3 lands development consent is required for:

- Works more than one metre below the natural ground surface.
- Works by which the water table is likely to be lowered more than one metre below the natural ground surface.

For Class 4 lands development consent is required for:

- Works more than two metres below the natural ground surface.
- Works by which the water table is likely to be lowered more than 2 metres below the natural ground surface.

2.2 Site context

The site context was assessed using a site-based method undertaken 16 November 2017 and in 2015 (Biosis 2015a). The habitats and vegetation within the study area are a small subset of those in the wider landscape.

2.2.1 Native vegetation cover

Native vegetation cover was assessed using GIS based on the most suitable vegetation mapping, in this case *The Native Vegetation of the Sydney Metropolitan Area* (OEH 2016).

Native vegetation cover within the 1500 metre buffer was found to be 43.8%.

2.2.2 Patch size

Patch size was assessed as per the BAM (OEH 2017) using a select process in ArcGIS. All intact vegetation that has a gap of less than 100 metres from the next area of moderate to good condition native vegetation is considered to be of the same patch.

Vegetation within the study area meeting this criteria was mapped sequentially and it was found to form part of a relatively large patch of connecting vegetation with a patch size larger than 1000 hectares.

2.2.3 Hydrology

The site is mapped as having Groundwater Vulnerability (SLEP 2015). In deciding whether to grant development consent for development on land to which this clause applies, the consent authority must consider the following:

- The likelihood of groundwater contamination from the development (including from any on-site storage or disposal of solid or liquid waste and chemicals).
- Any adverse impacts the development may have on groundwater dependent ecosystems (GDEs).
- The cumulative impact the development may have on groundwater (including impacts on nearby groundwater extraction for a potable water supply or stock water supply).
- Any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

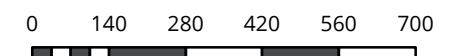
- The development is designed, sited and will be managed to avoid any significant adverse environmental impact, or
- If that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or
- If that impact cannot be minimised—the development will be managed to mitigate that impact.



Legend

- Impact area
- Study area
- Study area 1500m buffer
- Native vegetation

Figure 3: Native vegetation and connectivity



Scale: 1:13,817 @ A3
 Coordinate System: GDA 1994 MGA Zone 56



Albury, Ballarat, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter:
 Date: 22 February 2018,
 Checked by: , Drawn by: , Last edited by: cwharfe
 Location: P:\24900s\24932\Mapping\24932_BDAR_E3_NativeVeg

3 Native vegetation

The extent of native vegetation, threatened ecological communities and vegetation integrity within the study area was determined using the results of site investigations, previous studies undertaken at the site (Biosis 2015 a, b) and Chapter 5 and Appendix 6 of the BAM (OEH 2017).

3.1 Methods

3.1.1 Background review

Regional vegetation mapping OEH (2016) and existing site reports (Biosis 2015 a,b) as well as database searches (See Section 1.3) were reviewed to inform the site investigations. Based on the results of the background review and the requirements of the BAM with respect to this BDAR, appropriate surveys were designed for the study area and impact area.

3.1.2 Site investigation

A floristic assessment of the study area was undertaken by Biosis on 16 November 2017 by a qualified and experienced ecologist. The study area was surveyed in accordance with the BAM (OEH 2017), the *NSW Guide to surveying Threatened Plants* (OEH 2016) and random meander methods (Cropper 1993). This involved:

- The identification and mapping of PCTs according to the structural definitions of Native Vegetation of the Sydney Metropolitan Area (OEH 2016).
- Undertaking floristic plots within each vegetation zone in accordance with Section 5 of the BAM (OEH 2017).
- The identification of native and exotic plant species, according to the Flora of NSW (Harden 1992, 1993, 2000, 2002), with reference to recent taxonomic changes.
- Targeted searches for plant species of conservation significance according to the *NSW Guide to surveying Threatened Plants* (OEH 2016)
- Incidental observations using the “random meander” method (Cropper 1993).
- Identifying fauna habitats, assessing their condition and assessing their value to threatened fauna species.
- Observations of animal activity and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings).
- An assessment of the natural resilience of the vegetation of the site.
- Identification of previous and current factors threatening the ecological function and survival of native vegetation within and adjacent to the study area.

The conservation significance of plant species and plant communities was determined according to:

- BC Act for significance within NSW.
- EPBC Act for significance within Australia.

Detailed mapping of PCTs was conducted using hand-held (uncorrected) tablet units (Samsung Galaxy Tab 3) using the ArcGIS Collector application and aerial photo interpretation. Areas of native vegetation for which a PCT could validly be assigned were identified and delineated in the field, and their condition determined.

Identification of PCTs within the study area was confirmed with reference to the community profile descriptors (and diagnostic species tests) held within the OEH (2016) mapping project and NSW BioNet Vegetation Classification database (OEH 2017b).

Locations of floristic plots surveyed are provided as Figure 5.

3.2 Results

3.2.1 Vegetation description

The study area supports 6.6 hectares of native vegetation with varying levels of disturbance.

Native vegetation within the study area varied in composition and condition as a result of previous industrial land uses. The central portion of the site, primarily surrounding the now cleared and removed site infrastructure was limited to planted native tree species as Broad-leaved paperbark *Melaleuca quinquenervia*, Norfolk Island Hibiscus *Lagunaria patersonia* littered with isolated stands of Coastal Banksia *Banksia integrifolia* and Swamp Oak *Casuarina glauca*. The understory was predominately represented by a conglomeration exotic herbs and horticultural grass species as a result of regular slashing and mowing.

Vegetation recorded in the south western portion of the study area was in varying condition pending the remnants locale to Captain Cook Drive and the associated edges effects generated through service and asset maintenance such as fence lines and access gates.

Vegetation deemed within the impact area was found to be heavily degraded and as result of historical clearing and weed invasion. Whilst occasional native canopy species were observed within the mapped vegetation type, the mid storey stratum was primarily dominated by NSW Priority Weed species such Bitou Bush *Chrysanthemoides monilifera* subsp. *rotundata* and Lantana *Lantana camara*. In sections where woody weed species were limited in their dominance, scrambling exotic flora such as Morning Glory *Ipomoea indica* covered mullock heaps combined within site generated waste.

BAM Plot 1 (Figure 5) indicated a significant dominance of exotic flora species (90-100%) resulting in reduced species richness and native structural diversity. BAM Plot 2 (Figure 5) showed an increased native species canopy cover (43%) a limited native mid (23%) and ground storey (18%) yet due to the plot's position in relation to roads and infrastructure, several exotic species were recorded within the ground layer. BAM Plot 3 (Figure 5) recorded a moderate level of species richness (20 species) combined with a suitable level of florist structural iversity. Portions mapped as Planted natives and exotic grasses (Figure 4) with no native over storey or mid storey cover and less than 50% cover of native groundcover met the definition of cleared land and were not mapped as native vegetation.

3.2.2 Native vegetation extent

Figure 4 provides a map of the native vegetation extent recorded within the study area and impact area, as assessed during field investigations undertaken in November 2017. The figure includes all areas of native vegetation (native ground cover and areas with canopy). Areas not shown as native vegetation cover within Figure 4 are not included for further assessment in accordance with Section 5.1.1.5 of the BAM)(OEH 2017).

3.2.3 Plant community types

The following PCTs were assessed as present within the within the study area:

- PCT 659 Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion.
- PCT 1071, Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion.

- PCT 1795 Coastal Flats Swamp Mahogany Forest.
- PCT1232 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion.

Table 2 to Table 6 provide a detailed description of the five PCTs recorded within the study area.

Table 2 Vegetation type–Bangalay - Old-man Banksia open forest on coastal sands

PCT 659 Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion	
Vegetation formation	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	South Coast Sands Dry Sclerophyll Forests
Extent within study area	Approximately 0.18 ha (Figure 4)
Extent within impact area	0.0 ha
Condition	Moderate. This vegetation was distinct from the remainder of the vegetation along the eastern property boundary based on the floristic composition, particularly in the canopy, where Bangalay <i>Eucalyptus botryoides</i> was recorded. The surrounding vegetation is dominated by species such as Swamp Oak <i>Casuarina glauca</i> and Cheese Tree <i>Glochidion fernandii</i> which were absent in this community. The small patch of this community was generally in moderate condition with moderate diversity through each strata and limited exotic vegetation cover. (Biosis 2015a)
Description	The Bangalay Sand Forest was characterised by an open canopy of Bangalay <i>Eucalyptus botryoides</i> , Swamp Oak <i>Casuarina glauca</i> , Swamp Paperbark <i>Melaleuca ericifolia</i> , Prickly-leaved Paperbark <i>Melaleuca nodosa</i> , Large Mock-Olive <i>Notelaea longifolia</i> , Sydney Golden Wattle <i>Acacia longifolia</i> , Coast Teatree <i>Leptospermum laevigatum</i> , Coast Banksia <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> and Coffee Bush <i>Breynia oblongifolia</i> . The understory was dominated by Blady Grass <i>Imperata cylindrica</i> , Twiggy Rush <i>Baumea juncea</i> , Bracken Fern <i>Pteridium esculentum</i> with Scrambling Lily <i>Geitonoplesium cymosum</i> , <i>Cassytha glabella</i> and Scented Marsdenia <i>Marsdenia suaveolens</i> twining throughout.(Biosis 2015a)
Survey effort	Due to the vegetation type's location outside of the proposed impact area the BAM was not applied. Mapping and floristic information is based on Biosis (2015a).
Justification of PCT	Floristic composition soil type and landscape position align with the final determination (NSW Scientific Committee, 2008)
TEC Status	Commonwealth EPBC Act: Not listed NSW TSC Act: Endangered - Bangalay Sand Forest
Estimate of percent cleared value of PCT in the major catchment area	50 %

Table 3 Vegetation type- Freshwater Wetlands on Coastal Floodplains EEC

PCT 1071 <i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands of the Sydney Basin Bioregion	
Vegetation formation	KF_CH8 Freshwater wetlands
Vegetation class	Coastal Freshwater Lagoons
Extent within study area	Approximately 0.13 hectares (Figure 4)
Extent within impact area	0.0 ha
Condition	Poor. The Freshwater Wetland in the study area was considered to be in poor condition, given the lack of native species diversity which is likely due to it being constructed, rather than naturally occurring.
Description	The small wetland was located in the south-western corner of the study area around an artificial pond, draining into the creek on the study area's western boundary. A jetty had been built to provide access to water pumping equipment in the centre of the pond. Emergent vegetation such as Broadleaf Cumbungi <i>Typha orientalis</i> , Common Reed <i>Phragmites australis</i> and Tall Spike Rush <i>Eleocharis sphacelata</i> was recorded within the wetland and the edges of the wetland supported Bitou Bush <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> and Crofton Weed <i>Ageratina adenophora</i> . A tree line of Swamp Oak <i>Casuarina glauca</i> continued southeast beyond the pond through a dry, shallow gully, suggesting that the original creekline may have followed this course.
Survey effort	Due to the vegetation type's location outside of the proposed impact area the BAM was not applied. Mapping and floristic information is based on Biosis (2015a).
Justification of PCT	Floristic composition soil type and landscape position align with the PCT and the final determination (NSW Scientific Committee, 2008).
TEC Status	Commonwealth EPBC Act: Not listed NSW TSC Act: Not listed (man-made)
Estimate of percent cleared value of PCT in the major catchment area	75 %

Table 4 Vegetation type - Coastal Flats Swamp Forest

PCT 1795 Coastal Flats Swamp Mahogany Forest	
Vegetation formation	KF_CH9 Forested Wetlands
Vegetation class	Coastal Swamp Forests
Extent within study area	Approximately 2.6 ha in Good condition Approximately 0.8 ha in Poor condition (Figure 4)
Extent within impact area	0.0 ha
Condition	Two condition states were recorded: Good and Poor.

PCT 1795 Coastal Flats Swamp Mahogany Forest

Description	<p>The Good condition vegetation is located in the southwest portion of the study area and is a natural extension to the adjacent Poor condition vegetation which runs parallel in a south easterly direction (Figure 4). Native species recorded within the vegetation include Swamp Mahogany <i>Eucalyptus robusta</i> Swamp oak <i>Casuarina glauca</i> and Cheese tree <i>Glochidion ferdinandi</i>. Saw-sedge <i>Gahnia sieberiana</i> dominated the mid storey in moist portions of the community and was supported by tall native shrub species such as Sandpapaer Fig <i>Ficus coronata</i>, Bleeding Heart <i>Homalanthus populifolius</i> and climbers such as Silk Pod <i>Parsonsia straminea</i>, and Snake Vine <i>Stephania japonica</i> var. <i>discolour</i>. The ground storey recorded a variety of native sedges and herbs for which included <i>Baumea juncea</i>, Bracken Fern <i>Pteridium esculentum</i> and large scrambling mats of Native Violet <i>Viola hederacea</i>. Exotic species were recorded in low densities, opportunistic woody weed species were recorded along the Good / Poor condition vegetation interface and decreased significantly in number and density in a south easterly direction. Weed species recorded included Bitou Bush <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>, <i>Polygala virgata</i> and Asparagus fern <i>Asparagus aethiopicus</i>.</p> <p>The extent of the Poor condition vegetation was limited to the south west border of the impact area which followed an existing fence line in south easterly direction and boarded a large portion of the mapped PCT 1071.</p> <p>Native species recorded within this vegetation included a reduced canopy represented by Cheese Tree <i>Glochidion ferdinandi</i>, Swamp Oak <i>Casuarina glauca</i> with a partial mid storey consisting of Tall Saw-sedge <i>Gahnia clarkei</i>, Bitou Bush <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> and occasional representations of Coastal wattle <i>Acacia longifolia</i> ssp. <i>sophorae</i> and Lantana <i>Lantana camara</i>. The ground story saw a dominant representation of both native and exotic species alike with mixed monocultures Blady Grass <i>Imperata cylindrica</i>, Buffalo Grass <i>Stenotaphrum secundatum</i>, Large-leaf Pennywort <i>Hydrocotyle bonariensis</i>. <i>Baumea juncea</i> was also recorded in low densities throughout the vegetation.</p>
Survey effort	One BAM plot was undertaken within the PCT (Figure 4) which informed the finalised mapping.
Justification of PCT	Species recorded in the canopy, ground and mid stratum are consistent with a Forested Wetland community. Diagnostic species included Swamp Mahogany, Cheese Tree, Blady Grass, <i>Baumea juncea</i> Tall Saw-sedge are diagnostic features of the PCT 1795, yet the degraded vegetate type community does not achieve the required BioNet conditional benchmarks (OEH 2017) . Additional species recorded within the community are a result of opportunistic encroachment of aggressive woody weed species and adaptable native species for which confirm the communities degraded nature.
TEC Status	Commonwealth EPBC Act: Not listed NSW TSC Act: Endangered
Estimate of percent cleared value of PCT in the major catchment area	50%

Table 5 Vegetation type– Swamp Oak-Prickly Tea-tree-Swamp Paperbark Swamp Forest on Coastal Floodplains, Sydney Basin and South East Corner

PCT 1232 Swamp Oak-Prickly Tea-tree-Swamp Paperbark Swamp Forest on Coastal Floodplains, Sydney Basin and South East Corner	
Vegetation formation	KF_CH9 Forested Wetlands
Vegetation class	Coastal Swamp Forests
Extent within study area	Approximately 1.0 ha in Moderate condition Approximately 3.8 ha in Poor condition (Figure 4)
Extent within impact area	0.0 ha
Condition	Along the western boundary of the study area this community is generally in Moderate condition with moderate diversity through the canopy and understorey but stands of <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> and <i>Lantana camara</i> throughout. Historical clearing and disturbance has resulted in a Poor condition area of this community in the eastern (adjacent to cleared land) portions of the study area.
Description	The vegetation is dominated by Swamp Oak <i>Casuarina glauca</i> , in the canopy to a height of approximately 15 meters. The small tree layer was sparse in density, reached a height of approximately 6 meters and was dominated by <i>Casuarina glauca</i> , <i>Banksia integrifolia</i> and Coast Wattle <i>Acacia longifolia</i> var. <i>sophorae</i> . The shrub layer was relatively sparse in most areas and supported native species such as Coffee Bush <i>Breynia oblongifolia</i> and Sweet Pittosporum <i>Pittosporum undulatum</i> . The understorey was relatively dense and Bracken <i>Pteridium esculentum</i> and Bordered Panic <i>Entolasia marginata</i> . A dense layer of Bitou Bush <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> and Lantana <i>Lantana camara</i> was present in the understorey in more open patches and along tracks and edges. Other common exotic species recorded in the understorey along tracks, edges and open patches included Kurnell Curse Hydrocotyle <i>bonariensis</i> , Kikuyu Grass <i>Cenchrus clandestinus</i> , Buffalo Grass <i>Stenotaphrum secundatum</i> , Catsear <i>Hypochaeris radicata</i> and Crofton Weed <i>Ageratina adenophora</i> .
Survey effort	One BAM plot was undertaken within the Moderate condition vegetation (Figure 4) which informed the finalised mapping.
Justification of PCT	Floristic composition soil type and landscape position align with the final determination (NSW Scientific Committee, 2008).
TEC Status	Commonwealth EPBC Act: Not listed NSW TSC Act: Endangered
Estimate of percent cleared value of PCT in the major catchment	95%

Table 6 Vegetation Type - Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion

PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	
Vegetation formation	KF_CH6 Heathlands
Vegetation class	Sydney Coastal Heaths
Extent within study area	Approximately 1.4 ha
Extent within impact area	1.2 ha
Condition	Poor
Description	The vegetation is heavily dominated by exotic woody weed and aggressive vine species such as Bitou Bush <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> , Lantana <i>Lantana camara</i> , Montpellier Broom <i>Genista monspessulana</i> and Morning Glory <i>Ipomoea indica</i> . Amongst the predominately exotic midstory native species were recorded in low densities. Canopy species included Swamp Oak and Coastal Banksia <i>Banksia integrifolia</i> only. Additionally, the native midstory was sparsely represented by individual aging specimens of Coastal wattle <i>Acacia longifolia</i> subsp. <i>sophorae</i> with scattered native vine and scramblers species that included Native Grape <i>Cayratia clematidea</i> and Snake Vine <i>Stephania japonica</i> . Due to the smothering effects associated with the high densities of woody weed and vine species, native ground cover was reduce to a few token specimens of Spiny Matt Rush <i>Lomandra longifolia</i> located around the edges of the weed plumes.
Survey effort	One BAM plot was undertaken within the vegetation (Figures 4 and 5) to inform impact calculations and finalised mapping.
Justification of PCT	Species recorded in the canopy, ground and mid stratum are consistent with the Sydney Coastal Heath community. Where species such as Coastal banksia, Coastal wattle and Spiny Matt Rush are diagnostic features of the PCT 772, the degraded vegetation does not achieve the required BioNet conditional benchmarks (OEH 2017). Additional species recorded within the community are a result of opportunistic encroachment of aggressive woody weed species and adaptable native species for which confirm the communities degraded nature.
TEC Status	Commonwealth EPBC Act: Not listed NSW TSC Act: Not listed
Estimate of percent cleared value of PCT in the major catchment	65%

3.2.4 Threatened ecological communities

Vegetation within the impact area was not found to represent a threatened ecological community (TEC) listed under either the NSW BC Act or the Commonwealth EPBC Act. Figure 6 illustrates the TECs recorded within the broader study area as detailed in Table 2 to Table 6 above.

3.3 Vegetation integrity assessment

3.3.1 Vegetation zones

PCTs within the impact area were assessed and stratified, based on broad condition state, into vegetation zones. This resulted in a single vegetation zone identified as PCT 772_Poor (Table 7) within the impact area.

Table 7 Vegetation zones mapped within the impact area

Plant community type	Vegetation zone	Condition	Area	Patch size class
PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	772_Poor	Poor	1.2ha	>100ha

A detailed description of the vegetation zones is provided in Table 6 above.

3.3.2 Vegetation integrity

Vegetation integrity was assessed using data obtained from undertaking BAM plots, as per the methodology outlined in Section 5.3.4 of the BAM (OEH 2017). Plot data was collected via:

- A 20 metre x 50 metre quadrat and 50 metre transect for assessment of site attributes and function.
- A 20 metre x 20 metre quadrat, nested within the larger quadrat for full floristic survey to determine composition and structure of the PCT.

The minimum number of BAM plots per vegetation zone was determined using Table 4 of the BAM (OEH 2017). A total of one Bam plot was completed within the impact area. An assessment of vegetation integrity was undertaken using benchmark data collected as outlined in Subsection 5.3.3 of the BAM

No additional local data was used for this assessment.

A list of flora species was compiled, and records of all flora species will be submitted to OEH for incorporation into the Atlas of NSW Wildlife.

3.3.3 Vegetation integrity score

Plots data was entered into the BAM calculator to determine vegetation integrity score. Plot data is presented in Appendix 2. Vegetation integrity scores for the vegetation zone in the impact t area is provided in Table 8.

Table 8 Vegetation zone ingetrity scores

Vegetation zone	Composition condition score	Structure condition score	Function condition score	Vegetation integrity score
772_Poor	13.4	2.5	5.8

As outlined in Section 10.3.1 of the BAM, an offset is not required for impacts on native vegetation where the vegetation integrity score is:

- ≥ 15 where the PCT is representative of an endangered or critically endangered ecological community.
- ≥ 17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community.

- ≥ 20 where the PCT is not representative of a TEC or associated with threatened species habitat.

Vegetation zone 772_Poor is not a TEC, however it is associated with some threatened species habitat. As such, with a vegetation integrity score of 5.8 (ie. ≤ 17), offsets are not required for impact to native vegetation.



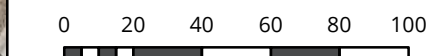
Legend

- Impact area
- Study area
- BAM plots

Vegetation community

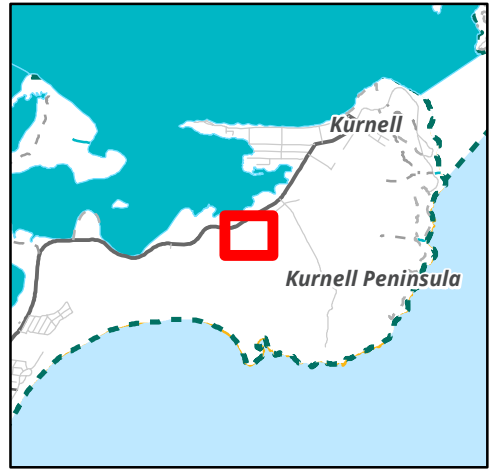
- PCT 1795 Coastal Flats Swamp Mahogany Forest – Good
- PCT 1795 Coastal Flats Swamp Mahogany Forest – Poor
- PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
- PCT1232 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion – Moderate
- PCT1232 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion – Poor
- PCT659 Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion
- PCT772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion (SR531)
- Planted natives and exotic grasses
- Cleared Vegetation

Figure 4: PCTs within the study area



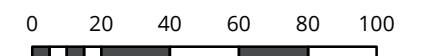
Scale: 1:2,197 @ A3
 Coordinate System: GDA 1994 MGA Zone 56





- Legend**
- Impact area
 - Study area
 - BAM plots
 - Call playback
 - Camera trap
 - Spotlighting transects
- Vegetation Zone**
- PCT 772_Poor

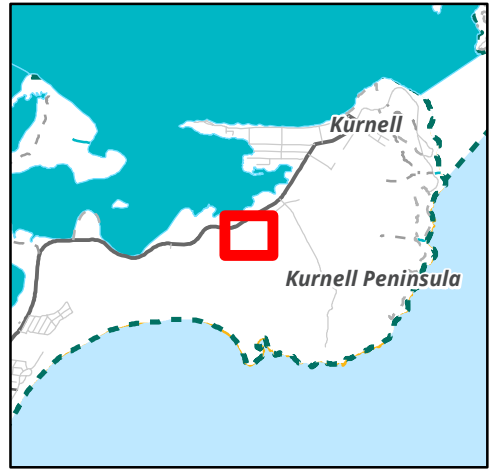
Figure 4: Vegetation Zones and survey effort



Scale: 1:2,196 @ A3
 Coordinate System: GDA 1994 MGA Zone 56



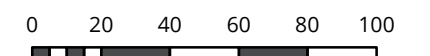
Albury, Ballarat, Melbourne,
 Newcastle, Sydney, Wangaratta & Wollongong



Legend

- Impact area
- Study area
- TEC**
- Bangalay Sand Forest
- Swamp Oak Floodplain Forest
- Swamp Sclerophyll Forest

Figure 6: TECs within the study area



Scale: 1:2,197 @ A3
 Coordinate System: GDA 1994 MGA Zone 56



Albury, Ballarat, Melbourne,
 Newcastle, Sydney, Wangaratta & Wollongong

4 Threatened species

4.1 Predicted species

A list of predicted species (ecosystem credit species) expected to occur within the study area, based on information obtained from the Threatened Biodiversity Data Collection, and refined as per Section 6 of the BAM is provided in Table 9 below. Impacts to these species require assessment, however targeted survey is not required.

Table 9 Assessment of ecosystem credit species within the study area

Scientific name	Common name	Habitat type	Habitat constraints	Geographic limitations	Veg Zone	Sensitivity to gain class	NSW listing status	Comm. listing status.
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	Foraging	--	--	772_Poor	High	V	--
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	--	--	--	772_Poor	High	V	--
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	--	--	--	772_Poor	High	V	E1
<i>Lathamus discolor</i>	Swift Parrot	Foraging	--	--	772_Poor	Moderate	E1	CE
<i>Lophoictinia isura</i>	Square-tailed Kite	Foraging	--	--	772_Poor	Moderate	V	--
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	--	--	--	772_Poor	Moderate	V	--
<i>Miniopterus australis</i>	Little Bentwing-bat	Foraging	--	--	772_Poor	High	V	--
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	Foraging	--	--	772_Poor	High	V	--
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	--	--	--	772_Poor	High	V	--
<i>Ninox connivens</i>	Barking Owl	Foraging	--	--	772_Poor	High	V	--
<i>Ninox strenua</i>	Powerful Owl	Foraging	--	--	772_Poor	High	V	--
<i>Pandion cristatus</i>	Eastern Osprey	Foraging	--	--	772_Poor	Moderate	V	--
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Foraging	--	--	772_Poor	High	V	V
<i>Saccolaimus</i>	Yellow-bellied	--	--	--	772_Poor	High	V	--

Scientific name	Common name	Habitat type	Habitat constraints	Geographic limitations	Veg Zone	Sensitivity to gain class	NSW listing status	Comm. listing status.
<i>flaviventris</i>	Sheath-tail-bat							
<i>Stagonopleura guttata</i>	Diamond Firetail	--	--	--	772_Poor	Moderate	V	--
<i>Tyto novaehollandiae</i>	Masked Owl	Foraging	--	--	772_Poor	High	V	--
<i>Anthochaera phrygia</i>	Regent Honeyeater	Foraging	--	--	772_Poor	High	CE	CE
<i>Glossopsitta pusilla</i>	Little Lorikeet	--	--	--	772_Poor	High	V	--
<i>Hieraaetus morphnoides</i>	Little Eagle	Foraging	--	--	772_Poor	Moderate	V	--
<i>Circus assimilis</i>	Spotted Harrier	--	--	--	772_Poor	Moderate	V	--
<i>Daphoenositta chrysoptera</i>	Varied Sittella	--	--	--	772_Poor	Moderate	V	--
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Foraging	--	--	772_Poor	High	V	--

The presence of these species could not be discounted using the methodology outlined in Step 1, Section 6.4 of the BAM. It was therefore assumed that these species may occur within the study area.

4.2 Species credit species

Table 10 provides a list of species credit species predicted to occur within the study area, based on information obtained from the Threatened Biodiversity Data Collection. An assessment of whether suitable habitat occurs within the study area, and therefore targeted survey is required, is also provided. The potential for a species to occur within the study area was assessed in accordance with Sections 6.3 and 6.4 of the BAM.

Table 10 Species credit species and status within the study area

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Comm. listing status.	Candidate species requiring targeted survey
Flora								
<i>Caladenia tessellata</i> Thick Lip Spider Orchid	--	--	--	Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Moderate	E1	V	No. Species habitat not present within the impact area.
<i>Chamaesyce psammogeton</i> Sand Spurge	--	Dunes Fore-dunes or exposed headlands	Foredunes and headlands	Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (<i>Spinifex sericeus</i>) and Prickly Couch (<i>Zoysia macrantha</i>)	High	E1	--	No. Species habitat not present within the impact area.
<i>Senecio spathulatus</i> Coast Groundsel	--	--	--	Coast Groundsel grows on frontal dunes.	Moderate	E1	--	No. Species habitat not present within the impact area
Amphibians								
<i>Litoria aurea</i> . Green and Golden Bell Frog	--	Semi-permanent ephemeral wet areas Within 1km of wet areas swamps Within 1km of swam waterbodies Within 1km of waterbody	--	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas.	High	E1	V	Yes. Potential habitat exists contiguous with the impact area.
<i>Litoria brevipalmata</i> Green-thighed	--	--	--	Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter	Moderate	V	--	No. Species habitat not present within the impact area

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Comm. listing status.	Candidate species requiring targeted survey
Frog				forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland. Breeding occurs following heavy rainfall from spring to autumn, with larger temporary pools and flooded areas preferred. Frogs may aggregate around breeding sites and eggs are laid in loose clumps among waterplants, including water weeds. The larvae are free swimming. The frogs are thought to forage in leaf-litter.				
Reptiles								
<i>Hoplocephalus bitorquatus</i> Pale-headed Snake	--	--	--	The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. In drier environments, it appears to favour habitats close to riparian areas. Shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees.	High	V	--	No. Species habitat not present within the impact area.
<i>Burhinus gallarius</i> Bush Stone-curlew	--	Fallen/standing dead timber including logs	--	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Nest on the ground in a scrape or small bare patch.	High	E1	--	No. Species habitat not present within the impact area.
<i>Calyptorhynchus lathamii</i> Glossy Black-Cockatoo	Breeding	--	--	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with	High	V	--	No. Species breeding habitat not present within the impact area.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Comm. listing status.	Candidate species requiring targeted survey
				<p>the massive bill.</p> <p>Dependent on large hollow-bearing eucalypts for nest sites. A single egg is laid between March and May.</p>				
<p><i>Haematopus longirostris</i> Pied Oystercatcher</p>	--	Within 100m of estuarine areas and the ocean	--	<p>Favours intertidal flats of inlets and bays, open beaches and sandbanks.</p> <p>Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish.</p> <p>Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones.</p>	High	E1	--	No. Species habitat not present within the impact area.
<p><i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle</p>	Breeding	--	--	<p>Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea.</p> <p>Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh.</p> <p>Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).</p> <p>Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large structures built from sticks and lined with leaves or grass.</p>	High	V	--	No. Species breeding habitat not present within the impact area.
<p><i>Hieraetus morphnoides</i></p>	Breeding	--	--	<p>Occupies open eucalypt forest, woodland or open woodland.</p> <p>Sheoak or Acacia woodlands and riparian woodlands of interior</p>	Moderate	V	--	No. Species breeding habitat not

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Comm. listing status.	Candidate species requiring targeted survey
Little Eagle				NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.				present within the impact area.
<i>Lathamus discolor</i> Swift Parrot	Breeding	--	--	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummifera, Mugga Ironbark E. sideroxyton, and White Box E. albens. Commonly used lerp infested trees include Inland Grey Box E. microcarpa, Grey Box E. moluccana and Blackbutt E. pilularis.	Moderate	E1	CE	No. Species habitat not present within the impact area.
<i>Lophoictinia isura</i> Square-tailed Kite	Breeding	--	--	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Appears to occupy large hunting ranges of more than 100km ² . Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	Moderate	V	--	No. Species breeding habitat not present within the impact area.
<i>Ninox connivens</i> Barking Owl	Breeding	--	--	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species.	High	V	--	No. Species breeding habitat not present within the impact area.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Comm. listing status.	Candidate species requiring targeted survey
				<p>During nesting season, the male perches in a nearby tree overlooking the hollow entrance.</p> <p>Two or three eggs are laid in hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed by predators (e.g. goannas).</p>				
<i>Ninox strenua</i> Powerful Owl	Breeding	--	--	<p>The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.</p> <p>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 hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine <i>Syncarpia glomulifera</i>, Black She-oak <i>Allocasuarina littoralis</i>, Blackwood <i>Acacia melanoxylon</i>, Rough-barked Apple <i>Angophora floribunda</i>, Cherry Ballart <i>Exocarpus cupressiformis</i> and a number of eucalypt species.</p> <p>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. While the female and young are in the nest hollow the male Powerful Owl roosts nearby (10-200 m) guarding them, often choosing a dense "grove" of trees that provide concealment from other birds that harass him.</p>	High	V	--	No. Species breeding habitat not present within the impact area.
<i>Pandion cristatus</i> Eastern Osprey	Breeding	--	--	<p>Favour coastal areas, especially the mouths of large rivers, lagoons and lakes.</p> <p>Feed over clear, open water. Nests usually within 1km of the sea.</p>	Moderate	V	--	No. Species breeding habitat not present within the impact area.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Comm. listing status.	Candidate species requiring targeted survey
<i>Tyto novaehollandiae</i> Masked Owl	Breeding	--	--	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. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	High	V	--	No. Species breeding habitat not present within the impact area.
Mammals								
<i>Cercartetus nanus</i> Eastern Pygmy-possum	--	--	--	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (<i>Pseudocheirus peregrinus</i>) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.	High	V	--	Yes. Potential habitat exists contiguous with the impact area.
<i>Chalinolobus dwyeri</i>	--	Cliffs Within two kilometres	--	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy	Very High	V	V	No. Species roosting or breeding

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Comm. listing status.	Candidate species requiring targeted survey
Large-eared Pied Bat		of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.		Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.				habitat not present within the impact area.
<i>Isoodon obesulus obesulus</i> Southern Brown Bandicoot (eastern)	--	Requires dense ground cover in a variety of habitats	--	Southern Brown Bandicoots are largely crepuscular (active mainly after dusk and/or before dawn). They are generally only found in heath or open forest with a healthy understorey on sandy or friable soils. 1 They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruited) fungi. Their searches for food often create distinctive conical holes in the soil. Nest during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees <i>Xanthorrhoea</i> spp., blackberry bushes and other shrubs, or in rabbit burrows. The upper surface of the nest may be mixed with earth to waterproof the inside of the nest.	High	E1	E1	Yes. Potential habitat exists contiguous with the impact area.
<i>Miniopterus australis</i> Little Bentwing-bat	Breeding	--	--	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. Little Bentwing-bats roost 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.	Very High	V	--	No. Species breeding habitat not present within the impact area.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Comm. listing status.	Candidate species requiring targeted survey
<i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat	Breeding	--	--	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia. Hunt in forested areas, catching moths and other flying insects above the tree tops.	Very High	V	--	No. Species breeding habitat not present within the impact area.
<i>Myotis macropus</i> Southern Myotis	--	Hollow bearing trees Within 200 m of riparian zone Bridges, caves or artificial structures within 200 m of riparian zone	--	Generally roost in groups of 10 - 15 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.	High	V	--	No. Species roosting or breeding habitat not present within the impact area.
<i>Petaurus norfolcensis</i> Squirrel Glider	--	--	--	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. Feeds on Acacia gum, eucalypt sap, nectar, honeydew and manna, invertebrates and pollen.	High	V	--	No. Species habitat not present within the impact area
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	Breeding	--	--	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular	High	V	V	No. Species breeding habitat not present within the impact area.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Comm. listing status.	Candidate species requiring targeted survey
				<p>food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.</p> <p>Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.</p> <p>Also forage in cultivated gardens and fruit crops.</p>				
<i>Vespadelus troughtoni</i> Eastern Cave Bat	--	<p>Caves</p> <p>Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.</p>	--	<p>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.</p> <p>Occasionally found along cliff-lines in wet eucalypt forest and rainforest.</p> <p>Little is understood of its feeding or breeding requirements or behaviour.</p>	Very High	V	--	<p>No.</p> <p>Species roosting or breeding habitat not present within the impact area.</p>

4.2.1 Biodiversity risk weighting

Table 11 outlines the Biodiversity Risk Weighting for threatened species potentially impacted by the proposed development.

Table 11 Threatened species Biodiversity Risk Weighting

Scientific name	Common name	Biodiversity Risk Weighting
Fauna		
<i>Cercartetus nanus</i>	Eastern-Pygmy Possum	2
<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot	2
<i>Litoria aurea</i>	Green and Golden Bell Frog	2

4.3 Threatened species surveys

Targeted flora and fauna survey of the study area were undertaken from 16 November 2017 to 09 January 2018. Weather observations for each survey date are shown in Table 12.

Table 12 Weather observations during flora and fauna surveys (Sydney, NSW)

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)
		Min.	Max.	
Flora survey	09/11/2017	18	24	0
Nocturnal frog and mammal survey	21/11/2017	21	25	1.6 (7.4mm over 5 days preceding)
Nocturnal frog and mammal survey	22/11/2017			7.8 (15.2mm over 5 days preceding)
Nocturnal frog and mammal survey	05/12/2017	26	25	7.6 (20mm over 5 days preceding)
Nocturnal frog and mammal survey	09/01/2017			18.6 (21.8mm over 5 days preceding)

Information from the Australia Government Bureau of Meteorology website.

4.3.1 Threatened flora habitat and survey

Habitat for threatened flora species within the impact area is considered to be very limited. Historical and ongoing disturbance in the form of vegetation removal and invasion of dense and smothering exotic species has significantly degraded the habitats present within Vegetation Zone 772_Poor. Candidate species (as listed in Table 10) are low growing ground-cover species, highly sensitive to this from of disturbance. As such, potential occurrence of these species is considered to be low.

Despite the assessed lack of habitat within the impact area, targeted surveys for threatened flora were undertaken, and in accordance with the NSW Guide to surveying Threatened Plants (OEH 2016). This included a comprehensive survey of Vegetation Zone 772_Poor using parallel line traverses separated by between 5 and 10 metres, depending on vegetation density.

Targeted surveys using parallel line traverses were also undertaken within the PCT 1795 and PCT 1232 vegetation (to be retained) over the western boundary of the impact area (Figure 4). This additional survey was undertaken to assess likelihood of indirect impacts to listed flora species that may have occurred in this area. This vegetation was selected as it is of the highest condition and most suitable habitats, in close proximity to the proposed impacts of the development.

Target species included:

- Thick Lip Spider Orchid *Caladenia tessellate*
- Sand Spurge *Chamaesyce psammogeton*
- Coast groundsel *Senecio spathulatus*

No threatened flora species were recorded within the study area.

4.3.2 Fauna habitat assessment and field survey

Fauna habitat assessment was undertaken to determine whether the vegetation to be impacted by the proposed development contained microhabitats suitable to support the threatened fauna species outlined in Table 9 and Table 10 above. The habitat assessments focussed on the presence of the following features within the study area:

- Habitat trees including large hollow-bearing trees, availability of flowering shrubs and feed tree species.
- Condition of native vegetation and the presence of exotic species.
- Condition of pools and waterways.
- Quantity of ground litter and logs.
- Searches for indirect evidence.
- General degradation of the site as a result of past industrial land management practices and lack of maintenance.

Fauna habitats within Vegetation Zone 772_Poor were found to be significantly degraded due to the dense occurrence of exotic vegetation such as Bitou Bush, Lantana, Montpellier Broom and Morning Glory. Native species including Swamp Oak, Coastal Banksia and Coastal Wattle occur sparsely through the vegetation, but are not considered to provide fauna habitat of any significance to the species listed in the tables above.

As such, the potential presence of the majority of the listed fauna species outlined above is considered to be on a transient basis only, as they fly over the site foraging as part of their larger home range.

Dense vegetation is known to support species such as Eastern-Pygmy Possum *Cercartetus nanus* and Southern Brown Bandicoot *Isodon obesulus obesulus*, and as such these species were targeted during field surveys. There are also numerous records of Green and Golden Bell Frog *Litoria aurea* within the locality and thus the species was also the target of field surveys.

Habitats values increase with improved vegetation condition in the retained vegetation to the north-east and west of Vegetation Zone 772_Poor (Figure 5), and a man-made wetland occurs directly west of the impact area. These areas have been assessed as holding a higher potential to support threatened fauna and were targeted to ensure indirect impacts and/or potential movement corridors through the impact areas were considered.

The remainder of the impact area supports no fauna habitat of significance. The site has recently been demolished, under a previous DA, and currently exists as recently created piles of rubble and soil, and

concrete slabs. Some native and exotic vegetation occurs sparsely over the site however it is not considered to support habitat of any significance to species other than those common to urban/industrial environments.

Table 13 and Figure 5 outline the fauna survey effort undertaken as part of the current assessment.

Table 13 Fauna survey effort details

Survey undertaken	Survey dates	Target species	Survey effort
Baited camera traps	21/11 – 05/12/17	Southern Brown Bandicoot	30 trap nights (15 nights x 2 cameras)
Spotlighting and call-playback	21/11/17 22/11/17 05/12/17 09/01/18	Southern Brown Bandicoot Eastern Pygmy-possum Bush Stone Curlew Green and Golden Bell Frog	8 hours (1 hour per night x 2 persons)
Active searches for frog	21/11/17 22/11/17 05/12/17 09/01/18	Green and Golden Bell Frog	6 hours (0.75 hours per night x 2 persons)

No threatened fauna species were recorded during the filed survey as detailed above.

Stage 2 – Impact assessment (biodiversity values)

5 Avoid and minimise impacts

This section identifies the potential impacts of proposed development on the biodiversity values of the study area and includes measures taken to date and additional recommendations to assist the final design of the development to further avoid and minimise impacts on biodiversity within and surrounding the study area.

5.1 Actions to avoid/minimise project impacts

The principal means to reduce impacts on biodiversity values within the study area are to avoid and minimise removal of native vegetation and fauna habitat. Additional recommendations may include measures to mitigate residual impacts after all measures to avoid and minimise impacts have been considered.

Steps taken are broken down into site selection and planning, construction and operation.

Site selection and planning

The current development site has been selected, in part, to minimise impacts to the native vegetation and flora and fauna habitats present within the broader study area.

Prior studies undertaken by Biosis (2015) identified the presence of vegetation listed under the NSW *Threatened Species Conservation Act 1995* (now listed under the BC Act) within the study area along the western and northern lot boundaries, and in the north-eastern corner of the lot (Figure 6).

The presence of this threatened vegetation has been considered during the design phase of the current development and all direct impacts to these areas have been avoided. Impacts to vegetation have been restricted to the poor condition, non-threatened dune scrub vegetation present along the site's eastern boundary. This area does not conform to a listed ecological community and is considered to supported limited habitat values.

Biosis (2015) also considered the site to support limited habitat for Green and Golden Bell Frog and Wallum Froglet *Crinia tinnula* present within and surrounding the man-made dam in the southern portion of the lot (Figure 4). This area was also designated for retention during the design phase of the current development.

Construction

No additional direct impacts are expected to occur as a result of the construction phase. However, indirect impacts to retained biodiversity values have the potential to occur. Additional mitigation measures recommended to avoid and minimise impacts include:

- Installation of appropriate exclusion fencing around trees and vegetation to be retained in the study area.
 - The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12. ($TPZ = DBH \times 12$) in accordance with the Standards Australia Committee (2009).
 - A TPZ should not be less than 2 metres nor did greater than 15 metres, except where crown protection is required (Standards Australia Committee 2009).
 - This would include appropriate signage such as 'No Go Zone' or 'Environmental Protection Area'.

- Identify the location of any 'No Go Zones' in site inductions and a Construction Environmental Management Plan.
- All material stockpiles, vehicle parking and machinery storage will be located within cleared areas proposed for clearing, and not in areas of native vegetation that are to be retained.
- Any hollow-bearing trees to be removed should be placed in areas of retained vegetation to provide additional fauna habitat.
- Where appropriate native vegetation cleared from the study area should be mulched for re-use on the site, to stabilise bare ground.
- Wet down areas to reduce dust generation during construction.
- Implementation of temporary stormwater controls during construction and to ensure that discharges to the drainage channels are consistent with existing conditions.
- Sediment and erosion control measures should be implemented prior to construction works commencing (e.g. silt fences, sediment traps), to protect the drainage channels to the west and to the south. These should conform to relevant guidelines, should be maintained throughout the construction period and should be carefully removed following the completion of works.

Prescriptions for mitigation of potential impacts of construction activities on retained native vegetation and habitat should be addressed in a site-specific Construction Environmental Management Plan (CEMP). The CEMP should include all measures outlined above.

Operation

The impacts arising from the operation of the proposed development are expected to be negligible. As a result, no additional mitigation measures are recommended.

5.2 Assessment of unavoidable impacts

Assessment of direct and indirect impacts unable to be avoided has been undertaken in accordance with the BAM (OEH 2017). The following direct and indirect impacts are unable to be avoided in progressing the proposed development.

5.2.1 Direct impacts

Direct impacts arising from the project include:

- Removal of all native and non-native vegetation within Vegetation Zone 772_Poor comprising 1.2 hectares of Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion.
- Removal of 1.2 hectares of low quality flora and fauna habitat within Vegetation Zone 772_Poor.
- Removal of scattered native and non-native vegetation providing potential foraging resources to threatened and non-threatened fauna species common to urban / industrial environment such as the study area.

These impacts will be permanent and will occur from the outset of the development. Mitigation measures outlined in Section 5.1 above will help to minimise the potential impacts to biodiversity values that remain present within the study area.

Towra Point Estuarine Wetland is mapped as surrounding the study area as listed on the Australian Directory of Important Wetlands. Occurrences of the mapped wetland are present within the vegetation to be retained in the east and west of the site, and along the edge of the vegetation to be removed within Vegetation Zone 772_Poor. The centre of the study area has been excluded from the mapped extent of the wetland (Figures 1 and 2).

It is clear that the intent of the mapping is to include the vegetation surrounding the proposed impact area and that the scale and coarseness of the mapping has resulted in a cross-over in proposed impacts and the mapped extent of the wetland. Direct impacts to the mapped wetland will not result from the proposed development, with the exception of potential removal of highly disturbed edge vegetation within Vegetation Zone 772_Poor.

The proposed development will not result in a change of land use from the current/former industrial use, and as such it is not expected that construction or operational impacts to the wetland will occur.

The Ramsar wetland Towra Point Nature Reserve occurs approximately 250 metres to the north of the study area, however no direct or indirect impacts to the wetland are expected to occur. Again, no change in land use is proposed and as such no novel or additional impacts are likely.

5.2.2 Indirect impacts

Potential indirect impacts arising from the project are outlined and addressed in Table 14 below.

Table 14 Assessment of indirect impacts

Indirect impact	Assessment / likelihood of occurrence
Inadvertent impacts on adjacent habitat or vegetation.	The proposed development has the potential to result in inadvertent impacts on adjacent retained habitat or vegetation. However, the mitigation measures described above will minimise the likelihood of occurrence of this indirect impact during the construction and operations phases of the project.
Reduced viability of adjacent habitat due to edge effects.	The proposed development will not result in a significant increase in edge effects impacting upon the retained vegetation. The majority of the site has been historically cleared and as such edge effects have been an ongoing impact to the retained vegetation within the study area. The proposed development will increase edge effects to a small portion of the vegetation present in the southern and eastern corners of the study area. This vegetation is currently disturbed and will remain connected to other areas of higher condition vegetation and as such any increased edge effects are expected only to result in negligible impacts.
Reduced viability of adjacent habitat due to noise, dust or light spill.	This is unlikely to occur outside the construction phase of the project and the land use of the site is not changing. Mitigation measures outlined above and standard construction environmental controls will ensure potential impact are minimised.
Transport of weeds and pathogens from the site to adjacent vegetation.	This is unlikely to occur outside the construction phase of the project and the land use of the site is not changing. Mitigation measures outlined above and standard construction environmental controls will ensure potential impact are minimised.
Increased risk of starvation, exposure and loss of shade or shelter.	This is unlikely to occur as the proposed development will not substantially impact on fauna habitats within and surrounding the study area.

Indirect impact	Assessment / likelihood of occurrence
Loss of breeding habitats.	The study area has been assessed to contain minimal breeding habitat. Two hollow-bearing trees were recorded within the north-western retained vegetation. No breeding habitats were recorded within the impact area.
Trampling of threatened flora species.	No threatened flora species were recorded within the study area.
Inhibition of nitrogen fixation and increased soil salinity.	The proposed development will not result in the removal of a substantial area of native vegetation, there is also large patches of vegetation, both within and adjacent to the study area, that will not be impacted. As such it is not considered likely that nitrogen fixation or soil salinity will be impacted.
Fertiliser drift.	No fertiliser is proposed to be used.
Rubbish dumping.	Mitigation measures outlined above and standard construction environmental controls will ensure potential impact are minimised.
Wood collection.	The proposed development is industrial in nature and it is considered unlikely those persons who will work at the site will collect wood from the retained vegetation.
Bush rock removal and disturbance.	The sandy soil present within the study area does not support bush rock.
Increase in predatory species populations.	There is no proposed change to land use that will likely lead to an increase in predatory species populations.
Increase in pest animal populations.	There is no proposed change to land use that will likely lead to an increase in pest animal populations.
Increased risk of fire.	There is no proposed change to land use that will likely lead to an increased risk of fire.
Disturbance to specialist breeding and foraging habitat, e.g. Beach nesting for shorebirds.	No specialist breeding or foraging habitat occurs within or directly adjacent to the study area
Fragmentation of movement corridors.	<p>Vegetation to be removed within Vegetation Zone 772_Poor comprises a highly disturbed edge of a movement corridor linking habitats surrounding the study area to Towra Point Estuarine Wetland to the north with Boat Harbor Park to the south, and Botany bay National Park to the east. Removal of 1.2 hectares of highly disturbed vegetation is not considered likely to result in substantial or significant adverse impedance to fauna species that may use the corridor for dispersal.</p> <p>Large areas of vegetation, present in higher ecological condition, will be retained maintaining the corridor at, or just below, its current width and functionality. At a maximum the width of the vegetated corridor will be reduced from approximately 200m to 150m wide over an area of approximately 100m in length. As outlined above the vegetation to be removed is the highly disturbed edge of this patch.</p>

5.2.3 Prescribed impacts

Assessment of prescribed biodiversity impacts are outlined and addressed in Table 15 below.

Table 15 Assessment of prescribed impacts

Prescribed impact	Assessment / likelihood of occurrence
Impacts of development on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other features of geological significance.	No karst, caves, crevices, cliffs and other features of geological significance will be impacted by the proposed works and no threatened species associated with these features were recorded during the assessment.
Impacts of development on the habitat of threatened species or ecological communities associated with rocks.	No bush rock will be impacted by the proposed works and no threatened species associated with this habitat feature were recorded during the assessment.
Impacts of development on the habitat of threatened species or ecological communities associated with human made structures.	No human made structures will be impacted by the proposed works and no threatened species associated with this habitat feature were recorded during the assessment.
Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.	Non-native vegetation was recorded within the study area in the form of ornamental trees and invasive weed species. No threatened species that rely on this non-native vegetation as a habitat resource were recorded or predicted to occur within the study area during the assessment.
Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.	<p>As outlined in Figure 3 a movement corridor providing connectivity of habitats occurs surrounding the study and impact areas.</p> <p>It is considered reasonable to expect that all species listed in Table 9 and Table 10 could utilise this movement corridor.</p> <p>TECs mapped as present within and/or adjacent to this corridor include Swamp Oak Floodplain Forrest, Swamp Sclerophyll Forest, Sydney Freshwater Wetlands and Kurnell Dune Forrest.</p> <p>Based on local records the species most likely to benefit from persistence of this connectivity is Green and Golden Bell Frog.</p> <p>Potential impacts to this area of connectivity are described in Table 14 above and are considered minor, and indirect in nature.</p> <p>The indirect impacts to this movement corridor (removal of 1.2 hectares of highly disturbed edge vegetation) are considered negligible when being considered at the scale of the Sydney Basin bioregion.</p> <p>The local population of the species most likely impacted, Green and Golden Bell Frog, is a significant population within the bioregion due to its isolation from other populations by Sydney urban area.</p> <p>Significant disruption of this movement corridor may result in severance of connectivity between habitats within Towra Point Estuarine Reserve and Botany Bay National Park, and other habitats on the southern side of the Kurnell peninsula, however connectivity will be maintained.</p> <p>The proposed development will not sever the connectivity present in the broader locality and as such impacts to species using the corridor is considered negligible.</p>

Prescribed impact	Assessment / likelihood of occurrence
Impacts of the development on movement of threatened species that maintains their life cycle	Green and Golden Bell Frogs are known to move between breeding ponds and other habitats through vegetated areas (Commonwealth of Australia 2009) such as that which occurs to the east of the study and impact areas. In line with the information provided above the proposed impacts to this vegetation are not expected to result in substantial impedance to the movement of the species through the landscape.
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)	The proposed development is not expected to significantly or substantially alter water quality, water bodies and/or hydrological processes that sustain threatened species and threatened ecological communities. The proposed development will result in minor clearing of shallow rooted vegetation and the future land use will remain in-line with the current/recent historic industrial use of the site.
Impacts of wind turbine strikes on protected animals	n/a
Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	n/a

5.3 Impacts to groundwater dependent ecosystems

The study area is mapped as having Groundwater Vulnerability (SLEP 2015), and as supporting GDEs associated with the Botany Sand Bed aquifer in Appendix 8 of the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (DPI 2012a). As such, an assessment of the proposed activity has been undertaken in accordance with the NSW DPI Office of Water *Aquifer Interference Policy* (DPI 2012b).

The NSW DPI step by step guide for assessing a proposal against the NSW Aquifer Interference Policy states:

If an activity is not defined as an aquifer inference activity, then assessment is not required under the Aquifer Interference Policy.

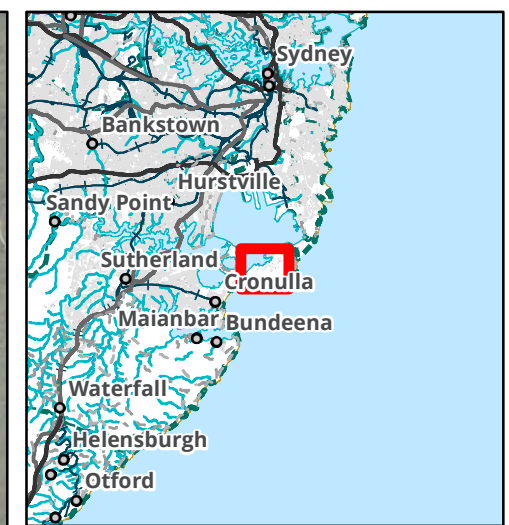
The Water Management Act defines an aquifer interference activity as an activity involving any of the following:

- The penetration of an aquifer.
- The interference with water in an aquifer.
- The obstruction of the flow of water in an aquifer.
- The taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations., and/or the disposal of that water.

The proposed development will not result in an aquifer interference activity and as such, will not impact upon GDEs.

5.4 Adaptive Management Strategy

The proposed development will not result in impacts relating to karst, caves, crevices, cliffs and other geological features of significance, subsidence and upsidence, wind turbine strikes or vehicle strikes and as such an Adaptive Management Strategy is not considered necessary.






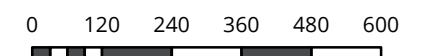
- Legend**
-  Study area
 -  Impact area
 -  1500m indirect impact zone

Figure 7: Indirect impact zones associated with the project



Scale: 1:13,000 @ A3
 Coordinate System: GDA 1994 MGA Zone 56



Albury, Ballarat, Melbourne,
 Newcastle, Sydney, Wangaratta & Wollongong

6 Impact summary

6.1 Thresholds for assessment and offsetting

This section outlines the thresholds for assessment and offsetting in accordance with Section 10 of the BAM.

6.1.1 Serious and irreversible impacts on biodiversity values

No potential serious and irreversible impacts on biodiversity values have been recorded or assessed as likely to occur as part of the current assessment.

6.1.2 Impacts requiring offsets

Impacts native vegetation and threatened species

As outlined in Section 10.3.1 of the BAM, an offset is not required for impacts on native vegetation where the vegetation integrity score is:

- ≥ 15 where the PCT is representative of an endangered or critically endangered ecological community.
- ≥ 17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community.
- ≥ 20 where the PCT is not representative of a TEC or associated with threatened species habitat.

Vegetation Zone 772_Poor is not a TEC, however it is associated with some threatened species habitat. As such, with a vegetation integrity score of 5.8 (ie. ≤ 17), offsets are not required for impact to native vegetation.

No threatened species credit species, or high quality habitats, were recorded during the field investigations and as such no offsets are required.

7 Biodiversity credits

Offsetting through the transfer and retirement of biodiversity credits is not required for the current assessment due to the avoidance of impacts to vegetation and threatened species habitats.

8 Assessment against biodiversity legislation

8.1 Environment Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposed development on Matters of NES, against heads of consideration outlined in Commonwealth of Australia (2013) was prepared to determine whether referral of the project to the Commonwealth Minister for the Environment is required. Matters of NES relevant to the project are summarised in Table 16.

Table 16 Assessment of the project against the EPBC Act

Matter of NES	Project specifics	Potential for significant impact
Threatened species	Four flora species and 22 fauna species have been recorded or are predicted to occur in the locality. As no impacts to significant flora or fauna habitats will result from the proposed industrial redevelopment, and no listed species were recorded within the study area, no impacts to threatened species will result from the project.	Significant impact unlikely to result from the proposed development.
Threatened ecological communities	<i>Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South-East Corner Bioregions</i> and <i>Eastern Suburbs Banksia Scrub</i> are mapped within the 1500m buffer area. The proposed development will not result in any impacts to these communities.	Significant impact unlikely to result from the proposed development.
Migratory species	51 migratory bird species have been recorded or are predicted to occur in the locality. The study area does not provide important habitat for any of these species.	Significant impact unlikely to result from the proposed development.
Wetlands of international importance (Ramsar sites)	The Ramsar wetland Towra Point Nature Reserve is within approximately 250m of the site. As the study area does not flow directly into the Ramsar site the development is not likely to result in a significant impact.	Significant impact unlikely to result from the proposed development.

On this basis, the EPBC Act is unlikely to be triggered and referral of the Project to the Australian Government Minister for the Environment will not be required.

8.2 Environmental Planning and Assessment Act 1979

8.2.1 Sutherland Shire LEP (2015)

The project has minimised impacts to native vegetation and flora and fauna habitats and is therefore consistent with the environmental (biodiversity) related objectives of the IN1 General Industrial zoning in the Sutherland Shire LEP 2015. The proposed activities are listed as Permitted with Consent.

8.2.2 SEPP No. 71 Coastal Protection

A key aim of the Coastal Protection SEPP is “to protect and preserve native coastal vegetation”, and it is a requirement that “certain development applications to carry out development in sensitive coastal locations to be referred to the Director-General (*Dept. Infrastructure, Planning and Natural Resources*) for comment”.

A “sensitive coastal location” is defined as:

- Land within 100m above mean high water mark of the sea, a bay or an estuary.
- A coastal lake.
- A declared Ramsar wetland within the meaning of the EPBC Act.
- A declared World Heritage property within the meaning of the EPBC Act.
- Land declared as an aquatic reserve under the NSW Fisheries Management Act 1994.
- Land declared as a marine park under the NSW Marine Parks Act 1997.
- Land within 100m of any of the following:
 - The water’s edge of a coastal lake.
 - Land to which above four dot points applies.
 - Land reserved or dedicated under the NSW National Parks and Wildlife Act 1974.
 - Land to which State Environmental Planning Policy No 14—Coastal Wetlands applies.
- Residential land (within the meaning of State Environmental Planning Policy No 26—Littoral Rainforests) that is within a distance of 100m from the outer edge of the heavy black line on the series of maps held in the Department of Planning and marked “State Environmental Planning Policy No 26—Littoral Rainforests (Amendment No 2)”.

It is not expected that any of the above clauses apply to the current development as such referral to, and comment from, the Director General is unlikely to be required.

However, given the proximity of the study area to Botany Bay, Towra Point Nature Reserve and Towra Point Estuarine Wetland, the distance from the high water mark should be reviewed to ensure the first dot point above does not apply.

8.3 Biosecurity Act 2015

The Biosecurity Act was enacted to provide for the identification, classification and control of Priority Weeds with the purpose of determining if a biosecurity risk is likely to occur, i.e.:

- The introduction, presence, spread or increase of a pest into or within the State or any part of the State.
- A pest plant has the potential to; harm or reduce biodiversity or out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.

Five Priority Weeds for Greater Sydney Region which includes the Sutherland Shire LGA, that have been recorded in the study area are listed in Table 17 along with their associated Duty.

Table 17 Assessment of the project against the EPBC Act

Scientific Name	Common Name	General Biosecurity Duty
<i>Asparagus aethiopicus</i>	Ground Asparagus	Prohibition on dealings <i>Must not be imported into the State or sold</i>
<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush	Biosecurity Zone <i>The Bitou Bush Biosecurity Zone is established for all land within the State except land within 10 kilometres of the mean high water mark of the Pacific Ocean between Cape Byron in the north and Point Perpendicular in the south. Within the Biosecurity Zone this weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed. The local control authority must be notified of any new infestations of this weed within the Biosecurity Zone</i>
<i>Lantana camara</i>	Lantana	Prohibition on dealings <i>Must not be imported into the State or sold</i>
<i>Genista monspessulana</i>	Cape Broom	Prohibition on dealings <i>Must not be imported into the State or sold</i>
<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	Regional Recommended Measure <i>An exclusion zone is established for all lands in Blue Mountains City Council and Central Coast local government areas. The remainder of the region is classified as the core infestation area.</i> <i>Whole region: The plant or parts of the plant are not traded, carried, grown or released into the environment.</i> <i>Exclusion zone: The plant is eradicated from the land and the land kept free of the plant. Core infestation area: Land managers prevent spread from their land where feasible.</i>

9 Conclusion

A total of 6.6 hectares of native vegetation was recorded within the study area representing three TECs. Avoidance of impacts to native vegetation, threatened ecological communities and threatened species habitat have been undertaken to restrict proposed impacts to 1.2 hectares of non-threatened and degraded coastal heath vegetation at the rear of the site.

No threatened species, or high quality habitats, were recorded within the study area during field investigation undertaken in accordance with the BAM. The vegetation integrity score of the vegetation to be impacted has been calculated as 5.8, and as such, in accordance with Section 10.3 of the BAM, offsets are not required for the proposed development.

No Matters of National Environmental Significance are likely to be impacted by the proposed development and as such, a referral of the project to the Commonwealth is not required.

References

- Biosis (2015a) *238-258 Captain Cook Drive, Kurnell – Flora and Fauna Assessment*, Prepared for Kerry Lowe by Biosis Pty Ltd.
- Biosis (2015b) *238-258 Captain Cook Drive, Kurnell, Vegetation Management Plan* Prepared for Kerry Lowe by Biosis Pty Ltd.
- Bureau of Meteorology, 2018. *Climate statistics for Australian locations*. Available from: <http://www.bom.gov.au/climate/data/> Accessed 12.01.2017
- Cropper 1993. *Management of Endangered Plants*. East Melbourne, Victoria: CSIRO.
- Commonwealth of Australia (2009). *Significant impact guidelines for the vulnerable green and golden bell frog (Litoria aurea) Nationally threatened species and ecological communities EPBC Act policy statement 3.19*. Department of the Environment Water, Heritage and the Arts, Canberra
- DPI 2012a. Risk assessment guidelines for groundwater dependent ecosystems, Various authors. NSW Department of Primary Industries.
- DPI2012b. NSW Aquifer Interference Policy NSW Government policy for the licensing and assessment of aquifer interference activities. NSW Department of Primary Industries.
- Office of Water, Sydney
- DPI 2013. *Policy and guidelines for fish habitat conservation and management (2013 update)*. NSW Department of Primary Industries.
- Mitchell, P.B. (2002) (unpub). *NSW ecosystems study: background and methodology*. Unpublished report to the NSW National Parks and Wildlife Service, Hurstville.
- NSW Office of Water 2012. *Controlled activities on waterfront land: Guidelines for riparian corridors on waterfront land*. Department of Primary Industries – Office of Water
- Hazelton PA and Tille PJ, 1990, *Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet map* and report, Soil Conservation Service of NSW, Sydney
- Office of Environmental and Heritage (OEH) 2017a Biodiversity Assessment Methodology (BAM)
- OEH 2017b NSW BioNet Vegetation Classification database <http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx> Accessed 09.01.2018
- OEH 2017c Ramsar Wetland mapping <http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=23> Accessed 23 November 2017.
- OEH 2017d Sydney Basin Bioregion Plant Communities <http://www.environment.nsw.gov.au/bioregions/SydneyBasin-Biodiversity.htm>. Accessed 23 November 2017.
- OEH 2016 *The Native Vegetation of the Sydney Metropolitan Area* Office of Environmental and Heritage, Parramatta
- Sutherland Shire Council 2015 *Local Environmental protection plan 2015*

Appendices

Appendix 1 Survey methods

A1.1 Nomenclature

The flora taxonomy (classification) used in this report follows the most recent Flora of NSW (Harden 1992, Harden 1993, Harden 2002). All doubtful species names were verified with the on-line Australian Plant Name Index (Australian National Botanic Gardens 2007). Flora species, including threatened species and introduced flora species, are referred to by both their common and then scientific names when first mentioned. Subsequent references to flora species cite the common names only, unless there is no common name, for which scientific name will be used. Common names, where available, have been included in threatened species tables and the complete flora list in Appendix 2.

Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by the Commonwealth Department of the Environment and Energy (DEE) (Commonwealth of Australia 2009). In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

A1.1 Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by the Office of Environment and Heritage under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 March 2018). Fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2019). The BAM Assessment was carried out by Accredited Assessor Rebecca Dwyer (BAAS17067).

A1.2 Limitations

Field surveys were undertaken in accordance with the BAM. Ecological surveys provide a sampling of flora and fauna at a given time and season. Factors influencing detectability of species during survey include species dormancy, seasonal conditions, ephemeral status of waterbodies, and migration and breeding behaviours of some fauna. In many cases, these factors do not present a significant limitation to assessing the overall biodiversity values of a site.

The field survey was conducted in summer during warm and variable weather, which is a suitable time to determine the presence of most threatened species. However, specific requirements for heavy rain in detecting Green and Golden Bell Frog were not met due to a lack of rain over the months of November to mid-January 2018, through surveys were timed to follow rain events.

Surveys undertaken, combined with habitat assessments and desktop analysis are considered sufficient to reach the conclusions herein in regards to this and all other species' likelihood of occurrence within the study area.

Database searches, and associated conclusions on the likelihood of species to occur within the study area, are reliant upon external data sources and information managed by third parties.

Appendix 2 Native vegetation data (BAM)

A2.1 BAM plot field data

Table A1 Flora species recorded from the study area from BAM plots

Family	Scientific Name	Common Name	BB01				BB02				BB03			
			N, E or HTE	Cover	Abundance	Stratum	N, E or HTE	Cover	Abundance	Stratum	N, E or HTE	Cover	Abundance	Stratum
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod					N	5	50	M/G/C	N	2	50	M/G
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak	N	1	1	C	N	30	20	C	N	50	100	C
Cyperaceae	<i>Baumea juncea</i>						N	2	100	M	N	60	3000	G
Cyperaceae	<i>Ficinia nodosa</i>	Knobby Club-rush					N	0.5	10	M				
Cyperaceae	<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge					N	0.1	1	M	N	5	50	M
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken	N	0.1	2	M/G					N	0.5	5	G
Euphorbiaceae	<i>Homalanthus populifolius</i>	Bleeding Heart, Native Poplar					N	20	50	G	N	5	50	M
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i>						N	1	3	M	N	0.5	2	M
Fabaceae (Mimosoideae)	<i>Acacia sophorae</i>	Coastal Wattle	N	2	5	M								
Lauraceae	<i>Cassytha pubescens</i>	Downy Dodder-laurel					N	0.1	2	G	N	0.5	10	G
Lobeliaceae	<i>Lobelia alata</i>	Angled Lobelia									N	0.1	2	G
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	N	0.1	1	G	N	1	10	M				
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily					N	3	50	G/M	N	0.5	2	M
Menispermaceae	<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine	N	1	20	M	N	1	10	M	N	1	20	G/M
Moraceae	<i>Ficus coronata</i>	Creek Sandpaper Fig									N	0.1	1	M
Moraceae	<i>Maclura cochinchinensis</i>	Cockspur Thorn	N	0.2	1	G	N	2	20	M/G	N	2	30	G/M
Myoporaceae	<i>Myoporum acuminatum</i>	Boobiolla									N	0.1	1	M
Phormiaceae	<i>Dianella caerulea</i>	Blue Flax-lily					N	0.1	1	G	N	1	2	G
Phyllanthaceae	<i>Glochidion ferdinandi</i>	Cheese Tree					N	2	50	M	N	50	100	M
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum					N	2	10	G/M				

Family	Scientific Name	Common Name	BB01				BB02				BB03			
			N, E or HTE	Cover	Abundance	Stratum	N, E or HTE	Cover	Abundance	Stratum	N, E or HTE	Cover	Abundance	Stratum
Poaceae	<i>Agrostis avenacea</i>	Blown Grass									N	0.1	1	G
Poaceae	<i>Cynodon dactylon</i>	Common Couch	E	1	50	G	N	0.1	10	G				
Poaceae	<i>Imperata cylindrica</i>	Blady Grass					N	2	100	G	N	2	1000	G
Poaceae	<i>Oplismenus aemulus</i>						N	0.1	10	M				
Poaceae	<i>Phragmites australis</i>	Common Reed	N	0.1	5	M								
Proteaceae	<i>Banksia integrifolia</i>	Coast Banksia	N	1	2	C	N	10	2	C				
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard					N	1	10	G/M	N	0.5	5	M
Sapindaceae	<i>Cupaniopsis anacardioides</i>	Tuckeroo					N	1	10	M	N	0.1	2	M
Violaceae	<i>Viola hederacea</i>	Ivy-leaved Violet									N	50	4000	G
Vitaceae	<i>Cayratia clematidea</i>	Native Grape	N	1	50	M	N	1	5	M				
Apiaceae	<i>Hydrocotyle bonariensis</i>		E	0.5	3	G	E	1	500	M	E	5	1000	G
Asparagaceae	<i>Asparagus aethiopicus</i>	Asparagus Fern	HTE	1	20	G	HTE	210	1000	G	HTE	5	500	G
Asteraceae	<i>Ageratina adenophora</i>	Crofton Weed					E	0.1	1	G	E	1	20	M
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs					E	0.5	50	G				
Asteraceae	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush	HTE	80	2000	M	HTE	10	50	M	HTE	2	3	M
Asteraceae	<i>Conyza bonariensis</i>	Fleabane									E	0.1	1	G
Asteraceae	<i>Lactuca</i> sp	Willow-leaved Lettuce									N	0.1	1	G
Asteraceae	<i>Sonchus</i> sp	Prickly Sowthistle	E	0.1	1	G								
Fabaceae (Faboideae)	<i>Genista monspessulana</i>	Montpellier Broom	HTE	10	100	M								
Geraniaceae	<i>Pelargonium capitatum</i>						E	2	10	G				
Iridaceae	<i>Watsonia x hybrida</i>						E	2	100	G				
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	E	0.1	1	M								
Oleaceae	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive					HTE	0.1	1	M				

Family	Scientific Name	Common Name	BB01				BB02				BB03			
			N, E or HTE	Cover	Abundance	Stratum	N, E or HTE	Cover	Abundance	Stratum	N, E or HTE	Cover	Abundance	Stratum
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues					E	0.1	1	G				
Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass	E	0.5	100	G	E	2	500	G				
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass					E	0.1	1	G				
Poaceae	<i>Stenotaphrum secundatum</i>	Buffalo Grass	E	2	50	G	E	5	1000	G	E	10	1000	G
Polygalaceae	<i>Polygala virgata</i>		E	0.1	2	M					E	0.1	2	M
Polygonaceae	<i>Acetosa sagittata</i>	Rambling Dock					E	1	50	G/M				
Solanaceae	<i>Physalis peruviana</i>	Cape Gooseberry	E	0.1	1	M								
Verbenaceae	<i>Lantana camara</i>	Lantana	HTE	10	500	M					HTE	2	10	M
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	E	0.1	10	M								

A2.2 BAM plot data sheets

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BAM Site - Field Survey Form Site Sheet no: 1 of

Date		16/11/17	238 CCD	Paul P	PP
Zone	Datum	IBRA region		Zone ID	BB01
Easting	Northing	Dimensions	in	Orientation of midline	05° Magnetic °
Vegetation Class		- High disturbed SOFF / RFEF			Confidence: H (M)
Plant Community Type		Photo: S: 7402, 7403 E, 7404, 7405		EEC: No	Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m ² plot)	Sum values
Trees	2
Shrubs	1
Grasses etc.	2
Forbs	0
Ferns	1
Other	3
Richness of	
Trees	2%
Shrubs	2%
Grasses etc.	0.2%
Forbs	0
Ferns	0.1%
Other	2.2%
Cover of	
Trees	2%
Shrubs	2%
Grasses etc.	0.2%
Forbs	0
Ferns	0.1%
Other	2.2%
High Threat Weed cover	103.6%

BAM Attribute (20 x 50 m plot)		# Tree Stems Count		
dbh	Euc*	Non Euc	Hollows†	
Mark large tree threshold for Euc* & Non Euc	80 + cm	Euc*	Non Euc	Hollows†
50 - 79 cm				
30 - 49 cm			✓	
20 - 29 cm			✓	
10 - 19 cm				
5 - 9 cm			✓	n/a
< 5 cm				n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	100% of space			total 20M

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30, ..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare-ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Subplot score (% in each)																				
Average of the 5 subplots	60	20	10	40	60	0	5	10	5	0	0	0	0	0	0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	Landform Element	Landform Pattern	Microrelief
Lithology	Soil Surface Texture	Soil Colour	Soil Depth
Slope	Aspect	Site Drainage	Distance to nearest water and type

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	0		large piles of woody debris piled in section
Cultivation (inc. pasture)			
Soil erosion			
Firewood collection			
Grazing			
Fire damage			
Storm damage			
Weediness	3		90% covered w/ exotic weed species
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet of

Date	16/11/17	Survey Name	BBO1-23840 BBO1	Recorders	PP
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GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
HTW	1 <i>Chrysanth. mono sub rotund.</i>	HTE	80	2000	M	
	2 <i>Verbena bono</i>	E	0.1	10	M	
G	3 <i>Phragmite australis</i>	N	0.1	5	M	
HTW	4 <i>Lantana camara</i>	HTE	10	500	M	
S	5 <i>Acacia soph.</i>	N	2	5	M	
O	6 <i>Cayratia clematid</i>	N	1	50	M	
O	7 <i>Stephania japon. var discot.</i>	N	1	20	M	
	8 <i>Physalis peruviana</i>	E	0.1	1	M	
HTW	9 <i>Stenotaph. secund.</i>	E	2	50	G	
E	10 <i>Abricid esculent.</i>	N	0.1	2	M/G	
HTW	11 <i>Asparag. aethopic</i>	HTE	1	20	G	
HTW	12 <i>Erharta erect.</i>	E	0.5	100	G	
HTW	13 <i>Genista monspess.</i>	HTE	10	100	M	
	14 <i>Sida rhomb.</i>	E	0.1	1	M	
	15 <i>Hydrocot. bonariensis</i>	E	0.5	3	G	
O	16 <i>Maeclyra cocch.</i>	N	0.2	1	G	
T	17 <i>Bank integ.</i>	N	1	2	C	
T	18 <i>Casi glauca</i>	N	1	1	C	
	19 <i>Sonchus spp.</i>	E	0.1	1	G	
G	20 <i>Lomandra bona</i>	N	0.1	1	G	
HTW	21 <i>Polygona rigata</i>	E	0.1	2	M	
	22 <i>Cynodo dactyl</i>	E	1	50	G	
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF - circle code if 'top 3'

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

BAM Site – Field Survey Form

Site Sheet no: 1 of

Date		16/11/17	Survey Name	238CCD	Plot Identifier	BB02	Recorders	PP	
Zone	Datum		IBRA region				Zone ID		
Easting	Northing		Dimensions		in		Orientation of midline	SE Magnetic °	
Vegetation Class	Photos: S 7406, 7407. E: - 7412, 7413						Confidence:		H M L
Plant Community Type	Swamp oak flood plain - moderate						Confidence:		(H) M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m ² plot)	Sum values
Trees	4
Shrubs	3
Grasses etc.	7
Forbs	1
Ferns	0
Other	7
Richness of	
Trees	43%
Shrubs	23%
Grasses etc.	5.8%
Forbs	0.1%
Ferns	0
Other	13.1%
Cover of	
Trees	43%
Shrubs	23%
Grasses etc.	5.8%
Forbs	0.1%
Ferns	0
Other	13.1%
High Threat Weed cover	68.8%

BAM Attribute (20 x 50 m plot)		# Tree Stems Count		Record number of living eucalypt* (Euc*) and living non-eucalypt (Non Euc) stems separately
dbh	Euc*	Non Euc	Hollows†	
Mark large tree threshold for Euc* & Non Euc	80 + cm	Euc*	Non Euc	
50 – 79 cm		✓		
30 – 49 cm		✓	1	
20 – 29 cm		✓		
10 – 19 cm		✓		
5 – 9 cm		✓	n/a	
< 5 cm		✓	n/a	
Length of logs (m) (≥10 cm diameter, >50 cm in length)	111 111 ally space		total	15M

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare-ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	90	5	80	60	30	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	Landform Element	Landform Pattern	Microrelief
Lithology	Soil Surface Texture	Soil Colour	Soil Depth
Slope	Aspect	Site Drainage	Distance to nearest water and type

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	1	NR	previously cleared track. Areas N. of the transect line disturbed
Cultivation (inc. pasture)			
Soil erosion			
Firewood collection			
Grazing			
Fire damage			
Storm damage			
Weediness	2	R	approx. 60% weed coverage (ground & mid)
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m ² plot: Sheet <u> </u> of <u> </u>	Survey Name	Plot Identifier	Recorders
Date <u>16/11/17</u>	<u>23820 D</u>	<u>B802</u>	<u>PP</u>

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
HTW	1 <i>Chyrtamoides monsub. rotundata</i>	HTE	10	50	M	
HTW	2 <i>Lantana camara</i>	HTE	10	50	M	
-	3 <i>Hydrocot. bonariensis</i>	E	1	500	G	
G	4 <i>Impati. cylind</i>	N	2	100	G	
-	5 <i>Watsonia x hybrida</i>	E	2	100	G	
HTW	6 <i>Echrtata erect</i>	E	2	500	G	
HTW	7 <i>Acetosa sag.</i>	E	1	50	G/M	
T	8 <i>Cari. glauca</i>	N	30	20	C	
O	9 <i>Clematis arist.</i>	N	1	10	G/M	
O	10 <i>Beitonoplosidm cymos.</i>	N	3	50	G/M	
HTW	11 <i>Asparagus setropic</i>	HTE	20	1000	G	
-	12 <i>Physalis periana</i>	E	1	10	G	✓
S	13 <i>Hemidictyonis pop.</i>	N	20	50	G	
	14 <i>Geranium capittata (?) check spelling</i>	E	2	10	G	
HTW	15 <i>Eragrostis curv.</i>	E	0.1	1	G	
HTW	16 <i>Stenotaph succ. - Buffalo - check spelling</i>	E	5	1000	G	
HTW	17 <i>Bindens pill.</i>	E	0.5	50	G	
S	18 <i>Atho undulatum</i>	N	2	10	G/M	
F	19 <i>Dianella caer.</i>	N	0.1	1	G	
O	20 <i>Parsonsia stram</i>	N	5	50	M/G/C	
T	21 <i>Gleichen ferendani (seed/sapling)</i>	N	2	50	M	
G	22 <i>Lomandra long</i>	N	1	10	M	
O	23 <i>Stephania japonica var disc.</i>	N	1	10	M	
G	24 <i>Gahnia seib.</i>	N	0.1	1	M	
S	25 <i>Acacia long</i>	N	1	3	M	
G	26 <i>Baum yulnea</i>	N	2	100	M	
G	27 <i>Funkia nodosa</i>	N	0.5	10	M	
O	28 <i>Maclada coech (seed/ornatue)</i>	N	2	30	G/M	
O	29 <i>Casyntha apube (amer se)</i>	N	0.1	2	G	
T	30 <i>Banksia integ</i>	N	10	2	C	
T	31 <i>Cuparniaspis anarchard (seed/sapling)</i>	N	1	10	M	
O	32 <i>Coyratia clem.</i>	N	1	5	M	
G	33 <i>Opismenus aem - check.</i>	N	0.1	10	M	
G	34 <i>Cyrdor daet</i>	N	0.1	10	G	
HTW	35 <i>Agertua adeno</i>	E	0.1	1	G	
-	36 <i>Plantago lance</i>	E	0.1	1	G	
HTW	37 <i>Olea african sub cupidata</i>	HTE	0.1	1	M	
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF - circle code if 'top 3'.
 Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover) Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

BAM Site – Field Survey Form

Site Sheet no: 1 of

Date		16/11/17	Survey Name	238CCD	Plot Identifier	BB03	Recorders	PP
Zone	Datum	IBRA region			Zone ID			
Easting	Northing	Dimensions		in	Orientation of midline		SE	Magnetic °
Vegetation Class							Confidence:	
Plant Community Type							Confidence:	
photos: S 7408, 7409 E: 7410, 7411							H M L	
Swamp Scheele Forest							H M L	
EEC: 7								

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m ² plot)	Sum values
Trees	3
Shrubs	3
Grasses etc.	4
Forbs	3
Ferns	1
Other	6
Richness of	
Trees	100.5%
Shrubs	5.7%
Grasses etc.	67.1%
Forbs	51.1%
Ferns	0.5%
Other	6.5%
Cover of	
High Threat Weed cover	20.1%

BAM Attribute (20 x 50 m plot)		# Tree Stems Count			Record number of living eucalypt* (Euc*) and living non-eucalypt (Non Euc) stems separately
dbh	Euc*	Non Euc	Hollows†		
Mark large tree threshold for Euc* & Non Euc	80 + cm	Euc*	Non Euc	Hollows†	* includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia † Record total number of stems by size class with hollows (including dead stems/trees)
50 – 79 cm			✓		
30 – 49 cm			✓		
20 – 29 cm			✓		
10 – 19 cm			✓		
5 – 9 cm			✓	n/a	
< 5 cm			✓	n/a	
Length of logs (m) (≥10 cm diameter, >50 cm in length)		Total			total
		5M			5M

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30, ..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare-ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	30	5	80	90	40	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	Landform Element	Landform Pattern	Microrelief
Lithology	Soil Surface Texture	Soil Colour	Soil Depth
Slope	Aspect	Site Drainage	Distance to nearest water and type
			5-10m

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood collection			
Grazing			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet of

Survey Name

Plot Identifier

Recorders

Date	16/11/17	23800D	B803	PP
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GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
G	1 <i>Bambusa nana</i>	N	60	3000	G	
HTW	2 <i>Stenopeltis succulenta</i>	E	10	1000	G	
	3 <i>Hydrocotyle bonariensis</i>	E	5	1000	G	
F	4 <i>Viola hederacea</i>	N	50	1000	G	
F	5 <i>Lobelia alata</i>	N	0.1	2	G	
T	6 <i>Crochidion frandii</i>	N	50	100	M	
T	7 <i>Casuarina glauca</i>	N	50	100	C	
	8 <i>Coryza bonariensis</i>	E	0.1	1	G	
HTW	9 <i>Polydora virgata</i>	E	0.1	2	M	
HTW	10 <i>Agrostis adenophora</i>	E	1	20	M	
O	11 <i>Stephan. japonica var bicolor</i>	N	1	20	G/M	
O	12 <i>Forsonia stram</i>	N	2	50	M/G	
HTW	13 <i>Olspargas octropic.</i>	HTE	5	500	G	
S	14 <i>Fomblactus pop.</i>	N	5	50	M	
O	15 <i>Madure coch. (seed/sap & mature)</i>	N	2	20	M/G	
F	16 <i>Dianella caerulea</i>	N	1	2	G	
O	17 <i>Cassytha puberula</i>	N	0.5	10	G	✓
G	18 <i>Gahnia sibiriana</i>	N	5	50	M	
G	19 <i>Imperata cylindrica</i>	N	2	1000	G	
E	20 <i>Pteridium esculent.</i>	N	0.5	5	G	
HTW	21 <i>Lantana camara</i>	HTE	2	10	M	
O	22 <i>Clematis integr. arist.</i>	N	0.5	5	M	
ATW	23 <i>Chrysanthemoides monosub rotund.</i>	HTE	2	3	M	
S	24 <i>Acacia long</i>	N	0.5	2	M	
T	25 <i>Cupaniopsis anacard</i>	N	0.1	2	M	
O	26 <i>Geitonoplesium lymasum</i>	N	0.5	2	M	
G	27 <i>Agrostis avenacea</i>	N	0.1	1	G	✓
	28 <i>Lactuca sp</i>	N	0.1	1	G	
S	29 <i>Myoporum acuminatum</i>	N	0.1	1	M	
S	30 <i>Ficus coronata</i>	N	0.1	1	M	
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF - circle code if 'top 3'

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover) Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m