Appendix K – Biodiversity Development Assessment Report

Hunter Water Corporation

Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

July 2020

26 June 2020

Hunter Water Corporation

Our ref: 2219573-80961-2216
Your ref:

Dear Approver

HWC - Belmont Temporary Desalination Design and EA
Certification under Section 6.15 of the Biodiversity Conservation Act 2016

I, Arien Quin, (BAAS 17098), certify that this Biodiversity Development Assessment Report and the accompanying finalised credit report dated 25 June 2020 has been prepared in accordance with the requirements of (and information provided under) the Biodiversity Assessment Method.

Sincerely
GHD

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Team Leader - Ecology
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1. Introduction

1.1 Project background

Hunter Water Corporation (Hunter Water) is seeking approval to construct and operate a drought response desalination plant (the 'Project'), adjacent to the Belmont Wastewater Treatment Works (WWTW) in Belmont South, a suburb of Lake Macquarie Local Government Area (LGA) of New South Wales (NSW) (the 'Project area').

Like much of NSW, the Lower Hunter region continues to experience ongoing drought conditions. In response to the drought, Hunter Water is rolling out a program of drought response measures as outlined in the 2014 Lower Hunter Water Plan (LHWP). Measures include the staged introduction of water restrictions, implementation of a broad range of water conservation and water loss initiatives as well as various operational measures. The 2014 LHWP identified the implementation of emergency desalination as a measure of last resort in response to a severe drought, and would only be implemented if water storage levels reached a critical point and all other measures have been implemented.

GHD Pty Ltd (GHD) were engaged by Hunter Water to prepare an Environmental Impact Statement (EIS) (GHD, 2019a) to support a development application for the Project as State Significant Infrastructure (SSI) under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The EIS was prepared in accordance with the provisions of the EP&A Act and the EP&A Regulation and addresses the Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning, Industry and Environment (DPIE) for the Project on 12 December 2017 and revised on 24 January 2018. The EIS was publicly exhibited by DPIE for 28 days from 21 November 2019 to 19 December 2019.

The Project described in the EIS included the construction and operation of a desalination plant, designed to produce up to 15 megalitres per day (ML/day) of potable water, with two sub-surface intake structures.

Since commencing this Project, Hunter Water has begun a major review of the 2014 LHWP, now referred to as the Lower Hunter Water Security Plan (LHWSP). The LHWSP seeks to determine the preferred portfolio of supply and demand side options to ensure a sustainable and resilient supply for the region, over the long term as well as during drought. This work indicates that a drought response portfolio including a desalination plant at Belmont with a nominal production capacity of up to 30 ML/day would provide the best balance of meeting the community's needs should a severe drought occur, while still providing value for money.

In addition to the proposed increase in plant capacity, further design development and assessment following completion of the EIS has identified that a direct ocean intake would perform considerably better than a sub-surface option across key criteria including, reliability, efficiency and scalability.

1.2 Purpose and scope of this report

This Biodiversity Development Assessment Report (BDAR) has been prepared to support the EIS for the proposed Belmont drought response desalination plant. The EIS has been prepared to accompany the application for approval of the Project, and addresses the environmental assessment requirements of the SEARs.

The purpose of this BDAR is to assess the likely impacts of the future construction and operation of the Project on biodiversity values, in particular threatened species and communities listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and *Fisheries Management Act 1994* (FM Act); and relevant Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), namely threatened species and communities, migratory species and important wetlands.

This BDAR has been prepared in accordance with the Biodiversity Assessment Methodology. (BAM). The BAM has been established by the *Biodiversity Assessment Method Order 2017* under the provisions of Part 6, Division 2 of the BC Act. The preparation of a BDAR in accordance with the BAM is required by Section 7.9 of the BC Act, which states that an application for approval of an SSI must be accompanied by a BDAR, unless the Minister for Planning or the Chief Executive of the NSW Office of Environment and Heritage (OEH, now the Biodiversity and Conservation Division (BCD) of Department of Planning, Industry and Environment) determines that there is unlikely to be a significant impact on biodiversity values.

Specifically this BDAR aims to:

- Outline the methods used in the biodiversity assessment.
- Briefly describe the Project and identify the proposed construction and operational footprints.
- Describe the existing environment within the buffered assessment area surrounding the Project area.
- Identify and describe the value and conservation significance of native vegetation and habitats within the Project area and evaluate the potential for threatened biota and MNES to occur within the Project area or be affected by the Project.
- Identify measures to avoid and mitigate impacts associated with the Project.
- Assess the potential impacts of the Project on biodiversity values and describe measures to avoid or mitigate impacts.
- Assess the significance of impacts on threatened biota and MNES.
- Assess any potential serious and irreversible impacts (SAII) on potential SAII entities.
- Present the data used to perform the BAM credit calculations for the Project.
- Calculate the number and type of biodiversity credits that would be required to offset impacts of the Project in accordance with the BAM.
- Address the relevant SEARs for the Project.

The scope of this BDAR is limited to assessment of terrestrial and aquatic/estuarine biodiversity values (onshore project area); the assessment of marine values is covered in a separate marine impact assessment report and includes the offshore area (Appendix E of the EIS main report and Appendix J of Amendment Report). Any reference made to the Project area within this report refers to the onshore Project area only.

This BDAR has been updated from the one included in the Project EIS, to include information regarding additional biodiversity assessments and impacts associated with the amendments to the Project area. This assessment takes into account additional terrestrial impacts for both the water treatment process plant and direct ocean intake as the two project components have overlapping impacts on terrestrial biodiversity that cannot be easily separated. Furthermore the majority of terrestrial impacts associated with the amended Project design for the direct ocean intake area, including the on-shore pump station and intake pipeline have been assessed in the Project EIS.

1.3 Secretary's Environmental Assessment Requirements

Hunter Water submitted a SSI application for the proposal with the Department of Planning and Environment (DPE) (now DPIE) in November 2017 and received SEARs in December 2017.

A revised SEARs was issued following comment and discussed between Hunter Water and DPE on 24 January 2018. The SEARs relevant biodiversity issues are summarised in Table 1-1.

Table 1-1 SEARs (SSI 8896) – Biodiversity

Key issues	Requirements	Where addressed
Biodiversity	An assessment of the biodiversity values and the likely biodiversity impacts of the proposed development, in accordance with the *Biodiversity Conservation Act 2016*	Biodiversity values are described in Section 5 (landscape context), Section 6 (Vegetation and habitat) and Section 7 (Conservation Significance). Biodiversity impacts are identified and assessed in accordance with the BAM and reported in Section 8 (Impact assessment).
	A detailed description of the proposed regime for minimising, management and reporting on the biodiversity impacts of the proposed development over time	Proposed minimisation, management and reporting of measures to reduce biodiversity impacts are included in Section 8.2 (Mitigation of impacts on biodiversity values).
	A strategy to offset any residual impacts of the proposed development in accordance with the *Biodiversity Conservation Act 2016*	Offsetting requirements are presented in Section 9 (Offset and credit summary).
Aquatic ecology	A description of the aquatic and riparian habitats adjacent to the development site	Aquatic values are described in Section 5.1.5 (Wetlands) and Section 6.5 (Aquatic biodiversity).
	An analysis of any interactions of the proposed development with aquatic and riparian environments and predictions of any impacts upon these environments	Potential impacts on aquatic and riparian environments are discussed in Section 8.3 (Residual impacts).
	Details of proposed buffer distances between the development and adjacent aquatic and riparian habitats	There are no buffer distances proposed between the Project area and the adjacent riparian habitats. The riparian habitats form a buffer of approximately 200 m width to the aquatic habitats associated with Belmont Lagoon.
	Details of the mitigation measures for potential impacts to marine vegetation and key fish habitats, including water quality impacts, to be implemented during the construction and operation of the proposed development	Potential impacts to marine biodiversity and fish are covered in the marine assessment report (Appendix E of the EIS main report).

1.4 Assumptions and accredited assessor judgements

This report has been prepared based on the Project description, concept plans and Project area provided in the EIS and subsequent concept plans and Project area for the amendment report (AR). The assessment undertaken in accordance with the BAM (OEH, 2017a) are based on these inputs and confirmed in consultation with the proponent. It is assumed that the description and spatial data accurately represent the extent of direct impacts arising from the Project and so these data have been used to calculate the extent of removal of vegetation and habitat arising from the Project using Geographical Information Systems (GIS).

These calculations have in turn been relied upon in the BAM calculations and the determination of key thresholds such as whether the Project would have a direct impact on a threatened species, whether biodiversity offsets are required for a particular impact, and whether a particular impact is likely to be significant. The assessment conclusions may change as a result of the provision of an updated Project design and/or spatial data.

1.5 Glossary of terms and acronyms

In preparing this BDAR, the following terms are used that defines the scope of the assessment:

- **Project area**: The land in respect of which the development application is made and within which the Project is proposed to be carried out (both construction and operational), as shown in Figure 2-1. The Project area corresponds to the 'subject lands' assessed in Stage 1 of the BAM (OEH, 2017a) and the 'development footprint' as assessed in Stage 2 of the BAM (OEH, 2017a).
- **Study area**: refers to the Project area as surrounding land that was assessed during field investigations (refer to Figure 6-1).
- **Buffered assessment area**: refers to land within a 1,500 m buffered zone around the Project area, which is determined in accordance with Section 4 of the BAM (OEH, 2017a) to assess landscape features.
- **Locality**: refers to the area within a 10 kilometre (km) radius of the Project area.

The following terms are used in relation to the threatened species assessment component of the BAM:

- **Predicted threatened species**: a threatened species that is assessed for ecosystem credits.
- **Candidate threatened species**: a threatened species that is assessed for species credits.

Additional terms and abbreviations are listed in the following table below.

Term	Definition
AOBV	Areas of Outstanding Biodiversity Value
BC Act	*Biodiversity Conservation Act 2016*
BCD	Biodiversity and Conservation Division (previously OEH)
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
Biodiversity Assessment Method (BAM)	The rules for biodiversity assessment established under the BC Act that determine credits created, credits required and the circumstances that improve or maintain biodiversity values.
Biodiversity credit	A unit of biodiversity value to measure specific development impacts or conservation gains in accordance with the BAM. Includes ecosystem credits and species credits.

Term	Definition
Biodiversity credit report	Specifies the number and type of biodiversity credits: required to offset the impacts of a development to obtain a Biodiversity Certification Agreement; or that would be generated through conservation and management of a Stewardship site under a Biodiversity Stewardship site agreement.
Biodiversity offsets	Specific measures that are put in place to compensate for impacts on biodiversity values.
Biodiversity values	The composition, structure and function of ecosystems, including threatened species, populations and ecological communities, and their habitats.
BOS	Biodiversity Offset Scheme
BDRDP	Belmont drought response desalination plant
CEEC	Critically endangered ecological community
CEMP	Construction Environmental Management Plan
DAWE	Department of Agriculture, Water and Environment
DEE	Department of the Environment and Energy (now Department of Agriculture, Water and Environment (DAWE))
DIWA	Directory of Important Wetlands in Australia
DPE	Department of Planning and Environment (now the Department of Planning, Industry and Environment, or DPIE)
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment (previously Department of Planning and Environment, or DPE)
Ecosystem credit	A credit that relates to a vegetation type and the threatened species that are reliably predicted by that vegetation type (as a habitat surrogate)
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FFMP	Flora and Fauna Management Plan
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	Local Environment Plan
LGA	Local Government Area
LMCC	Lake Macquarie City Council
Migratory species	Species listed under listed under international agreements (i.e. Ramsar, JAMBA and CAMBA conventions) to which Australia is a party
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage, now the Biodiversity and Conservation Division (BCD) of the Department of Planning, Industry and Environment
PCT	Plant community type
Project	The development that is the subject of this EIS, being the proposed construction and operation of a drought response desalination plant (see Section 2).
SAII	Serious and irreversible impacts
SAII entity	Species and ecological communities that are likely to be the subject of serious and irreversible impacts (SAIIs)
SEPP	State Environment Planning Policy

Term	Definition
Species credit	A credit that relates to an individual threatened species that cannot be reliably predicted based on habitat surrogates. Threatened species that require species credits are identified in the Threatened Biodiversity Data Collection.
TBDC	Threatened Biodiversity Data Collection, a subset of the BioNet database (a repository for biodiversity data) and managed by the BCD.
TEC	Threatened ecological community
Threatened biota	Threatened species, populations or ecological communities listed under the BC Act and/or the EPBC Act
WWTW	Refers to the Belmont Wastewater Treatment Works

1.6 Disclaimer

This BDAR has been prepared by GHD for Hunter Water Corporation and may only be used and relied on by Hunter Water Corporation for the purpose agreed between GHD and the Hunter Water Corporation as set out in Section 1.2 of this report.

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

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

The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the Report. GHD has no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was prepared. Specifically, this Report does not take into account the effects, implications and consequences of or responses to COVID-19, which is a highly dynamic situation and rapidly changing. These effects, implications, consequences of and responses to COVID-19 may have a material effect on the opinions, conclusions, recommendations, assumptions, qualifications and limitations in this Report, and the entire Report must be re-examined and revisited in light of COVID-19. Where this Report is relied on or used without obtaining this further advice from GHD, to the maximum extent permitted by law, GHD disclaims all liability and responsibility to any person in connection with, arising from or in respect of this Report whether such liability arises in contract, tort (including negligence) or under statute.

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section(s) 1.4 and 4.7 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this BDAR are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the Project area may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. The Project

A brief overview of the proposed desalination plant and associated infrastructure is presented in this Chapter to provide context for the BDAR. A more detailed description of the Project is provided in the EIS and AR (GHD, 2019; 2020).

2.1 Project location

The drought response desalination plant is proposed to be located on the southern portion of the current Belmont wastewater treatment works (WWTW) site, located off Ocean Park Road, to the east of the Pacific Highway. The proposed plant is situated to the east of the Belmont Lagoon and to the west of the coastal dunes along Nine Mile Beach, as shown in Figure 2-1.

2.2 Land use and ownership

2.2.1 Land zoning

The Project would be located on Hunter Water owned land, zoned primarily SP2 – Infrastructure in the *Lake Macquarie Local Environmental Plan 2014* (Lake Macquarie LEP), within the existing Belmont WWTW site (Lot 1 DP433549). Ocean Park Road is zoned E2 – Environmental Conservation and associated with recreational land uses as well as providing access to the Belmont WWTW.

2.2.2 Potable water pipelines

A separate Review of Environmental Factors under Division 5.1 of the EP&A Act has been prepared to assess the impacts of construction and operation of the potable water pipes that will take water from the desalination plant and feed into the existing supply network. The decision to assess the pipes separately was made during design development as it was identified that the potable water pipes would perform as water network augmentation regardless of whether the drought response desalination plant was constructed or not. Having the pipes constructed and performing as part of the existing network would provide a level of readiness in the event the desalination plant is constructed in drought conditions when timeframes would be critical.

2.2.3 Land use

The drought response desalination plant would be located primarily to the south of the existing WWTW in an area that was previously used for evaporation ponds, the embankments of which are still visible despite being decommissioned as part of previous WWTW upgrades (see Photograph 2-1). A small component of the Project area would also be situated in to the west of the WWTW and Ocean Park Rd; this area is currently mapped as Coastal Wetlands associated Belmont Wetlands State Park (see Photograph 2-2).

Photograph 2-1 **Former evaporation pond at drought response desalination plant site**

Photograph 2-2 **Freshwater Wetland vegetation within the Project area located to the west of Ocean Park Road**

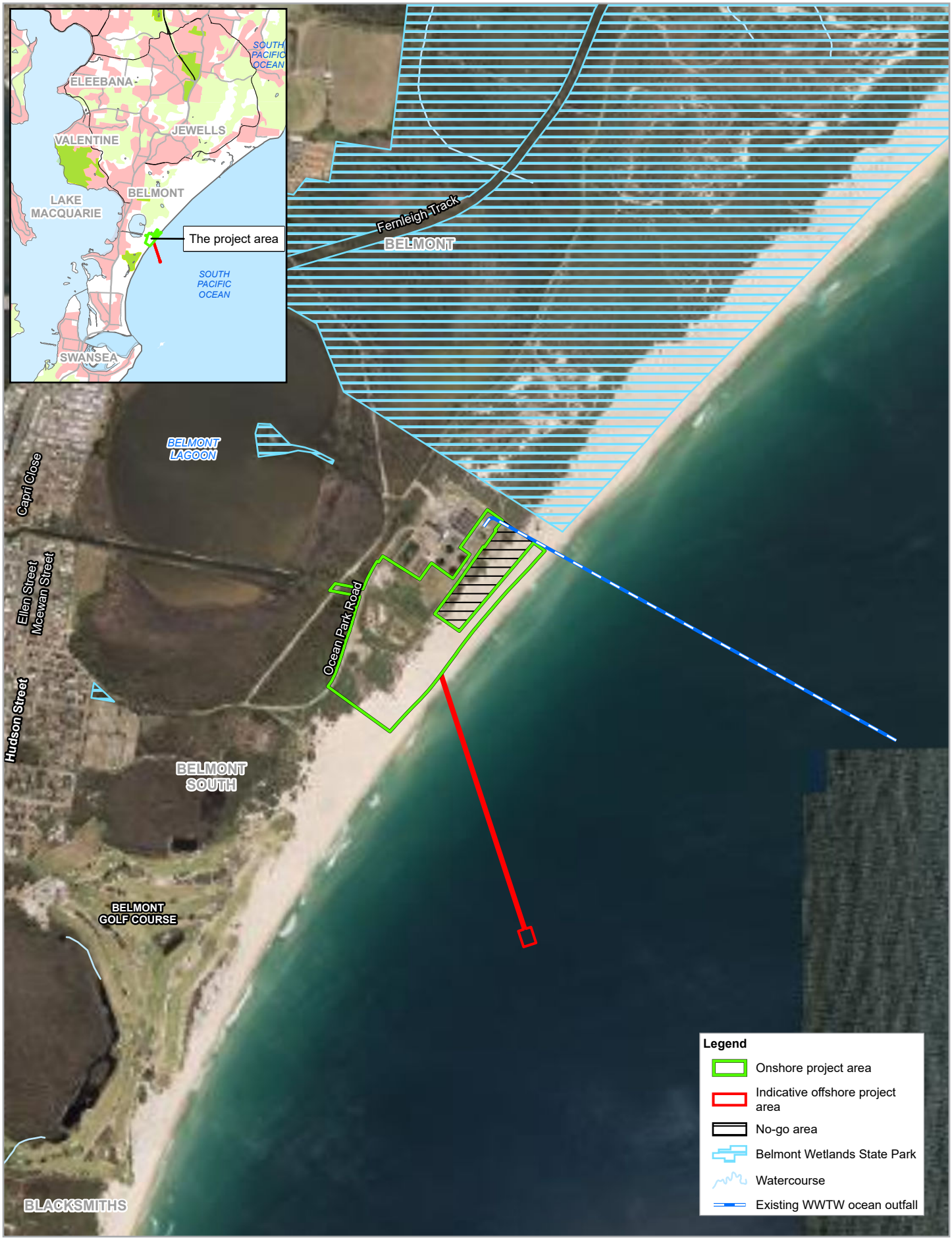
2.3 Surrounding environment

The Project is located within the suburbs of Belmont South, Belmont, Belmont North and Jewells, predominantly situated on low lying terrain between Lake Macquarie and the Pacific Ocean (also referred to in this BDAR as the Belmont peninsula).

The Project occurs alongside land mapped as Coastal Wetlands under the Coastal Management SEPP, which are associated with Belmont Lagoon and Belmont Wetlands State Park (see Figure 2-1). Coastal Wetlands are discussed further in Section 5.1.5. Belmont Wetlands State Park is a large area of natural bushland with approximately 4.5 km of beach frontage and approximately 240 ha of wetlands, located to the north of the Belmont WWTW site (BWSP, 2019). It is popular with walkers, 4WD vehicles and bird watchers. Belmont Lagoon and Belmont Wetlands State Park are known to support a number of threatened species and ecological communities listed under the BC Act and EPBC Act.

Belmont Golf Course and Belmont Cemetery are located to the south of the Project on land zoned RE2 – Private Recreation and RE1 – Public Recreation respectively. Nine Mile beach is located to the east of the Project on land zoned E2 – Environmental Conservation. Nine Mile Beach is commonly used for recreation including 4WD access and camping.

To the east of the WWTW site there is a patch of Coastal Wattle Dune Scrub that forms part of a dune restoration project that is proposed to be undertaken by Hunter Water (refer to Section 2.5.2). This area is shown on Figure 2-1, as a No-Go zone and does not form part of the Project area assessed within this BDAR.



Paper Size ISO A4

0 110 220 330 440

Metres

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

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Hunter Water Corporation
Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Project location

Figure 2-1

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Print date: 29 Jun 2020 - 07:40

Data source: LPI: DTDB / DCDB, 2017; public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

2.4 Project description

2.4.1 Objectives

The key objectives of the Project are to:

- Provide a rainfall independent water source in the event of an extreme drought
- Slow the depletion of existing water storages in the event of an extreme drought

The Project would address these objectives while considering the environmental, social and economic impacts, with the options assessment process considering these factors.

2.4.2 Key features

The Project is for the construction and operation of a drought response desalination plant, designed to produce up to 30 ML/day of potable water, with key components including:

- **Direct ocean intake** – To ensure provision of sufficient quantities of raw feed water for the water treatment process plant, a direct ocean intake is proposed as part of the amended Project, as follows:
  - *Sea Water Pump Station (On-shore), including a central well, screening and pump housing*, proposed to be a concrete structure (referred to as a wet well) of approximately nine to 11 m diameter, installed to a depth up to 20 m below existing surface levels.
  - *Intake pipeline,* the indicative pipeline alignment is approximately 1000 m in length, extending outwards from the central housing to the off-shore intake structure. Construction of the intake pipeline would be determined during detailed design; however, the following construction methodologies/considered and assessed included Construction method 1 (CM1) Horizontal directional drilling (HDD) and (CM2) Pipejacking/micro-tunnelling.
  - *Intake structure (Off-shore)*, the intake structure would be in the form of a horizontal intake with a velocity cap structure and low through-screen velocity to minimise impacts on marine species and habitat. The intake structure would be 5 m in diameter, have a minimum of 5 m clearance from the seabed and a depth of approximately 18 m of water.

  The scope of this BDAR is limited to assessment of terrestrial and aquatic/estuarine biodiversity values; the assessment of the intake pipeline and intake structure on impacts to marine values is covered in a separate marine impact assessment report (Appendix E of the EIS main report and Appendix J of Environmental Amendment Report).
- **Water treatment process plant** – The water treatment process plant would not significantly change from that described in the EIS. The inclusion of buildings to house equipment rather than the installation of containerised equipment is the primary change. The buildings would be placed above ground level and located to allow incremental installation, if required. Services to and from the process equipment (e.g. power, communications, and raw feed water (seawater)) would comprise a mix of buried and overhead methods. The general components of the water treatment process would comprise:
  - *Pre-treatment:* a pre-treatment system is required to remove micro-organisms, sediment, and organic material from the raw feed water.
  - *Desalination:* a reverse osmosis (RO) desalination system made up of pressurising pumps and membranes. These would be comprised of modular components. In addition, a number of tanks and internal pipework would be required.
  - *Post treatment:* desalinated water would be treated to drinking water standards and stored prior to pumping to the potable water supply network.

- **Brine disposal system** – The desalination process would produce up to 56 ML/d of wastewater, comprising predominantly brine, as well as a small amount of pre-treatment and RO membrane cleaning waste. The waste brine from the desalination process would be transferred via a pipeline to a brine pump station at the Belmont WWTW for disposal via the existing ocean outfall pipe.
- **Power supply** – Power requirements of the amended water treatment process plant would require connection to Ausgrid's 33 kV line to the north-west of the water treatment process plant site, with new private power line connecting to a substation within the plant site.
- **Ancillary facilities** – including a tank farm, equipment housing buildings, chemical storage and dosing, hardstand areas, stormwater and cross drainage, access roads, parking areas, and fencing, signage and lighting.

A description of each of the key components of the Project is provided in Section 4 of the EIS and Section 3.1.3 of the AR (GHD, 2019; 2020).

The desalination plant would be connected to Hunter Water's potable water network via a potable water pipeline proposed to be constructed to augment the existing water network. The pipeline does not form part of the Project and would be part of a separate design and approvals process.

2.4.3 Construction methodology

Construction activities associated with the key components of the Project which are relevant to the assessment of biodiversity impacts include:

- **Site establishment** – installation of erosion and sediment controls and vegetation clearing.
- **Seawater intakes** – earthworks and associated temporary stockpile of material and removal of excess material from the Project area.
- **Water treatment process plant** – earthworks and construction of hardstand, stabilisation and revegetation.
- **Power connection –** installation of three new powerpoles on the western side of Ocean Park Road.

Paper Size ISO A4

0 60 120 180 240

Metres

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

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Project area

Project No. **22-19573**
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Date **29/06/2020**

Figure 2-2

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Print date: 29 Jun 2020 - 07:33

Data source: HWC: Aerial Imagery, Existing outfall: 2019; LPI: DTDB / DCDB, 2017; public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

2.5 Relationships to other projects

2.5.1 Potable water pipelines

A separate Review of Environmental Factors under Division 5.1 of the EP&A Act has been prepared to assess the impacts of construction and operation of the potable water pipes that will take water from the desalination plant and feed into the existing supply network. The decision to assess the pipes separately was made during design development as it was identified that the potable water pipes would perform as water network augmentation regardless of whether the drought response desalination plant was constructed or not. Having the pipes constructed and performing as part of the existing network would provide a level of readiness in the event the desalination plant is constructed in drought conditions when timeframes would be critical.

2.5.2 Belmont WWTW dune restoration project

The existing coastal dune system at Belmont WWTW currently acts as a buffer for the WWTW infrastructure from the dynamics of the ocean and beach environment. The dune is presently in poor condition, containing hummocks caused by vehicle tracks. There has been a progressive loss of native vegetation on the dunes and the invasive species Bitou Bush (*Chrysanthemoides monilifera* subsp*. rotundata*) is present. The loss of vegetation and vehicle tracks leaves the dunes vulnerable to destabilisation and erosion. In the longer term if there is ongoing dune erosion and destabilisation this would result in the WWTW being more vulnerable to large and extreme storm events.

Hunter Water is proposing a dune protection and restoration project within the Belmont WWTW site. This is a separate project and scope to the drought response desalination plant development; however areas of the restoration project were assessed as part of the study area. As the restoration project would include the beach frontage of the Project area, it would assist with the future protection of the WWTW and potential drought response desalination plant site as well as providing a valuable coastal ecosystem. The works proposed would involve:

- Possible dune reshaping
- Installation of dune forming fences within the fenced area to provide for sand build up
- Perimeter fencing to restrict access to approximately 12 ha of dune to enable native vegetation regrowth
- Spinifex seeding
- Bitou Bush removal

The area proposed for these restoration works is marked on all Figures as a ‘No-Go area’. This area does not form part of assessed Project area.

Photograph 2-3 Site of proposed dune restoration project (decommissioned evaporation ponds and Belmont WWTW in background)

3. Statutory context

3.1 New South Wales legislation

3.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the primary legislation regulating land-use planning and development assessment in New South Wales (NSW). As described in the EIS, the Project is declared to be State Significant Infrastructure (SSI) in accordance with Section 5.12 of the EP&A Act. Part 5, Division 5.2 provides for the assessment of State significant infrastructure, which must be approved by the Minister for Planning.

In addition, Section 5.7(1) of the EP&A Act states that an EIS must be prepared for an activity likely to significantly affect the environment. A determining authority (such as Hunter Water) shall not carry out an activity or grant an approval in relation to an activity that is likely to significantly affect the environment, prior to the approval of an EIS by the Minister for Planning.

This BDAR comprises the biodiversity assessment that forms part of the Project EIS. SEARs have been issued by the Minister for Planning for the EIS that set out the minimum assessment requirements relating to the assessment of biodiversity (see Section 1.3).

State Environmental Planning Policy (Coastal Management) 2018

The *State Environmental Planning Policy (Coastal Management) 2018* (Coastal SEPP) aims to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objectives of the *Coastal Management Act 2016*.

The Coastal SEPP identifies four coastal management areas that comprise the coastal zone and establishes planning controls to guide development assessment in these areas. One of the coastal management areas identified by the Coastal SEPP is 'Coastal Wetland', which include:

- Mangroves
- Saltmarshes
- *Melaleuca* forests
- *Casuarina* forests
- Sedgelands
- Brackish and freshwater swamps
- Wet meadows

A small section in the west of the Project area is located within land mapped as coastal wetlands (refer to Figure 5-5). Clause 11(1) of the Coastal SEPP states that before granting consent for developments on land mapped as proximity area for coastal wetlands or littoral rainforests, the consent authority must be satisfied that proposed development will not significantly impact on:

> *(a) the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, or*
>
> *(b) the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest.*

Clause 5.22(2) states that "*environmental planning instruments do not apply to or in respect of State significant infrastructure*". Therefore, the Coastal SEPP does not apply to the Project.

Although the Coastal SEPP does not apply to the Project, the identification of Coastal SEPP wetlands is required under Section 4 of the BAM (OEH, 2017a). In addition, the intent of the Coastal SEPP is still addressed in this BDAR through the consideration and assessment of potential impacts on coastal wetland values, including wetland and swamp forest habitats located within and adjacent to the Project area. Assessment of potential impacts on surface and ground water flows are addressed in Section 7.2 of the EIS main report.

State Environmental Planning Policy– Koala Habitat Protection

State Environmental Planning Policy– Koala Habitat Protection aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas (*Phascolarctos cinereus*) to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline by:

> *(a) Requiring the preparation of plans of management before development consent can be granted in relation to areas of core Koala habitat, and*
>
> *(b) Encouraging the identification of areas of core Koala habitat, and*
>
> *(c) Encouraging the inclusion of areas of core Koala habitat in environment protection zones.*

LMCC is listed as a local government area (LGA) under Schedule 1 to which SEPP 44 would ordinarily apply. However, it is acknowledged that in this instance, due to the development being SSI and the function of SEPP 44 relating only to the conservation of Koala habitat, SEPP Koala Habitat Protection does not apply. Nevertheless, the impacts on Koala habitat have been considered for consistency within Section 7 of this report.

3.1.2 Biodiversity Conservation Act 2016

The BC Act provides legal status for biota of conservation significance in NSW. The BC Act aims to, amongst other things, 'maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development'. It provides for the listing of threatened species and communities, establishes a framework to avoid, minimise and offset the impacts of proposed development (the Biodiversity Offset Scheme, or BOS), and establishes a standard method for assessing the likely impacts on biodiversity values and calculating measures to offset those impacts (the BAM).

The aim of the BOS is to provide a consistent approach to biodiversity assessment and offsetting and to ensure that the impacts of development will result in no net loss of biodiversity. The scheme provides the mechanisms to offset impacts of development, clearing or biodiversity certification such that there is no loss of biodiversity values. It allows for the establishment of biodiversity stewardship agreements (BSAs), which are in-perpetuity agreements entered into by landholders to secure offset sites and generate biodiversity credits; these credits can then be used to offset impacts of development.

The BAM was established by the Biodiversity and Conservation Division (BCD) of DPIE (formerly OEH) as a standard method to implement the aims of the BOS and to address the loss of biodiversity and threatened species. The BAM sets out how biodiversity values will be assessed, prescribes requirements to avoid and minimise impacts, establishes rules for calculating the number and class of credits required for unavoidable impacts, and determines the trading rules that will apply. The BAM must be applied by a person accredited under the BC Act and used to prepare a BDAR stating the number and type of credits required to offset the impacts of a development.

The SEARs for the Project require an assessment of the biodiversity values and the likely biodiversity impacts to be prepared in accordance with the BC Act. The preparation of a BDAR in accordance with the BAM is required by Section 7.9 of the BC Act, which states that an application for approval of an SSI must be accompanied by a BDAR, unless the Minister for Planning or the Chief Executive of BCD determine that there is unlikely to be a significant impact on biodiversity values.

3.1.3 Fisheries Management Act 1994

The FM Act aims to conserve, develop and share the fishery resources of the state for the benefit of present and future generations. It provides legal status for aquatic and marine biota of conservation significance in NSW (including fish species and ecological communities), and makes provision for the protection of key fish habitat, marine vegetation, and fish passage by regulating developments and activities through obtaining permits and/or undertaking consultation with the NSW Department of Primary Industry (DPI).

The Project is situated on a sandy peninsula featuring coastal dunes and low-lying coastal wetlands. The Project has the potential to impact on key fish habitat associated with the freshwater and coastal lagoons present in the locality of the Project.

DPI generally enforces a 'no net loss' habitat policy as a permit condition or condition of consent. Achieving no net loss of key fish habitat may involve habitat rehabilitation or provision of habitat compensation on a minimum 2:1 basis.

Under Section 5.23 of the EP&A Act, the following permits are **not** required for a State significant infrastructure:

- **Section 201** – permit to carry out dredging or reclamation works (i.e. any excavation within, or filling or draining of, water land. Any removal of woody debris, snags, rocks or freshwater native aquatic vegetation or the removal of any other material from water land that disturbs, moves or harms these in-stream habitats).
- **Section 205** – permit to harm (cut, remove, damage, destroy, shade etc.) marine vegetation (saltmarshes, mangroves, seagrass and seaweed).
- **Section 219** – permit to obstruct the free passage of fish.

Consultation with the Minister for Primary Industries for dredging or reclamation works is not 'switched off' for State significant infrastructure. Under Section 199 of the FM Act, written notice must be provided to the Minister of the proposed works and any matters raised by the Minister for Primary Industries must be considered, typically within 21 days of having given the notice. Aquatic habitats are described in Section 6.5. Potential impacts to terrestrial and aquatic/estuarine biodiversity values are described in Section 8. The assessment of marine values under the FM Act in relation to the direct ocean intake is covered in a separate marine impact assessment report (Appendix E of the EIS main report and Appendix J of the Amendment Report).

3.1.4 Biosecurity Act 2015

The *Biosecurity Act 2015* provides for risk-based management of biosecurity in NSW. It provides a statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds.

The primary objective of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

A number of priority weed species were recorded within the Project area. Details of these along with the legal requirements to minimise the potential for the introduction and/or spread of weeds as a result of the Project are discussed in Section 6.2.1 of this BDAR.

3.2 Commonwealth legislation

3.2.1 Environment Protection and Biodiversity Conservation Act 1999

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on MNES or the environment of Commonwealth land undergo an assessment and approval process.

Under the EPBC Act, an action includes a Project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' or a significant impact to the environment of Commonwealth land is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Minister for the Environment.

The Department Agriculture, Water and Environment (DAWE) administers an environmental offset policy under the EPBC Act (DSEWPaC, 2012). Environmental offsets are only required for controlled actions where residual impacts are considered to be significant. Offsets are measured and assessed by DAWE using the *Offsets assessment guide*, which is a tool that accompanies the offset policy.

This BDAR assesses the potential impacts of the Project on threatened biota and migratory biota listed under the EPBC Act (see Section 7.3 and Section 8.7). This assessment indicates that there is unlikely to be a significant impact on MNES and therefore a Referral of the Project under the EPBC Act is not required (refer to Section 9).

4. Methodology

This chapter summarises the assessment methods, survey effort and data sources used in the preparation of this BDAR.

4.1 Information sources

The following table summarises the data sources used in the preparation of this BDAR. GHD also undertook a number of surveys in the surrounding area from late 2018 to late 2019 for the associated pipeline project (see Section 2.5.1). The survey results for the pipeline project have been considered in this BDAR as part of the review of existing information.

Table 4-1 Information sources

Data theme	Dataset or database	Application	Source
Aerial imagery	Aerial photograph	Primary basis for all linework and attribution. Used to estimate native vegetation cover within the buffered assessment area and native vegetation extent within the Project area.	Dataset sourced from Land and Property Information (© LPI 2019)
Aerial imagery	Aerial photograph	Secondary informer of linework. Areas obscured in the primary image by shadows or exposures were double-checked in this image.	Aerial images provided by Hunter Water (received by GHD on 16/04/2019 and 4/06/2018)
Bioregion	IBRA region and subregion	Assisted in the identification of region and subregional characteristics, and required for the landscape component of the BAM.	DEE (2017a)
GDE	Atlas of Groundwater Dependent Ecosystems (GDE) web service	A national dataset used to analyse the presence of GDE's within the locality of the study area.	BOM (2018a)
Geology and Soils	Acid Sulfate Soils Risk Data	Assisted in the identification of soil hazards, required for the landscape component of the BAM.	OEH (2019a)
Geology and Soils	NSW (Mitchells) Landscape - version 3.1	Assisted in the identification of soil landscapes, required for the landscape component of the BAM.	DECC (2008c)
Geology and Soils	Soil landscapes of the Gosford- lake Macquarie 1:100,000 sheet	Assisted in the determination of vegetation types and threatened communities.	Murphy (1993)
Threatened species and communities	NSW Bionet Atlas database (licensed)	Search conducted for records of threatened species, populations and threatened ecological communities (TECs) listed under the BC Act that have been recorded within the locality.	OEH (2020a)

Data theme	Dataset or database	Application	Source
Threatened species and communities	The DAWE Protected Matters Search Tool (PMST),	Search conducted for all MNES considered possible within a 10 km radius of the proposal.	DAWE (2020)
Threatened species and communities	Threatened Fish Distribution mapping	Assisted in identifying potential threatened freshwater fish species listed under the FM Act.	DPI (2018)
Threatened species	Birdata	Search conducted for specific species within the locality, focussing particularly on shorebirds and wetland bird species.	BirdLife Australia (2019)
Threatened species habitat	Key Fish Habitat mapping	Assisted in identifying threatened fish habitat protected under the FM Act.	DPI (2007)
Threatened species information	OEH Threatened Biodiversity Profiles	OEH online species profiles for threatened species and communities listed under the BC Act.	OEH (2018b)
Threatened species information	The DEE Species Profile and Threats Database	DEE online species profiles and threats database for species an ecological communities listed under the EPBC Act.	DEE (2018)
Threatened species information	Threatened Biodiversity Data Collection (TBDC) (as licenced user)	Source of ecological data used to undertake the threatened species component of the BAM.	OEH (2018b)
Vegetation	BioNet Vegetation Classification	Assisted in the identification of relevant PCTs.	OEH (2020b)
Vegetation	Lake Macquarie Local Government Area vegetation mapping	Assisted in the identification of relevant PCTs and used as preliminary mapping during ground-truthing surveys.	Bell (2016)
Waterways and wetlands	Coastal Wetland mapping (Coastal Management SEPP)	Assisted in the identification of significant wetlands, required for the landscape component of the BAM.	DPE (2018)
Waterways and wetlands	Directory of Important Wetlands spatial database (downloaded under licence)	Assisted in the identification of significant wetlands, required for the landscape component of the BAM.	DEWHA (2008)
Waterways and wetlands	National dataset of Australia's Ramsar Wetlands (downloaded under licence)	Assisted in the identification of significant wetlands, required for the landscape component of the BAM.	DoE (2015)
Waterways and wetlands	Watercourses	Assisted in the identification of waterways and stream orders, required for the landscape component of the BAM.	Dataset sourced from Land and Property Information (© LPI 2019). Based in data capture program dated 2003.

Data theme	Dataset or database	Application	Source
Waterways and wetlands	Estuaries habitat	Assisted in the identification of estuaries, required for the landscape component of the BAM.	Dataset sourced from Land and Property Information (© LPI 2019).
Weeds	NSW Weedwise	Assisted in identifying relevant priority weeds for the Hunter region.	DPI (2019)
Wildlife corridors	Key Fauna Corridors	Assisted in the identification of wildlife corridors, required for the landscape component of the BAM.	DECCW (2011); Scotts (2003)
Wildlife corridors	Lake Macquarie City Council Native Vegetation & Corridors 2015 (Map 1)	Assisted in the identification of wildlife corridors, required for the landscape component of the BAM.	LMCC (2016)

4.2 Desktop assessment

4.2.1 Literature and database review

A desktop database review was undertaken to identify threatened flora and fauna species, populations and ecological communities (threatened biota) listed under the BC Act, FM Act, and EPBC Act, that could be expected to occur in the locality, based on previous records, known distribution ranges, and habitats present. These were also used to obtain the necessary site data to perform BAM calculations.

Following collation of database records, species predicted to occur by the BAM calculator and threatened species and community profiles, a 'likelihood of occurrence' assessment was completed for threatened biota and migratory species with reference to the broad vegetation types and habitats contained within the Project area. This was further refined following field surveys and verification of vegetation types and identification and assessment of habitat present within the Project area. A likelihood of occurrence ranking was attributed to these biota based on this information.

In order to assess the suitability of the habitat within the Project area for threatened species and ecological communities, the desktop assessment evaluated the following baseline data:

- Landscape-scale features of the study area in accordance with Section 4.2 of the BAM (OEH, 2017a)
- Site context of the study area that includes assessing vegetation cover and patch size as required under Subsections 4.3.2 and 5.3.2 of the BAM (OEH, 2017a)
- The likely distribution of native vegetation and threatened ecological communities (TECs), based on previous mapping and aerial photograph interpretation, for targeted field verification as required under Section 5 of the BAM (OEH, 2017a)
- A list of predicted and candidate threatened species and populations of flora and fauna to assess the habitat suitability and threatened biodiversity data collection as required under Section 6 of the BAM (OEH, 2017a)
- Evaluate baseline information to determine whether additional surveys, mapping and reporting is required to support project approval

Note that pelagic species, marine mammals, shorebirds that nest offshore and other marine species were excluded from further assessment in this report. Marine mammals and wandering seabirds are not assessed under the BAM. These species are addressed in a separate marine impact assessment report (see Appendix E of the Project EIS and Appendix J of the Amendment Report).

The threatened biota and migratory species identified in the desktop assessment and the assessment of the likelihood that they would occur within the Project area are presented in the predicted species, candidate species and MNES tables in Appendix A.

4.2.2 Groundwater dependent ecosystems

The NSW Groundwater Dependent Ecosystem (GDE) Policy defines GDEs as ecosystems, which have their species composition, and their natural ecological processes determined by groundwater (DLWC, 2002). The Policy defines groundwater as the water beneath the earth's surface that has filtered down to the zone where the earth or rocks are fully saturated (DLWC, 2002). Ecosystems vary dramatically in the degree of dependency of groundwater, from having no apparent dependence through to being entirely dependent on it (DLWC, 2002).

Dependence (or interaction) of the vegetation communities within the Project area on groundwater was identified by referring to the Groundwater Dependent Ecosystems Atlas (BOM, 2018a). The Groundwater Dependent Ecosystems Atlas (BOM, 2018a) is a national dataset of Australian groundwater dependent ecosystems sourced from the 2009-12 national assessment (Australian Government, 2012) and updated with recent regional studies. The Atlas contains information and predicted distributions for three types of ecosystems:

- Aquatic - ecosystems that rely on the surface expression of groundwater (e.g. springs, wetlands and rivers)
- Terrestrial - ecosystems that interact with the subsurface presence of groundwater (e.g. vegetation)
- Subterranean ecosystems - caves and aquifer ecosystems

The Australian Government Atlas of Groundwater Dependent Ecosystems (BOM, 2018a) was used to identify any previously mapped GDEs that occur in or near the Project area. The Atlas was also reviewed to ascertain whether any GDEs are likely to occur in the Project area.

4.3 Site survey

4.3.1 Survey effort and timing

Site surveys were conducted by GHD ecologists on 8 and 22 August 2019, 6 September 2019, 15 January 2020 and February 12-14 2020. Site surveys included:

- Initial site stratification and vegetation mapping
- Sampling of ten BAM plots
- Habitat assessment
- Opportunistic fauna and flora observations
- Targeted surveys for threatened flora and fauna with potential to occur in the Project area

4.3.2 Vegetation mapping

Vegetation was assessed with reference to the BAM (OEH, 2017a). The Lake Macquarie Local Government Area vegetation mapping (Bell, 2016) was ground-truthed in the field to verify community type and boundaries, floristic and structural homogeneity within patches and to update mapping as required.

Native vegetation communities in the Project area were assigned to the closest equivalent Plant Community Type (PCT) held in the BioNet Vegetation Classification database (OEH, 2020b). The closest equivalent PCT for each vegetation community was determined through a comparison of the floristic descriptions of PCTs in the database with the plot/transect data collected from the Project area. In addition to floristic and structural similarity, the landscape position, soil type and other diagnostic features of the vegetation communities on the sites were also compared to the descriptions in the database in order to determine the most suitable PCT. TECs as defined in NSW and Commonwealth legislation were also identified.

The native vegetation in the Project area was then stratified into vegetation zones in accordance with Section 5.3.1 of the BAM (OEH, 2017a). A vegetation zone is defined in the BAM as a relatively homogenous area that is of the same vegetation type and broad condition. Vegetation zones identified for the Project area are discussed in Section 6.1.3 of this BDAR.

4.3.3 Vegetation integrity survey plots (assessing site condition)

Following the stratification of the Project area into vegetation zones, plot surveys were conducted in accordance with Section 5.3.3 and Section 5.3.4 the BAM (OEH, 2017a) to obtain vegetation integrity data for the calculation of biodiversity credits.

Plots were located to comply with the minimum number of plots required by Table 4 in the BAM (OEH, 2017a). The location of survey plots is shown on Figure 4-1 and the minimum plot survey requirements are summarised later in this BDAR in Table 6-2.

The site value was determined by assessing ten attributes used to assess function, composition and structure of vegetation. The site value is measured using replicate 400 m^2 plots nested within 1,000 m^2 plots. These attributes were then assessed against benchmark values. Benchmarks are quantitative measures that represent the ‘best-attainable’ condition, which acknowledges that native vegetation within the contemporary landscape has been subject to both natural and human-induced disturbance (OEH, 2017a).

Attributes assessed within each plot are listed in Table 4-2. All flora species were identified according to the nomenclature of the Royal Botanic Gardens and Domain Trust (RBGT, 2018). Each species identified was allocated a growth form group[1] and designated as either native, exotic or high threat exotic in accordance to the lists provided in the BAM calculator.

The overall condition of vegetation was assessed through general observation and comparison against the PCT condition benchmark data as well as using parameters such as species diversity, history of disturbance, weed invasion and canopy health.

[1] TG – tree, SG – shrub, GG – grass/grasslike, FG – forb, EG – fern, OG – other (Table 3 of the BAM, OEH 2017a)

Table 4-2 Site data collected within each plot

Attribute	Area assessed
Native plant species richness	10 x 40 metre plot
Percentage foliage cover for each species	10 x 40 metre plot
Estimated number of individuals for each species	10 x 40 metre plot
Number of large trees	10 x 100 metre plot
Tree regeneration (presence/absence)	10 x 100 metre plot
Tree stem size class	10 x 100 metre plot
Total length of fallen logs	10 x 100 metre plot
Litter cover	5 times 1 x 1 metre plot
High threat exotic vegetation cover	10 x 100 metre plot
Hollow bearing trees	10 x 100 metre plot

4.3.4 Fauna habitat assessment

Fauna habitat assessments were undertaken throughout the Project area, including searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as water bodies, food trees, density of understorey vegetation, composition of ground cover, soil type, presence of hollow-bearing trees, leaf litter and ground debris were noted. Artificial structures, such as culverts, stormwater drains and pipes, were also noted (if present).

Indicative habitat criteria for targeted threatened species (i.e. those determined as having the potential to occur within the Project area following the desktop review) were identified prior to fieldwork. Habitat criteria were based on information provided in BCD and DAWE threatened species profiles, field guides, and the knowledge and experience of GHD field ecologists.

Habitat assessments included recording (if present) resources of potential value to threatened fauna including:

- Trees with bird nests or other potential fauna roosts
- Rock outcrops or overhangs providing potential shelter sites for fauna
- Burrows, dens and warrens
- Distinctive scats or latrine sites, owl white wash and regurgitated pellets under roost sites
- Tracks or animal remains
- Evidence of activity such as feeding scars, scratches and diggings
- Specific food trees and evidence of foraging (e.g. chewed *Allocasuarina* cones)

The locations and quantitative descriptions of significant habitat features were captured with a handheld GPS unit and photographed where appropriate.

4.3.5 Targeted threatened species surveys

Predicted threatened species

Under Section 6.2 of the BAM (OEH, 2017a), targeted surveys are not required for threatened fauna species that can be reliably predicted to occur at the Project area based on habitat surrogates (‘predicted’ threatened species, or ‘ecosystem credit entities’). These species are assumed to be present within certain PCTs, given a certain patch size and condition. Predicted threatened species cannot be assumed to be absent unless it can be demonstrated that described habitat constraints for these species (i.e. essential habitat features or conditions as listed in the TBDC) are not present within the Project area.

Candidate threatened species

Species that cannot be reliably predicted through habitat surrogates are referred to as 'candidate' threatened species (or 'species credit entities'). For these species, a targeted survey or an expert report is required to confirm the presence or absence of the species in the Project area. A targeted survey is not required if one or more of the following can be demonstrated (see Part 3 of OEH, 2018a):

- Described habitat constraints for these species (i.e. essential habitat features or conditions as listed in the TBDC) are not present on the site, or
- Habitat is determined to be significantly degraded, or
- Vegetation is determined to be missing key structural elements

Dual credit species (those that require assessment as both ecosystem and species credits) are species where part of the habitat is assessed as a species credit entity, typically breeding or nesting habitat, and the remainder of the habitat is assessed for as ecosystem credits (such as foraging habitat). Targeted survey is only required for the species credit component.

In accordance with Section 6.4.1.9 to Section 6.4.1.19 of the BAM (OEH, 2017a), after carrying out the field assessment of habitat constraints and microhabitats in the Project area, the habitat within the Project area was deemed to be substantially degraded such that the majority of candidate threatened fauna species predicted to occur by the BAMcalculator were unlikely to utilise the Project area. For this reason most candidate species were discounted. Threatened candidate species identified as having potential to occur within the Project area are listed in Table 7-2. The majority of these that were targeted during site surveys were flora species that have the potential to occur in wetland and swamp habitats present within the Project area, as well as threatened fauna such as amphibians that were identified through the likelihood of occurrence assessment as having potential to occur within the Project area. Methods relevant to targeted threatened species surveys are described below.

4.3.6 Targeted survey for threatened flora

Potential candidate species credit entities for the Project area were identified and assessed in accordance with Section 6.3 and steps 1 to 4 of Section 6.4 of the BAM (OEH, 2017a). All threatened plants are classified under the BAM as species credit entities as their occurrence cannot be reliably predicted based on vegetation type.

The threatened plants with potential to occur in the Project area was identified based on the desktop assessment results and the species credit entities identified by preliminary BAM Credit Calculations (see Appendix F). Habitat for these species was identified and assessed based on OEH threatened species profiles and the experience and judgement of GHD ecologists. East of Ocean Park Road, the majority of the Project area is highly modified and is dominated by exotic species and can be readily discounted as supporting occurrences of threatened plant species.

Within the vegetated dune and wetland areas, threatened species have the potential to occur. A small number of threatened species associated with wetland and habitats and coastal sand dunes were considered to have potential habitat within the Project area. Flora species identified as having potential to occur in the Project area include:

- *Euphorbia psammogeton* (Sand Spurge)
- *Senecio spathulatus* (Coast Groundsel)
- *Melaleuca biconvexa (Biconvex paperbark)*
- *Maundia triglochinoides*
- *Persicaria elatior* (Tall Knotweed)

Noting the largely modified nature of the vegetation within the Project area east of Ocean Park Road, searches were undertaken with due consideration of threatened species survey guidelines (DEC, 2004; OEH, 2016a), by utilising meandering traverses in potential habitat within the Project area.

4.3.7 Targeted surveys for threatened fauna

The Project area contains wetland and swamp vegetation that has potential to provide habitat for threatened frogs including:

- Wallum Froglet (*Crinia tinnula*)
- Green and Golden Bell Frog (*Litoria aurea*)
- Mahoney's Toadlet (*Uperoleia mahonyi*)

Surveys were completed from the 12-14 February 2020. Weather conditions preceding the surveys were favourable for the detection of these species with significant rainfall in the Belmont area, totalling 260 mm in the week preceding the survey.

Surveys were conducted in accordance to the 'Threatened species survey and assessment guidelines: field survey methods for fauna- Amphibians' (DECC, 2009), and included spotlighting and call playback by two GHD ecologists over a two hour period each night over three consecutive nights.

A reference population for Mahony's Toadlet was checked prior to targeted surveys being completed and the species was confirmed to be calling on the 10 and 11 February. Despite this reference population being located approximately 40 km north of the Project area, significant rainfall prior to the targeted surveys provided sufficient suitable conditions for this species to be detected if present within the Project area.

4.3.8 Opportunistic observations

Opportunistic and incidental observations of fauna and flora species were recorded during field surveys. Survey effort focused on areas of suitable habitat; although it is noted that habitat within the majority of the Project area is substantially degraded and lacked significant habitat features such as fallen timber, mature trees and stags. Species lists are provided in Appendix C.

4.3.9 Aquatic habitat survey

Although the Project area is surrounded by wetland and swamp vegetation, no permanent aquatic habitat occurs within the Project area. For this reason, no targeted aquatic survey was undertaken for this BDAR.

4.4 Survey conditions

Bureau of Meteorology (BOM, 2019) records for the relevant survey dates are outlined in Table 4-3. These records were taken at the Lake Macquarie weather station [061412]. In the week preceding targeted surveys for threatened frogs which were undertaken from the 12-14 February 2020, the Project area received a total of 260 mm of rainfall (data taken from the Veolia rain gauge located within the Belmont WWTW site (Veolia, 2020)).

Table 4-3 Daily weather observations during the survey period

Date	Survey Timing	Minimum temp (Deg Celsius)	Max temp (Deg Celsius)	Rainfall (mm)	Max wind gust (km/hr)
8/08/2019	BAM surveys	4.2	23.3	0.4	50
22/08/2019	BAM surveys	12.7	21.7	0	46
6/09/2019	BAM surveys	7.0	32.1	0	76
15/01/2020	BAM surveys	15.4	27.8	0	26
7/02/2020	Preceding frog survey	19	22.3	52.4	39
8/02/2020	Preceding frog survey	19.5	23.7	79.8	46
9/02/2020	Preceding frog survey	19.8	22.4	83.6	56
10/02/2020	Preceding frog survey	20.8	29.4	44.2	20
11/02/2020	Preceding frog survey	19.4	29.5	2.4	30
12/02/2020	Frog survey	21.0	26.9	0	22
13/02/2020	Frog survey	22.1	27.1	2.0	30
14/02/2020	Frog survey	20.4	27.2	1.6	30

4.5 Geographical Information System (GIS) analysis

GIS analysis is an integral part of the BAM. GIS was used to:

- Plot the Project area on a high resolution aerial photo base and to map vegetation zones, survey effort, habitat resources and biodiversity values across the site.
- Calculate the extent of native vegetation to be impacted.
- Confirm the relevant Interim Biogeographic Regionalisation for Australia (IBRA) bioregion, IBRA subregion and Mitchell Landscape for the site.

Additional GIS analysis was used to plot a 1,500 m buffer area surrounding the Project area in which site context components were calculated. Native vegetation cover, extent and connectivity were assessed using aerial photography. Aerial photo interpretation was used to identify and record distinct vegetation patches, determine the broad condition state of vegetation types and the location and extent of vegetated habitat corridors.

The buffer area and GIS area calculations were used to enter information about landscape value and to determine the change in Landscape Value score by assessing the impact of the Project on native vegetation cover and connectivity as well as the patch size.

4.6 BAM calculations and staff qualifications

The Project was assessed according to the methodology presented in the BAM (OEH, 2017a), the BAM operational manual (OEH, 2018a), and the *Biodiversity Assessment Methods Calculator Users Guide* (OEH, 2017b). The credit calculator is a software application that is used to apply the BAM. Data is entered into the credit calculator based on information collected in the desktop assessment, site surveys and from using GIS mapping software.

This BDAR was prepared by Arien Quin (accredited assessor number BAAS17098) in accordance with the BAM, based on field surveys completed by Arien Quin, Cecilia Phu and Bianca Seal. A technical review of the report was undertaken by Cecilia Phu (accredited assessor number BAAS17058).

The BAM credit calculations were performed by Arien Quin using credit calculator version 1.2.4.00 (OEH, 2019b) with BAM data version 22 (updated 26/11/2019). Technical review was undertaken by Cecilia Phu and Kirsten Crosby.

Data entered into the BAM calculator is provided in Appendix D. The biodiversity credit report is included in Appendix E.

Table 4-4 GHD ecology staff and qualifications

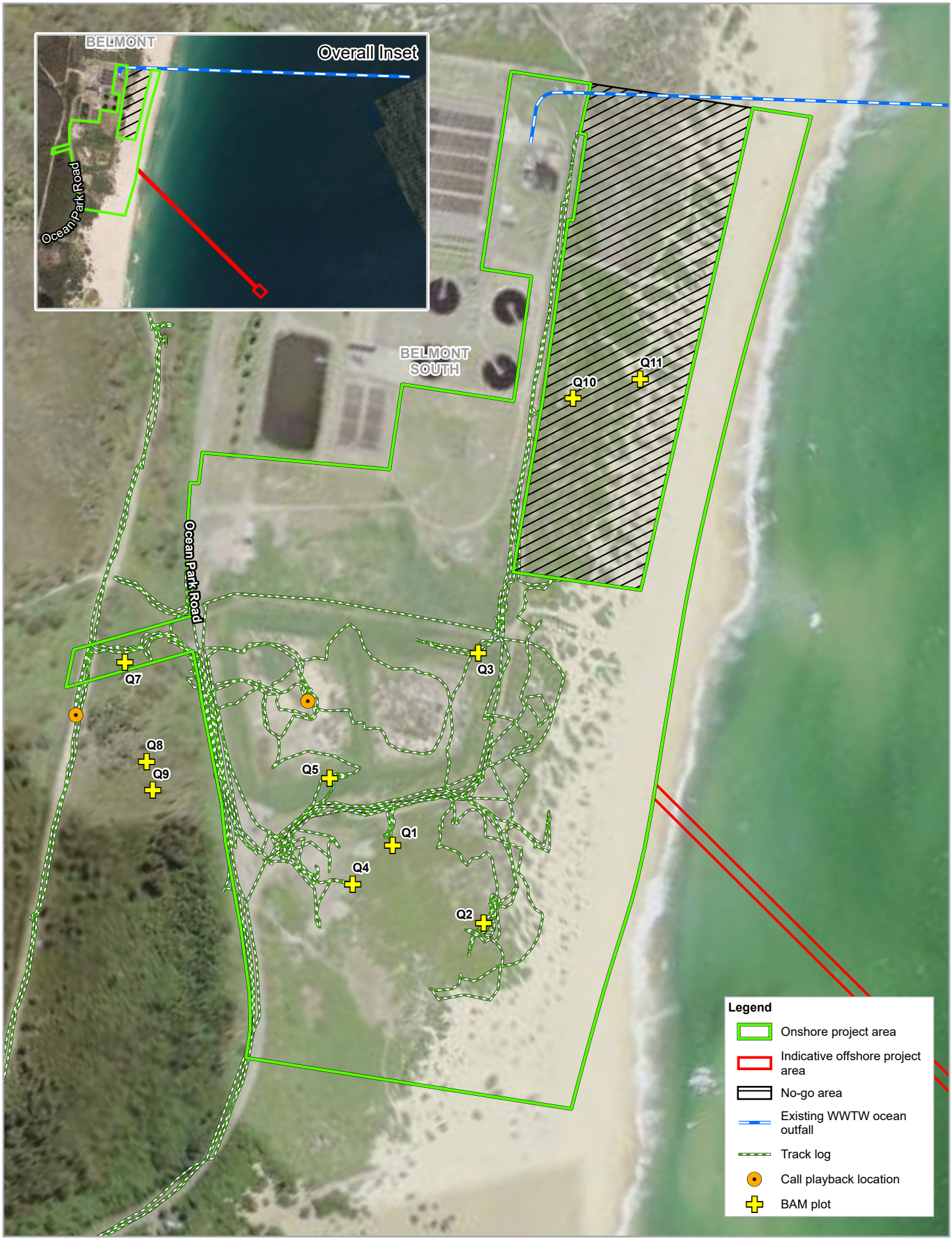
Name	Position	Project Role	Qualifications	Relevant Experience
Arien Quin	Senior Ecologist	Field survey Reporting BAM assessment	BA/BSc BAM accredited	12+ years
Cecilia Phu	Senior Ecologist	Field survey Technical review	BSc (Hons) BAM accredited	12+ years
Bianca Seal	Graduate Ecologist	Field assistant Reporting	BSc	3+ years
Luke O'Brien	Ecologist	Targeted frog surveys	BEnvSc BSc (Hons)	5+ years
Kirsten Crosby	Senior Principal Ecologist	Technical review	BSc (Hons) PhD (Zoology) BAM accredited	13+ years

4.7 Survey limitations

Threatened flora and fauna species can be present in any given area on a permanent, seasonal or transient basis. Floral and faunal assemblages can change in response to variations in season and environmental conditions and not all species will be present in the Project area during surveys. Although survey timing has been designed to fall within recommended survey months outlined in the TBDC for targeted species, this does not guarantee that the species will be detected even if suitable habitat is present.

Notwithstanding the above, as most of the Project area contains degraded habitat the survey approach and effort undertaken for the Project was matched to the quality of habitat present.

The likely occurrence of threatened species have been evaluated with due consideration of a combination of desktop data and field assessment of the environmental conditions of the Project area at the time of preparing this report.



Paper Size ISO A4

0 25 50 75 100

Metres

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

Hunter Water Corporation
Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Survey locations

Figure 4-1

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Print date: 29 Jun 2020 - 07:40

Data source: LPI: DTDB / DCDB, 2017; public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

5. Landscape context

This chapter has been prepared in accordance with Section 4 of the BAM (OEH, 2017a). It identifies a range of landscape features that occur on the Project area or within the buffered assessment area surrounding the Project area. Landscape features are likely to influence the biodiversity values of a site, and are used to inform the habitat suitability of the Project area for threatened species.

This chapter also identifies other site context attributes, including percentage native vegetation cover in the buffered assessment area (Section 4.3 of the BAM, OEH, 2017a), native vegetation cover/extent within the Project area (Section 5.1 of the BAM, OEH, 2017a), patch size areas (Section 5.3 of the BAM, OEH, 2017a) and other biodiversity attributes not assessed under the BC Act and the BAM.

5.1 Landscape features

Table 5-1 below identifies the landscape features relevant to the Project area and expands on each feature where appropriate in the following sub-sections. Figures showing the relevant landscape features are also indicated in Table 5-1.

Table 5-1 Summary of landscape features present within the Project area

Landscape feature	Project area	Figure Reference
Method applied for site context components	Site-based	n/a
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	Sydney Basin	Figure 5-1
IBRA subregion	Wyong	Figure 5-1
Mitchell landscapes	Sydney – Newcastle Barriers and Beaches	Figure 5-1
Rivers, streams and estuaries	The Project area does not contain any rivers, streams or estuaries. Several un-named first order streams are located to the south of the Project area and one un-named fourth order stream is mapped to the north of the Project area. Estuarine habitats are located around the margins of Belmont Lagoon and Lake Macquarie to the west of the Project area.	Figure 5-3

Landscape feature	Project area	Figure Reference
Wetlands	The Project area contains one wetland area. There are no Ramsar wetlands in the buffered assessment area. One wetland listed in the Directory of Important Wetlands in Australia (DIWA) is located directly adjacent to the west of the Project area, however does not occur within the Project area: - Lake Macquarie Coastal Wetlands (NSW189). The Project area is situated to the east of Coastal Wetlands mapped under the Coastal Management SEPP and occurs within the eastern margins of the Belmont Lagoon Coastal Wetland and subsequent proximity area for Coastal Wetlands. The mapped Coastal Wetlands broadly corresponds to the DIWA Lake Macquarie Coastal Wetlands (NSW189).	Figure 5-4 Figure 5-5
Connectivity features	The western extent of the Project area is located just within a key fauna corridor mapped under the Key Habitats and Corridors (KHC) Project (Scotts, 2003; DECCW, 2011). The regional corridor identified by the KHC project is named Nine Mile Beach and captures wetland and swamp forest habitats associated with the DIWA Lake Macquarie Coastal Wetlands (NSW189). The focal species identified for this corridor is the Brush-tailed Phascogale (*Phascogale tapoatafa*). The site of the drought response desalination plant includes vegetation mapped as “corridor of partially cleared remnant native vegetation” identified as a rehabilitation corridor on the *Lake Macquarie City Council Native Vegetation & Corridors 2015 (Map 1).* This corridor corresponds to the patch of Bitou Bush Scrub located in the southern portion of the site and along the eastern boundary of the site.	Figure 5-6
Areas of geological significance or soil hazard features	There are no karst, caves, crevices, cliffs or other areas of geological significance located within the Project area or buffer area surrounding the Project area. Soil landscapes for the Project area are characterised by quaternary coastal sediments on long recurved quartz sand beaches between rocky headlands and back by sand dunes. Acid sulphate soil risk mapping indicates that there is a high to medium probability of occurrence of acid sulphate soils across the south-west portion of the Project area. Where the acid sulphate soil risk is high, associated Aeolian processes on sandplains and swamps occur. Estimated depth to acid sulphate soils include 1-2 metres and 2-4 metres. The remainder of the Project area carries a low probability of occurrence of acid sulphate soils, with a depth to acid sulphate soils estimated at greater than 4 metres.	Figure 5-7
Areas of outstanding biodiversity value	There are no areas of outstanding biodiversity value mapped within the Project area.	n/a
Percentage native vegetation cover	24.34%	Figure 5-8

5.1.1 Bioregion and IBRA subregion

The Project area occurs within the Wyong IBRA subregion of the Sydney Basin IBRA bioregion. The Sydney Basin IBRA bioregion lies on the central east coast of NSW and covers an area of about 3,624,008 ha, which includes about 4.53 per cent of NSW. The region extends north from Batemans Bay to Nelson Bay and west to Mudgee and includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems (OEH, 2016c).

The Wyong subregion exhibits the coastal fall of the Sydney Basin, with characteristic rolling hills and sandstone plateau outliers. Beach, dune and lagoons of coastal barriers interspersed with coastal cliffs and rock platforms are also a common feature (OEH, 2016b).

5.1.2 NSW landscape region (Mitchell Landscapes)

The Project area is mapped within one Mitchell Landscape, the Sydney - Newcastle Barriers and Beaches landscape. A description of this soil landscape is provided in Table 5-2 (2008a).

5.1.3 Climate

The climate of the Belmont area is characterised by a sub-humid climate with warm summers and no dry season. Rainfall can occur throughout the year with heavier falls typically occurring during February with a mean fall of 139.6 millimetres and lighter falls occurring during July with a mean fall of 54.8 millimetres. Maximum temperatures occur during January with the mean temperature being 29.3 degrees Celsius and minimum temperatures occurring during July with mean temperatures being 7.3 degrees Celsius (BOM, 2018b).

5.1.4 Soils and geology

Soil landscapes

The Project area is mapped as occurring across three soil landscapes (Murphy and Tille, 1993). These are summarised in Table 5-3 and shown on Figure 5-2; descriptions are taken from Murphy (1993).

Areas of geological significance

There are no karst, caves, crevices, cliffs or other areas of geological significance located within the Project area or buffer area surrounding the site.

Soil hazards

Soil landscapes for the Project area indicate that all soils have high to very erodibility potential. Minor gully erosion occurs along poorly maintained unsealed tracks or where vegetation has been disturbed within the soil landscapes.

Acid sulphate soil risk mapping (Tulau, 2008) indicates that there is a high probability that acid sulphate soils occur within the Project area (behind sand dunes on lower elevations), associated with aeolian processes on swamps and sandplains; and estuarine processes on bottom sediments. The estimated depth to the acid sulphate soils layer are between 1 to 4 metres across the Project area. The frontal zone of the dunes (i.e. the eastern half of the desalination plant site) is associated with a low probability of acid sulphate soils, with an estimated depth to acid sulphate soil of greater than 4 metres.

The environmental risk associated with disturbance of the acid sulphate soil layer is categorised as high across the majority of the site where the probability of occurrence is high. The ground to the north of the Project area has historically been disturbed for sand mining; these areas correspond to the sand dunes and are generally low risk. The surrounding undisturbed ground encompassing the wetland areas to the west of the Project area is likely to contain acid sulphate soils, which are commonly associated with coastal estuarine landscapes like mangroves, saltmarsh and backswamps (OEH, 2019a).

Table 5-2 NSW landscape region description (DECC, 2008a)

NSW landscape region	Occurrence	Elevation	Vegetation
Sydney - Newcastle Barriers and Beaches	Occurs on Quaternary coastal sediments on long recurved quartz sand beaches between rocky headlands backed by sand dunes and intermittently closed and open lagoons. This includes areas of more extensive high dunes often located on top of headlands	Elevations within the landscape are generally 0 to 30 metres above sea level (ASL), with local relief of 10 metres	The vegetation exhibits distinct zonation from the beach to inland dunes. At the beach, Spinifex (*Spinifex hirsutus*), Spiky Mat-rush (*Lomandra longifolia*), Coastal Wattle (*Acacia longifolia* ssp. *sophorae*) and Coast Teatree (*Leptospermum laevigatum*) colonise the frontal dune in which there is little soil development. 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* spp.) and numerous understorey shrubs on deep sands. Vegetation includes *Banksia aemula* heathland and open scrub of Coast Banksia (*Banksia integrifolia*), Coast Rosemary (*Westringia fruticosa*), Coast Teatree (*Leptospermum laevigatum*) and grass trees (*Xanthorrhoea* spp.), with dwarfed Smooth-barked Apple (*Angophora costata*) and Red Bloodwood (*Corymbia gummifera*). Freshwater sedge swamps also occur in larger areas of sand. In the lagoons salinity varies depending on tidal flushing and they are often surrounded by Broad-leaved Paperbark (*Melaleuca quinquenervia*) and Swamp Oak (*Casuarina glauca*). Water margins are occupied by *Juncus* sp. and Common Reed (*Phragmites australis*) in fresh water areas.

Table 5-3 Soil landscapes within the buffered assessment area

Landscape type	Landscape position	Location	Description	Limitations
Tuggerah landscape	Within Project area	Associated with dunefields along the coast, this landscape is mapped on the eastern half of the desalination plant site towards This soil landscape is also mapped at the power connection site.	Gently undulating to rolling coastal dune fields. Local relief is up to 20 m and slope gradients are in the range of 5% to 45%. Soils include loose sands and are covered with heathland vegetation.	Wind erosion hazard, high permeability soils, localised flooding, high water table, strongly acid soil in places and the landscape coincides with a mine subsidence district.
Woy Woy landscape	Within Project area	Associated with non-tidal sand flats around Swansea and Belmont. Only a small proportion of the Project area is located on this soil landscape (at the Ocean Park Road frontage.	Level to gently undulating sand flats and beach ridges, with local relief of up to 3 m and slopes of up to 5%. Soils comprise loose shelly beach sands.	Periodic waterlogging in depressions, localised areas of high soil erosion hazard, permanently high water tables and mine subsidence districts.
Narrabeen landscape	Within Project area	Beaches and foredunes along the coast on mainland and barrier beaches exposed to ocean swell and salt-laden winds. The frontal dunes are situated on this soil landscape (i.e. the eastern half of the desalination plant site).	Beaches and foredunes usually not exceeding 200 m in width. Foredunes are commonly 1–10 m high and have often been reshaped and stabilised by humans. Berms and cusps are often present near the shoreline. This landscape is morphologically dynamic, continually being modified by wind and waves.	Severe wave erosion hazard, severe wind erosion hazard, extreme foundation hazard, non-cohesive highly permeable strongly alkaline saline soils of very low fertility.
Disturbed Terrain	Within Project area	Located to the north of the Project area and is associated with previous disturbance.	In these areas most of the original soil has either been removed, buried or greatly disturbed. These areas may be artificially topsoiled or covered by concrete and bitumen. Due to disturbance very little natural vegetation remains.	Limitations are highly variable depending on the site but may include mass movement hazard, steep slopes, foundation hazard, unconsolidated low wet bearing strength materials, impermeable soils, poor drainage, erosion hazard, very low fertility and toxic materials.

Landscape type	Landscape position	Location	Description	Limitations
Belmont Swamp landscape	Within 1,500 m buffered assessment area only	Associated with the Belmont Wetland complex directly west of the Project area.	Level to very gently undulating coastal swamps including shallow lakes and very shallow water tables. Dominant soil materials consist of organic topsoils underlain by saturated fine to coarse grained sands.	Flood hazard, permanently high watertables, waterlogging, high foundation hazard, high run-on, mine subsidence district (localised).
Mangrove Creek landscape	Within 1,500 m buffered assessment area only	Associated with the low tidal flats characteristic of waterlogged soils. Located south-west of the Project are adjacent to Lake Macquarie.	Level to very gently undulating tidal flats (mudflats, mangrove and saltmarsh) on Quaternary marine sediments. Dominant soil materials consist of organic topsoils underlain by shelly grey-brown sand and mottled gleyed clays.	Flood hazard, wave erosion hazard, waterlogging, non-cohesive materials (localised), high run-on, acid sulphate potential, high foundation hazard, permanent high water table.
Norah Head landscape	Within 1,500 m buffered assessment area only	Associated with the rolling sandsheet rises to the north-west of the Project area.	Elevated undulating sandsheet plains to rolling dunefields and sandsheets of windblown sands on coastal headlands. Local relief is up to 30 m with slopes of less than 1%.	Wind erosion hazard, seasonal waterlogging (localised), mine subsidence district (localised), non-cohesive soils.
Warners Bay landscape	Within 1,500 m buffered assessment area only	Associated with the undulating to rolling low rises and low hills on fi ne-grained sediments of the Newcastle Coal Measures. Located west of the Project are adjacent to Lake Macquarie	Undulating low hills, with localised steep areas, underlain by fine grained moderately deep soils.	Foundation hazard, potential mass movement hazard (localised on slopes >20%), steep slopes (localised), high erosion hazard, seasonal waterlogging (lower slopes), high run-on (localised), mine subsidence district, strongly acid and low fertility soils.

5.1.5 Wetlands

DIWA wetlands

The Project area is situated immediately adjacent to the Lake Macquarie Coastal Wetlands (NSW189), which comprises a chain of 17 permanent and semi-permanent wetlands located along the Belmont peninsula (DEWHA, 2008). The wetland adjacent to the Project area forms part of the Belmont Lagoons wetland complex with additional wetlands within the general vicinity of the Project area including:

- Belmont Cemetery wetland
- Belmont Golf Course wetland
- Pelican Flat

The eastern foreshore of Belmont Lagoon is located approximately 120 m to the west of the site of the drought response desalination plant, with surrounding coastal swamp vegetation occurring to the western edge of Ocean Park Road.

SEPP wetlands

The western extent of the Project area is located within mapped as a Coastal Wetland under the Coastal Management SEPP, associated with the Belmont Lagoon Coastal Wetland. The mapped Coastal Wetlands broadly corresponds to the DIWA Lake Macquarie Coastal Wetlands (NSW189).

5.1.6 Connectivity features

The vegetation within the east of the Project area is part of a network of coastal dune shrublands that would provide movement corridors up and down the coast for small birds and reptiles that are known to utilise dune vegetation, such as honeyeaters, swallows and ground skinks (i.e. *Lampropholis* spp.). Although the majority of this vegetation is dominated by Bitou Bush, it would continue to act as vegetated corridors for wildlife movement as it connects sections of native dune scrub to the north of the Project area with dune scrub to the south.

The vegetation within the west of the Project area is part of a network of hind dune swamp forests and wetlands that would also provide movement corridors up and down the coast for reptiles, mammals and amphibians known to utilise these habitats. Although this native vegetation has been previously disturbed, it would continue to act as vegetated corridors for wildlife movement as it connects sections of hind dune swamp forests and wetlands to the north and south of the Project area.

The vegetation within the Project area is part of a wider vegetated corridor, with the vegetation to the west of the Project area also providing movement corridors in a north-south direction along the Belmont peninsula for a range of native fauna including possums, gliders, frogs, bats, passerines and honeyeaters.

LMCC Native Vegetation Corridor mapping

The site of the drought response desalination plant includes vegetation mapped as “corridor of partially cleared remnant native vegetation” identified as a rehabilitation corridor on the *Lake Macquarie City Council Native Vegetation & Corridors 2015 (Map 1)* (LMCC, 2016). This corridor corresponds to the patch of Bitou Bush Scrub located in the northern portion of the site and along the eastern boundary of the Project area.

Key Habitats and Corridors Project

The Project area intersects the eastern margin of one key fauna corridor mapped under the Key Habitats and Corridors (KHC) Project (Scotts, 2003; DECCW, 2011). The name of the corridor is Nine Mile Beach. It is identified as a regional corridor with Brush-tailed Phascogale identified as the focal species selected to represent species assemblages. Regional corridors are defined by Scotts (2003) to be wide enough to have sufficient habitat for resident populations of focal species and interior habitat for species detrimentally impacted by edge effects.

Large sections of the corridor is located through developed land and is therefore fragmented, although connectivity is generally maintained by the chain of wetlands and wetland habitats, including Belmont Lagoon. The western extent of the drought response desalination plant site is located within the eastern side of the mapped corridor (refer to Figure 5-6).

5.2 Site context

5.2.1 Percent native vegetation cover

The percent native vegetation cover was calculated for the BAM assessment area in accordance with Section 4.3 of the BAM (OEH, 2017a), using a 1,500-metre buffer for site-based projects.

The vegetation extent of native woody and non-woody vegetation was estimated based on observations from site visits in combination with aerial photo interpretation and (LMCC, 2016) vegetation mapping. Native vegetation extent that was mapped includes remnant woody cover representing:

- Remnant eucalypt forests and woodland
- Remnant shrublands and native scrub communities
- Non-woody vegetation corresponding to native wetland vegetation (including reedlands and saltmarsh)
- Mining rehabilitation dominated by Bitou and pioneering Acacia species but representing rehabilitated native cover
- Mangroves

Areas excluded from the estimated native vegetation extent include:

- Cleared areas
- Bitou Bush scrub
- Water bodies or water channels
- Grasslands representing exotic pasture, lawn or sporting fields
- Street trees, landscaped trees, trees surrounding sports fields and within parklands or urban green spaces

The results of the percent native vegetation cover assessment is summarised in Table 5-4 below:

Table 5-4 Percent native vegetation cover

Attribute	Value
1,500 metre buffered area (ha)	1027.55 ha
Total native vegetation (ha)	250.16 ha
Per cent native vegetation cover	24.34%
Cover class	10-30%

5.3 Patch size and connectivity features

Patch size is defined under the BAM (OEH, 2017a) as an area of intact native vegetation that:

- Occurs on the development site (i.e. Project area)
- Includes native vegetation that has a gap of less than 100 m from the next area of moderate to good native vegetation (or ≤ 30 m for non-woody ecosystems)

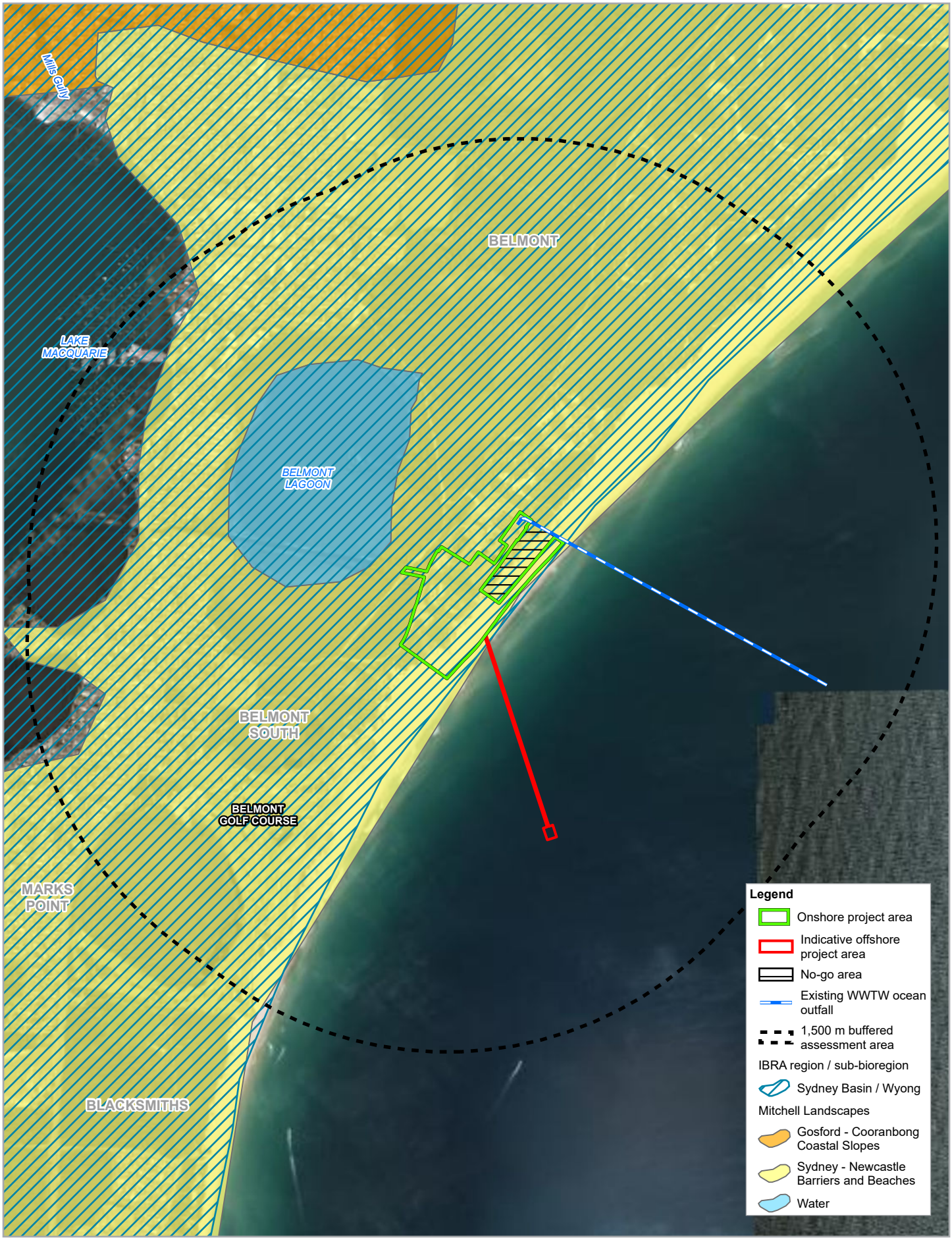
Intact native vegetation must contain all structural layers (strata) characteristic of the PCT.

Patch size may extend onto adjoining land that is not part of a development site or a stewardship site. Patch size area is assigned to each vegetation zone as a class, being < 5 ha, 5-24 ha, 25-100 ha or ≥ 100 ha.

Native vegetation within the Project area w is part of a larger patch that extends to the north and west of the site along the Belmont Peninsular. This vegetated patch extends from Belmont South through to Merewether Heights and includes vegetation within Belmont Wetlands State park, Awabakal Nature Reserve and Glenrock State Conservation Area. The total size of this patch is about 2000 hectares.

Within the 1,500 m buffer area surrounding the Project area there is approximately 250.2 ha of native vegetation. The majority of the vegetation in the buffer area is associated with the Belmont Wetlands (see Figure 5-8). Within the 1,500 m buffer area surrounding the Project area, native vegetation comprises approximately 24.34 percent of the buffer area.

The BAM provides guidance on assessing the patch size for a vegetation zone, and notes that patch size should be assigned to a class. All vegetation zones to the west of Ocean Park Road are connected to an intact native vegetation patch exceeding 100 ha and broadly comprising of non-woody wetland vegetation associated with the Belmont Lagoon Coastal Wetland in addition to woody coastal scrub. Similarly patches of PCT 772 Coast Banksia - Coast Wattle dune scrub in mod-good condition (zone 1) and PCT 1204 Spinifex Beach Strand Grassland (zone 2) are connected to large patches of native vegetation extending to the north and west of the Project area that exceed 100 ha. Therefore for all vegetation zones the maximum patch size of greater than 100 ha was entered into the credit calculator (i.e. 101 ha).



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

N

GHD

Hunter Water Corporation
Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Landscape features BioNet NSW landscapes and IBRA (sub)regions

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-1

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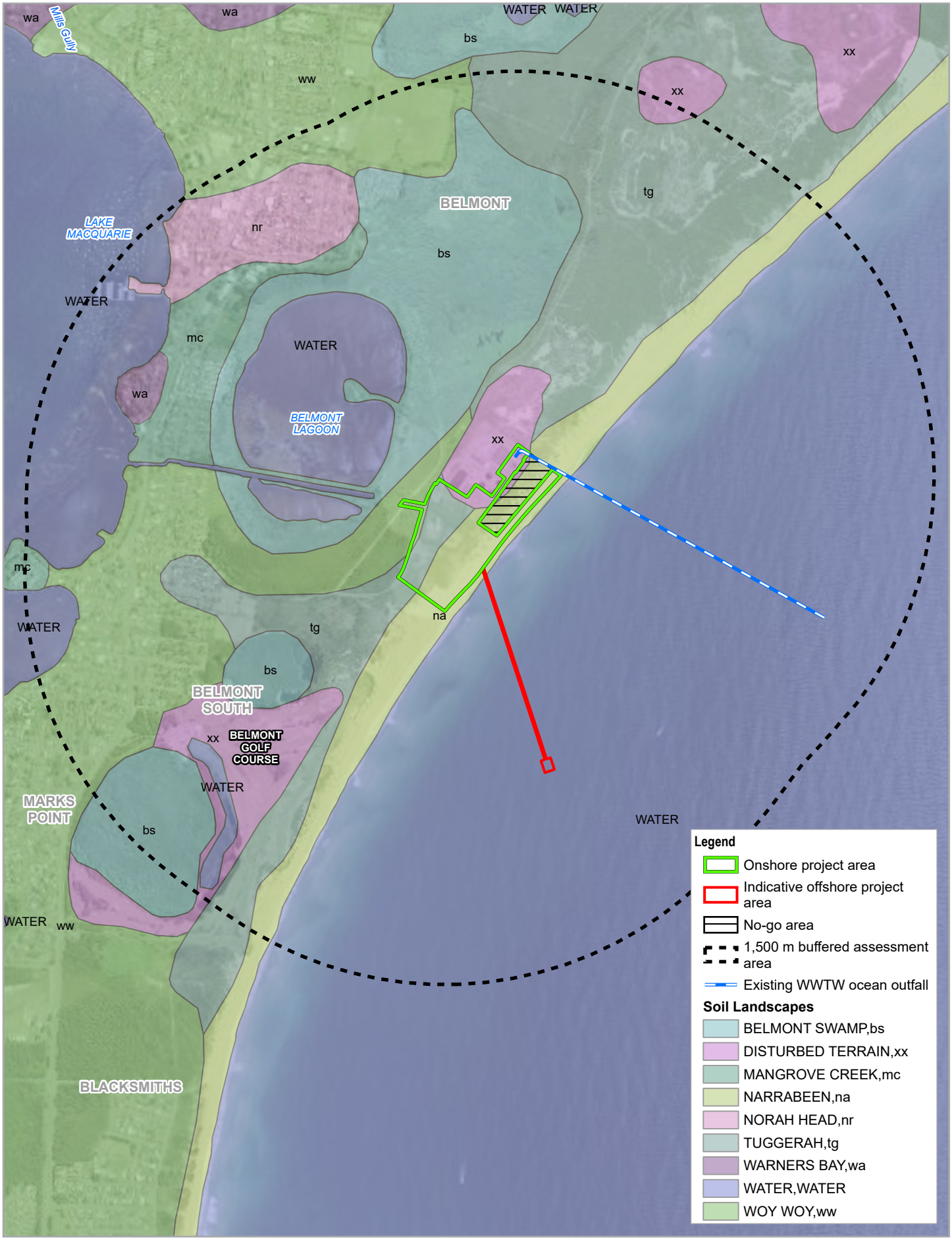

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Hunter Water Corporation
Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Soil landscapes

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-2

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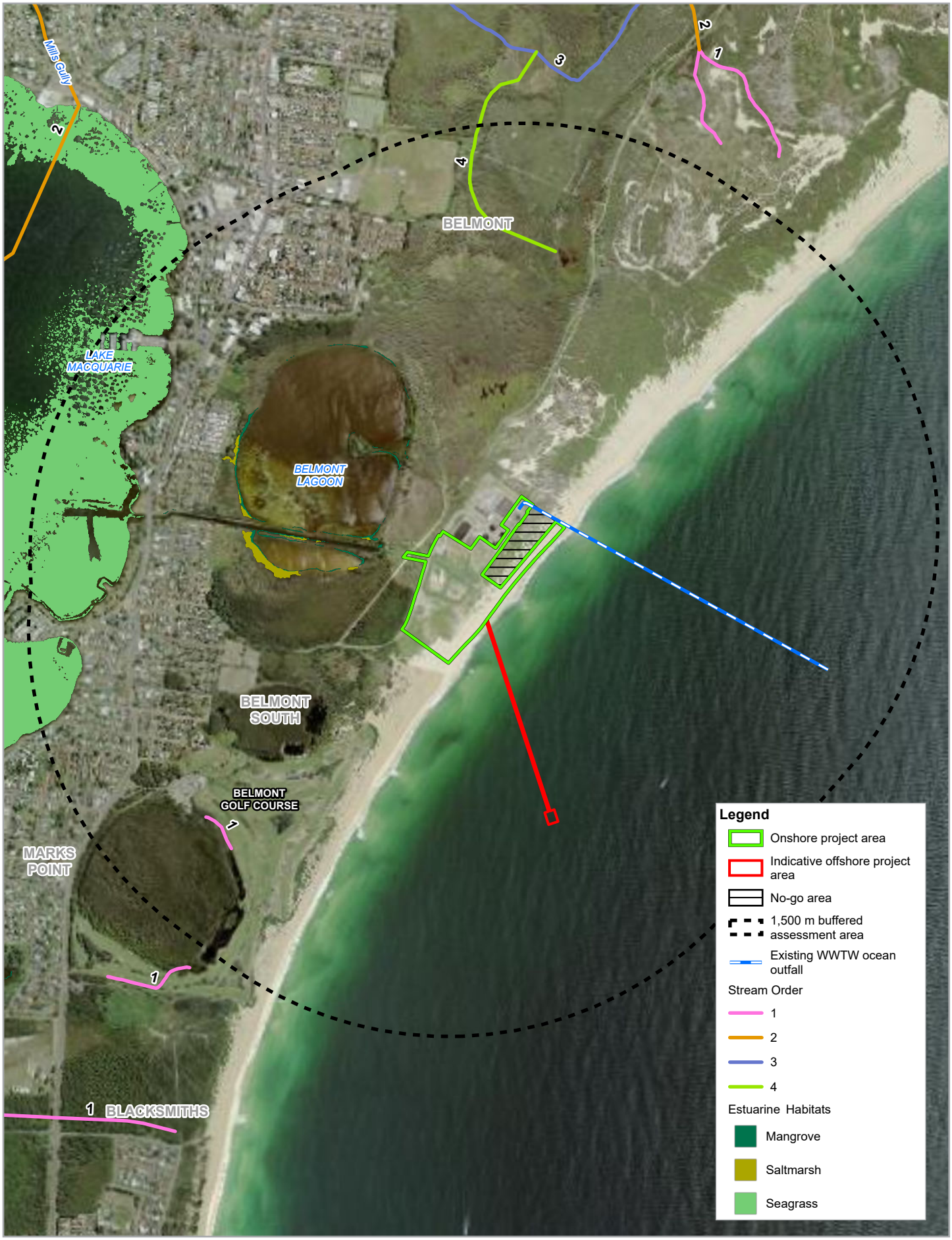

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Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Stream orders and estuarine habitats

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-3

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Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Nationally important wetlands

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-4

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Meters

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

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Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Landscape features: Coastal Management SEPP – Coastal Wetlands and Proximity areas for Coastal Wetlands

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-5

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Metres

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

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Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Key fauna corridors

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-6

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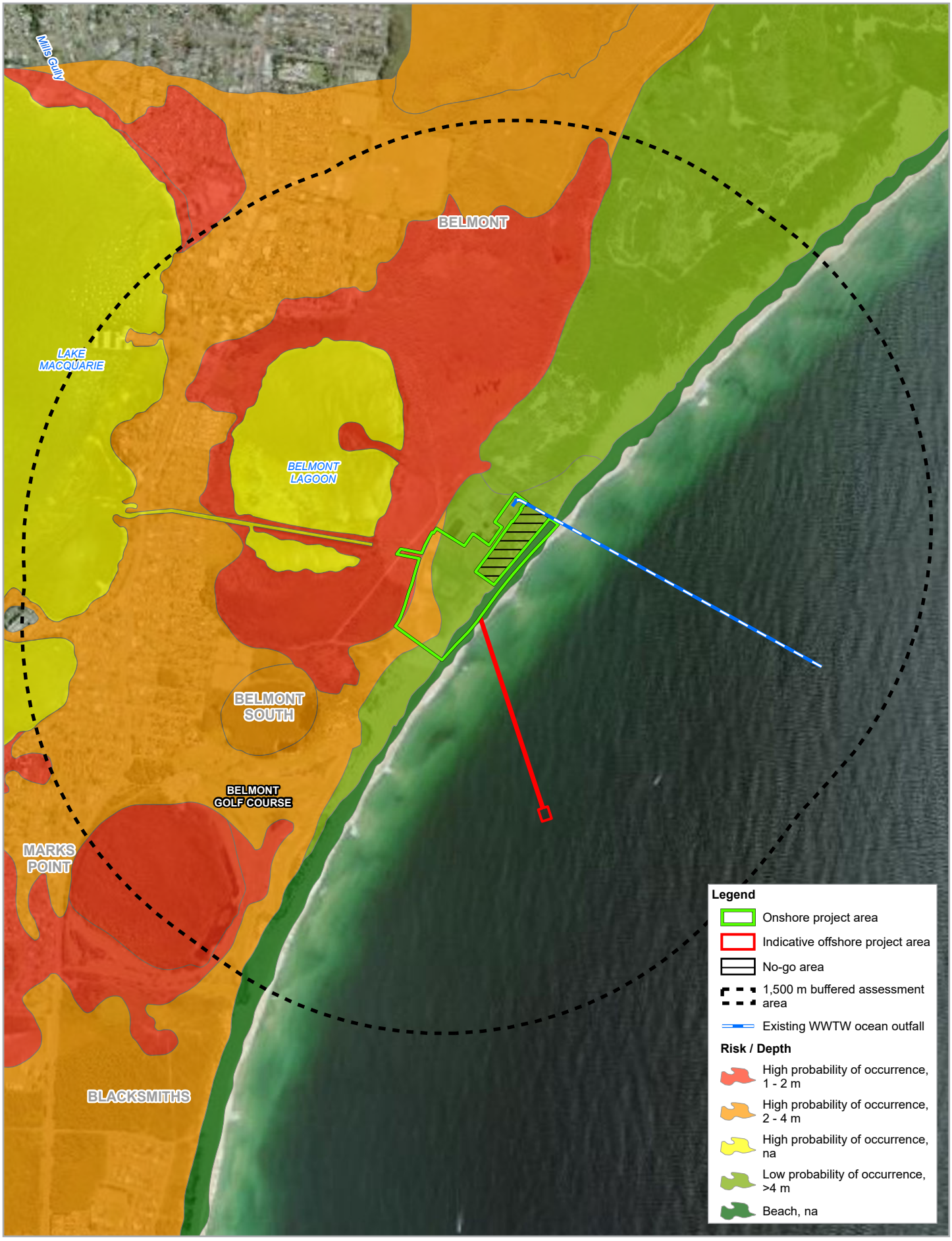

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Acid sulfate soil risk mapping

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-7

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Meters

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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Percent native vegetation cover

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-8

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6. Vegetation and habitat

6.1 Vegetation of the study area

6.1.1 General description

The Project area is located on the foredunes and hindunes of the Belmont peninsula, behind Nine Mile Beach. On the seaward side of the Project area, the foredunes contain areas vegetated by coastal scrub featuring salt pruned shrubs and stunted trees, which are typical of the coastal foredune zone in the Lake Macquarie area. Such shrubs and trees include *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia), *Leptospermum laevigatum* (Coast Teatree) and *Acacia longifolia* subsp. *sophorae* (Coastal Wattle). Vegetation on the seaward side also comprises large patches dominated by dense thickets of Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*) and exotic grassland. On the landward side of the dunes to the west of the Project area, native vegetation is represented by swamp forest, wet heath, rushland and estuarine vegetation associated with Belmont Lagoon and the greater Lake Macquarie Coastal Wetlands (NSW189).

A small area within the Project area that is located to the west of Ocean Park Drive contains small areas of freshwater wetland dominated by dense *Phragmites australis* (Common Rush) as well as coastal freshwater swamps.

The majority of the Project area has previously been used for the WWTW evaporation ponds (now decommissioned but still visible) and continues to be accessed by four-wheel drives and pedestrians, including dog-walkers. The dune is presently in poor condition, containing hummocks caused by vehicle tracks. As mentioned above there has been a progressive loss of native vegetation on the dunes, and the native vegetation along the foredunes is now largely replaced by the exotic species, Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata)* and exotic grassland.

Bitou Bush was first recorded in Newcastle around the beginning of the 20th century and may have been introduced via dumping of ships' ballast (CRC, 2003). It was planted along the coastline from 1946 to 1968 to revegetate areas after sandmining and to mitigate dune erosion (CRC, 2003). Bitou Bush is the dominant vegetation type across large sections of the foredunes in the locality, and is a prominent vegetation feature of the Project area.

6.1.2 Native vegetation extent

The native vegetation extent within the Project area was assessed and mapped in accordance with Section 5.1 of the BAM (OEH, 2017a). The Project area was mapped using site data in combination with aerial photo interpretation at an average scale of 1:1000 and no greater than 1:2000.

In accordance with the Stage 1 BAM Operational Manual (OEH, 2017a), native vegetation cover includes:

- All areas of native vegetation, including areas where woody cover may have been removed and only native groundcover remains
- All areas of exotic vegetation, or other site features that are assessed for habitat suitability in accordance with Section 6 of the BAM (OEH, 2017a)

The Project area contains 0.5 ha of native vegetation.

6.1.3 Plant community types and vegetation zones

Overview

To determine the appropriate Plant Community Types for the site the following data was collected in the field and then compared against PCTs outlined in the BioNet Vegetation Classification Database (OEH 2020c):

- Soil type
- Landscape position
- Floristics data and structural composition

Other things considered when determining the PCT types include:

- Regional Vegetation Mapping (LMCC, 2016)
- Site disturbance history (i.e. fire history)

Field surveys confirmed the presence of four PCTs within the Project represented by four vegetation zones. In addition there are two communities dominated by exotic vegetation. The remainder of the Project area is comprised of vehicle tracks, cleared areas with exposed soil and bare sand dunes. These areas are shown represented collectively as 'cleared'.

PCTs and vegetation zones within the Project area are shown on Figure 6-1, are summarised in Table 6-1 and described below.

Plant species lists and plot data are provided in Appendix C along with benchmark values for each PCT.

Bitou Bush Scrub (sensu. Unit 50c, Bell, 2016) and exotic grassland were the dominant vegetation types recorded within the Project area (see Figure 6-1) and represent non-native vegetation. Only a low number of native species are present in low abundances, and represent scattered occurrences of species like *Leptospermum laevigatum* (Coast Teatree), *Acacia longifolia* subsp. *sophorae* (Coastal Wattle) and *Carpobrotus glaucescens* (Pigface).

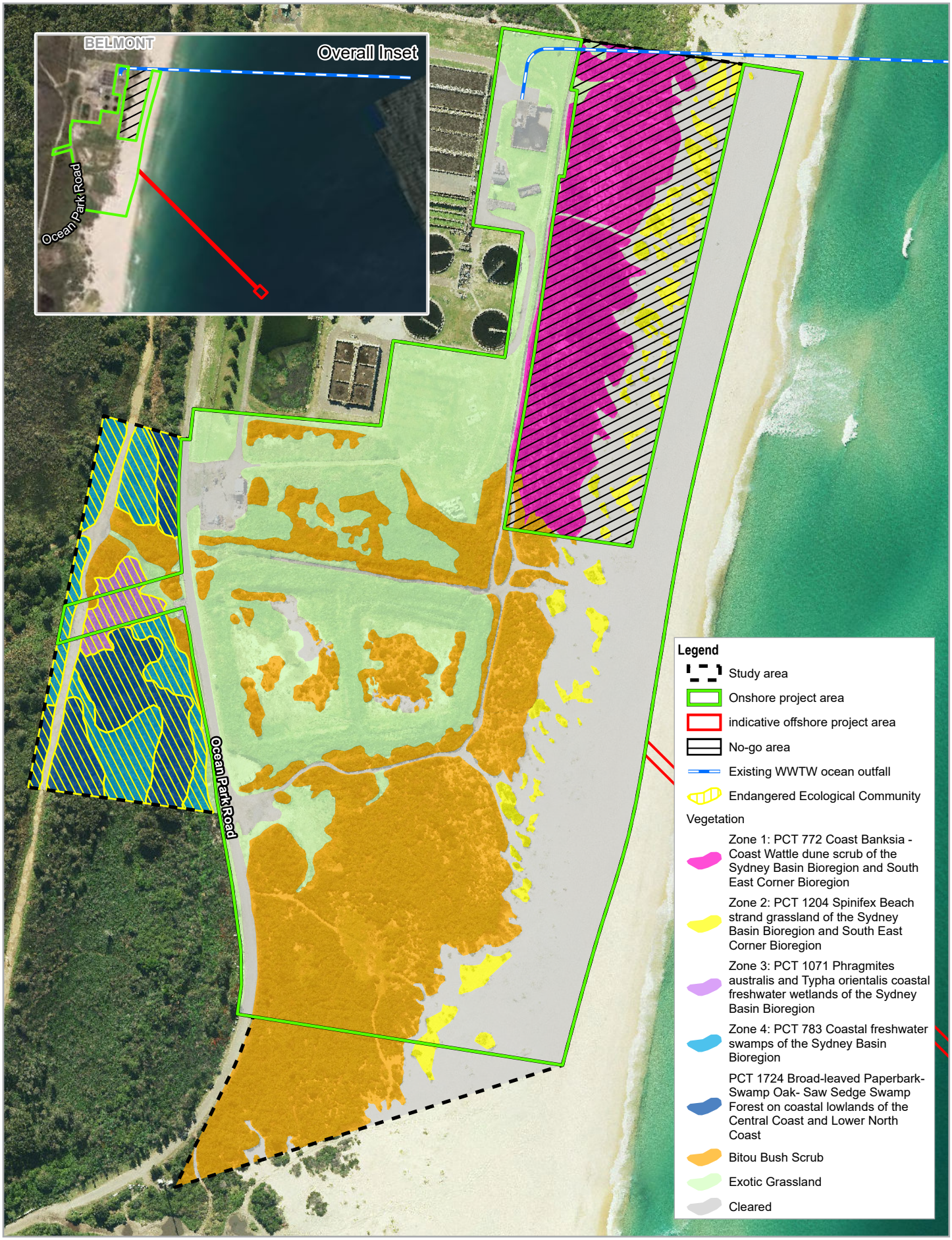
Within the areas of native vegetation that occur to the west of Ocean Park Road there are a high number of High Threat Weeds (HTW), these include *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush), *Lantana camara* (Lantana), *Hyparrhenia hirta* (Coolatai Grass), *Senecio madagascariensis* (Fireweed), *Ehrharta erecta* (Panic Veldtgrass) and *Ipomoea cairica* (Coastal Morning Glory).

Table 6-1 Vegetation within the Project area

Vegetation type	Extent within Project area (ha)
PCT 772 Coast Banksia- Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	0.08
PCT 1204 Spinifex Beach strand grassland of the Sydney Basin Bioregion and South East Corner Bioregion	0.29
PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	0.12
PCT 783 Coastal Freshwater Swamps of the Sydney Basin Bioregion	0.02
Bitou Bush Scrub	4.66
Exotic grassland	4.73
Cleared	5.28
Total (ha)	**15.2**

Table 6-2 Plant Community Types within the Project area

Vegetation Zone	PCT ID	Plant Community Type (OEH, 2020b)	Condition/ ancillary code	Patch size (ha)	EPBC Act status	BC Act status	Extent within Project area (ha)	No. plots required	No. plots sampled	VI score
1	772	Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate-good	101	Not listed	Not listed	0.08	1	1 (Q10)	19.1
2	1204	Spinifex Beach strand grassland of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate-good	101	Not listed	Not listed	0.29	1	1 (Q11)	2.4
3	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	101	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	0.12	1	1 (Q7)	65.3
4	783	Coastal Freshwater Swamps of the Sydney Basin Bioregion	Moderate-good	101	Not listed	Not listed	0.02	1	1(Q8)	47.4
N/A	N/A	Bitou Bush Scrub	Low- Bitou		Not listed	Not listed	4.66	2	3 (Q1, Q2, Q4)	2.8
N/A	N/A	Exotic grassland	Low- grass		Not listed	Not listed	4.73	2	2 (Q3, Q5)	2.5



Paper Size ISO A4

0 25 50 75 100

Meters

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

N

GHD

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Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Project No. **22-19573**
Revision No. **0**
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Vegetation zones in the Project area

Figure 6-1

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Print date: 29 Jun 2020 - 07:39

Data source: HWC: Aerial Imagery, 2018 public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

Table 6-3 Zone 1 - Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion

Attribute	Description
PCT name	Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion
PCT ID	772
Vegetation formation	Heathlands
Vegetation class	Sydney Coastal Heaths
PCT % cleared	65.00
Plots sampled	Q1, Q2, Q4, Q10
Occurrence within Project area	A very small area (0.08 ha) of this PCT is present within the project area, to the east of the Brine Pump station. There is also a much larger patch of this PCT located adjacent to the project area within the designated No-Go area (2.08 ha).
Floristic description	Foredune scrub vegetation forming a shrubland of *Acacia longifolia subsp. sophorae* (Coastal Wattle) with occurrences of the exotic *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush). Other species present include scattered occurrences of *Leptospermum laevigatum* (Coast Teatree), *Rhagodia candolleana subsp. candolleana* (Coastal Saltbush), *Galenia pubescens* (Galenia), *Carpobrotus glaucescens* (Pigface) and *Einadia hastata* (Berry Saltbush).
Justification for PCT selection	PCT 772 was assigned to this vegetation community due to the presence of *Acacia longifolia subsp. sophorae* (Coastal Wattle), *Leptospermum laevigatum* (Coast Teatree), *Spinifex sericeus* (Hairy Spinifex), *Rhagodia candolleana* subsp. *candolleana* (Coastal Saltbush) and *Carpobrotus glaucescens* (Pigface). These species are characteristic species for PCT 772. This landscape position of the community within the Project area aligns with this community, being found on coastal sand mass frontal dunes and beach ridges.
Condition	Within the Project area this community is in moderate condition with scattered occurrence of the HTW *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush), as well as other exotic species such as, *Hyparrhenia hirta* (Coolatai Grass), *Senecio madagascariensis* (Fireweed) and *Ehrharta erecta* (Panic Veldtgrass).
Conservation significance	Not listed as a threatened ecological community under the EPBC Act or BC Act
Photo	See Photograph 6-1

Photograph 6-1 Zone 1 PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion (Mod-Good Condition)

Table 6-4 Zone 2- Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion

Attribute	Description
PCT name	Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion
PCT ID	1204
Vegetation formation	Grasslands
Vegetation class	Maritime Grasslands
PCT % cleared	38
Plots sampled	Q11
Occurrence within Project area	This vegetation community occurs on the foredunes of the eastern extent of the Project area. This community occurs in a north-east direction due to the orientation of the foredune habitat.
Floristic description	This vegetation community is a grassland situated on the foredune rises in coastal beach habitat. The groundcover is sparse and dominated by salt-tolerant species such as *Spinifex sericeus* (Beach Spinifex), *Carpobrotus glaucescens* (Pigface) and *Scaevola calendulacea* (Dune Fan Flower). Two exotic species were recorded within the community *Cakile edentula* (American Sea Rocket) and *Chrysanthemoides monilifera subsp. rotundata* (Bitou Bush).
Justification for PCT selection	The vegetation community within the Project area is floristically similar to the described species for PCT 1204. Further due to its location on mobile, calcareous sands within the IBRA subregion, the vegetation on site conforms with PCT 1204.

Attribute	Description
Condition	The community is in moderate condition with a relatively high cover of the exotic species *Cakile edentula* (American Sea Rocket) and *Chrysanthemoides monilifera subsp. rotundata* (Bitou Bush).
Conservation significance	This vegetation community is not listed under the BC Act or EPBC Act.
Photo	See Photograph 6-2

Photograph 6-2 PCT 1204 Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion

Table 6-5 Zone 3 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

Attribute	Description
PCT name	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
PCT ID	1071
Vegetation formation	Freshwater Wetlands
Vegetation class	Coastal Freshwater Lagoons
PCT % cleared	75
Plots sampled	Q7
Occurrence within Project area	This vegetation community occurs as a small patch (0.12 ha) on the western side of Ocean Park Rd.
Floristic description	This vegetation community is a small ephemeral wetland which is dominated by *Phragmites australis* (Common Reed). Additional native ground cover species include *Baumea articulata*, *Ficinia nodosa* (Knobby Club-rush), *Commelina cyanea* (Native Wandering Jew), and *Stephania japonica* (Snake vine). The wetland patch has a dense groundcover dominated by the exotic species *Hydrocotyle bonariensis* (Largeleaf Pennywort). Dense patches of *Solanum nigrum* (Black-berry Nightshade) are also present. Condition of this vegetation community and exotic species diversity is discussed below.

Attribute	Description
Justification for PCT selection	The flora assemblage recorded within this wetland is closely aligned to the described floristic assemblage for PCT 1071. The vegetation within the Project site occurs in a previously disturbed area between two access tracks and its occurrence is likely due to altered surface hydrology in the area, potentially attributed to previous disturbance. The wetland is ephemeral (being dry at the time of the assessment). Due to the presence of Ocean Park road the wetland is unlikely to be inundated with saline or brackish water or influences by hydrology associated with Belmont Lagoon nor is it open to tidal influence, which is the characteristic difference that separates PCT 1071 from the similar PCT 1808. Whilst having similar floristic characteristics to PCT1808, PCT 1071 is characterised by a more freshwater influence; the reason for selecting PCT 1071 rather than 1808.
Condition	There was high number of exotic species recorded within the plot. Of the 11 exotic species recorded within this PCT, six are described as HTW. Exotic species recorded within the PCT include ground cover species such as *Hydrocotyle bonariensis* (Largeleaf Pennywort) *Cenchrus clandestinus* (Kikuyu Grass), *Paspalum urvillei* (Vasey Grass) and *Senecio madagascariensis* (Fireweed) in addition to shrub and vine species *Chrysanthemoides monilifera subsp. rotundata* (Bitou Bush), *Lantana camara* (Lantana) and *Ipomoea cairica* (Coastal Morning Glory).
Conservation significance	This PCT is commensurate with the PCT listed under the BC Act as Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC under the BC Act.
Photo	See Photograph 6-3

Photograph 6-3 PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetland of the Sydney Basin Bioregion

Table 6-6 Zone 4 Coastal Freshwater Swamps of the Sydney Basin Bioregion

Attribute	Description
PCT name	Coastal Freshwater Swamps of the Sydney Basin Bioregion
PCT ID	783
Vegetation formation	Freshwater Wetlands
Vegetation class	Coastal Freshwater Lagoons
PCT % cleared	80%
Plots sampled	Q9
Occurrence within Project area	This vegetation community occurs west of the existing WWTW, on the western side of Ocean Park Drive. There is 0.02 ha of this PCT within the Project area.
Floristic description	This vegetation community is an open swamp forest with a diverse shrub layer dominated by *Callistemon citrinus* (Crimson Bottlebrush), *Leptospermum juniperinum* (Prickly Tea-tree), *Viminaria juncea* (Native Broom), *Goodenia ovata* (Hop Goodenia) and *Exocarpos cupressiformis* (Cherry Ballart). The overstorey is sparse with occasional *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Casuarina glauca* (Swamp Oak), although no trees occur within the Project area. The groundcover layer is dominated by aquatic herbs, tussocks and rushes including *Liparophyllum exaltatum, Gahnia clarkei* (Tall Saw-sedge), *Bolboschoenus caldwellii* and *Empodisma minus* (Spreading rope-rush). Smaller occurrences of grasses and ferns are also present and include *Phragmites australis* (Common Reed), *Pteridium esculentum* (Bracken) and *Blechnum indicum* (Swamp Water Fern). Small occurrences of exotic weeds were recorded in this vegetation community. The high threat weed included *Chrysanthemoides monilifera subsp. rotundata* (Bitou Bush), however other exotic species included *Solanum nigrum* (Black-berry Nightshade), *Verbena bonariensis* (Purpletop), *Acacia saligna* (Golden Wreath Wattle) and *Hydrocotyle bonariensis* (Largeleaf Pennywort).
Justification for PCT selection	PCT 783 was chosen as the best fit PCT for this vegetation community as it occurs on the low nutrient sands of the hind dunes behind the Belmont WWTW site in depressions that hold water. The dominant species and floristic composition of the understorey of the community closely matches the described floristics for this community within the OEH vegetation information system (VIS) with 19 of the 33 species identified in the VIS recorded within the community. Other PCTs that were considered include PCT 1809 Crimson Bottlebrush- Banksia –Melaleuca - Baumea woody sedgeland in dune swales of the Sydney Basin. This community although floristically similar was discounted as only 8 out of the 23 flora species (35%) identified in the VIS was recorded within the community. Further the community had only a sparse woody shrub layer whereas PCT 1809 is characterised by a relatively diverse shrub layer which generally includes a number of low growing Banksia and Melaleuca species which were absent from the Project area.
Condition	The community has been recently burnt and is comprised by dense regeneration of groundcover species. A high native species cover within this vegetation community indicates good condition. The number of exotic species is relatively low, with one high threat weed species occurring.

Attribute	Description
Conservation significance	This PCT is commensurate with the PCT listed under the BC Act as Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC under the BC Act.
Photo	See Photograph 6-4

Photograph 6-4 PCT 783 Coastal Freshwater Swamps of the Sydney Basin Bioregion

Table 6-7 Bitou Bush Scrub

Attribute	Description
PCT name	N/A
PCT ID	N/A
Vegetation formation	Shrubland
Vegetation class	N/A
PCT % cleared	N/A
Plots sampled	Q1, Q2, Q4, Q10
Occurrence within Project area	This vegetation community dominates the Project area. It occurs primarily within the desalination plant component of the Project area on foredunes.
Floristic description	Foredune scrub vegetation forming almost a monoculture of the exotic *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush). Largely recorded to the south of the decommissioned evaporation ponds and along the southern fenceline of the existing WWTW grounds. Comprises large patches of Bitou Bush, with occasional occurrences of other weed species like *Lantana camara* (Lantana), *Acacia saligna* (Golden Wreath Wattle), *Hyparrhenia hirta* (Coolatai Grass), *Ehrharta erecta* (Panic Veldtgrass) and *Ipomoea cairica* (Coastal Morning Glory). Other frequently encountered weed species include *Ehrharta erecta* (Panic Veldtgrass), *Hydrocotyle bonariensis* and *Senecio madagascariensis* (Fireweed). Pockets of regenerating native shrubs, namely *Acacia longifolia* subsp. *sophorae* (Coastal Wattle) with occasional occurrences of stunted *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Leptospermum laevigatum* (Coast Teatree) were recorded within this vegetation zone, predominantly within the decommissioned evaporation ponds. Towards the beachfront of the foredunes (away from Ocean Park Road), occurrences of the native *Spinifex sericeus* (Hairy Spinifex), *Rhagodia candolleana* subsp. *candolleana* (Coastal Saltbush) and *Carpobrotus glaucescens* (Pigface) were recorded, with the frequency of such species increasing where the community transitions into, Beach Spinifex strand grassland (PCT 1204).
Justification for PCT selection	This community is dominated by dense thickets of Bitou Bush and does not include enough native species cover to be considered a PCT. Plot data indicates that prior to invasion by Bitou Bush the area would have supported PCT 772 (suggested by the presence of a small number of *Acacia longifolia subsp. sophorae* (Coastal Wattle), *Leptospermum laevigatum* (Coast Teatree), *Spinifex sericeus* (Hairy Spinifex), *Rhagodia candolleana* subsp. *candolleana* (Coastal Saltbush) and *Carpobrotus glaucescens* (Pigface) within the community. This landscape position of the community within the Project area aligns with PCT 772, being found on coastal sand mass frontal dunes and beach ridges. Plot data was entered into the BAM calculator with PCT 772 selected and a vegetation integrity score of 2.8 was generated. This demonstrates that the vegetation is predominantly exotic and no longer characteristic of the PCT.
Condition	Dominated by high threat weed *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) but other high threat weeds also present include *Lantana camara* (Lantana), *Hyparrhenia hirta* (Coolatai Grass), *Senecio madagascariensis* (Fireweed), *Ehrharta erecta* (Panic Veldtgrass) and *Ipomoea cairica* (Coastal Morning Glory).

Attribute	Description
Conservation significance	Not listed as a threatened ecological community under the EPBC Act or BC Act.
Photo	See Photograph 6-5

Photograph 6-5 Bitou Bush Scrub in the desalination plant component of the Project area

Table 6-8 Exotic grassland

Attribute	Description
PCT name	None
PCT ID	N/A
Vegetation formation	N/A
Vegetation class	N/A
PCT % cleared	N/A
Plots sampled	Q3, Q5
Occurrence within Project area	This vegetation zone occurs within the desalination plant component of the Project area on foredunes, largely in the area of the decommissioned evaporation ponds.
Floristic description	Exotic grassland dominated almost entirely by *Cenchrus clandestinus* (Kikuyu) was recorded around and within the decommissioned evaporation ponds, as well as in the existing WWTW grounds. Areas dominated by *Hyparrhenia hirta* (Coolatai Grass) and the native *Cynodon dactylon* (Common Couch) was recorded around the fringes of Bitou Bush Scrub at the Ocean Park Road frontage. Other exotic species also recorded in lower frequencies within this vegetation type include *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush), *Setaria parviflora* (Pigeon Grass), *Hydrocotyle bonariensis* (Largeleaf Pennywort), *Vicia sativa* (Vetch), *Sida rhombifolia* (Paddy's Lucerne), *Sonchus oleraceus* (Common Sowthistle), *Ipomoea cairica* (Coastal Morning Glory), *Arctotheca calendula* (Capeweed) and *Acacia saligna* (Golden Wreath Wattle).

Attribute	Description
	Areas of regenerating *Acacia sophorae* (Coastal Wattle) were recorded as scattered patches within the decommissioned evaporation ponds with one small patch of regenerating *Melaleuca quinquenervia* (Broad-leaved Paperbark) present in the south-west corner of the western evaporation pond. Low frequencies of native species were encountered within the grassland matrix and include individuals of *Pimelea linifolia* subsp. *linifolia* (Queen of the Bush), *Carpobrotus glaucescens* (Pigface), *Dianella caerulea* (Blue Flax-lily) and *Cassytha glabella* f. *glabella*. In areas where surface water pools within the evaporation ponds, patches of *Phragmites australis* (Common Reed) and *Juncus kraussii* (Sea Rush) were observed.
Justification for PCT selection	N/A
Condition	Dominated by high threat weed *Cenchrus clandestinus* (Kikuyu) and *Hyparrhenia hirta* (Coolatai Grass). Other high threat weeds recorded include *Senecio madagascariensis* (Fireweed), *Ipomoea cairica* (Coastal Morning Glory) and *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush).
Conservation significance	Not listed under the EPBC Act or BC Act as a threatened ecological community.
Photo	See Photograph 6-6

Photograph 6-6 Zone 7 - Exotic grassland in the desalination plant component of the Project area (on the embankment)

6.2 Flora species

6.2.1 Species recorded in the Project area

A total of 62 species were recorded within and immediately adjacent to the Project area, comprising 42 native species and 20 exotic species. Of the native species, six were represented by Cyperaceae species, four by Myrtaceous species and four by Poaceae species, with the remaining representing a number of groundcover forbs and low shrubs typically found in foredune and wetland environments. None of the native species recorded are threatened species listed under the BC Act or EPBC Act. Of the exotic species, the families most represented were Asteraceae (daisies) and Poaceae (grasses).

A full list of flora species recorded is provided in Appendix C.

6.2.2 High threat weed species

The exotic species listed in Table 6-9 were recorded within and immediately adjacent to the Project area and are classified as high threat weeds for the purposes of the BAM. The vegetation cover within the Project area (at the drought response desalination plant site) is dominated by high threat weed species, namely *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Cenchrus clandestinus* (Kikuyu Grass).

Table 6-9 High threat weeds recorded within and adjacent to the Project area

Row Labels	Species	Name
Aizoaceae	*Galenia pubescens* var. *pubescens*	Galenia
Asteraceae	*Chrysanthemoides monilifera* subsp. *Rotundata*	Bitou Bush
Asteraceae	*Senecio madagascariensis*	Fireweed
Convolvulaceae	*Ipomoea cairica*	Coastal Morning Glory
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass
Poaceae	*Ehrharta erecta*	Panic Veldtgrass
Poaceae	*Paspalum urvillei*	Vasey Grass
Verbenaceae	*Lantana camara*	Lantana

6.2.1 Priority weed species

All weed species are regulated with a general biosecurity duty under the *Biosecurity Act 2015* to, "…prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable."

Six priority weeds that are declared for the Hunter region (which includes the Lake Macquarie LGA) were recorded within the Project area. The species, their relevant weed objectives (HLLS, 2017) and related regulatory measures are summarised in Table 6-10 below.

Table 6-10 Priority weeds recorded within and adjacent to the Project area

Species	Name	Weed objective	Measure
Chrysanthemoides monilifera subsp. *rotundata*	Bitou Bush	Containment (State)	**Prohibition on dealings** must not be imported into the State or sold.
Senecio madagascariensis	Fireweed	Asset protection (State)	**Prohibition on dealings** must not be imported into the State or sold.
Lantana camara	Lantana	Asset protection (State)	**Prohibition on dealings** must not be imported into the State or sold.

6.2.2 Weeds of National Significance

Bitou Bush, Fireweed and Lantana are also Weeds of National Significance declared under the National Weed Strategy (IPAC, 2016; AWC, 2019), which recommends that their spread should be minimised to protect priority assets. Specific assets have not been identified in the national strategy but Priority 3.3 of the strategy identifies that asset assessments should be undertaken to assess which assets need to be protected and from which weed species (IPAC, 2016).

6.3 Groundwater dependent ecosystems

6.3.1 GDEs within the Project area

The Groundwater Dependent Ecosystems Atlas indicates that the seaward side of the foredunes within the Project area is likely to contain vegetation that represents high potential terrestrial GDEs (as updated by regional studies). The associated vegetation that the atlas identifies as being a high potential terrestrial GDE is PCT 1644 Coast Tea Tree – Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast (BOM, 2018a). This PCT however does occur within the Project area.

A number of terrestrial and aquatic GDEs are mapped by the GDE atlas adjacent to the Project area and area associated with Belmont Lagoon and terrestrial vegetation to the west of Ocean Park Road. Belmont Lagoon is identified as a moderate potential GDE from the national assessment and is listed as a High Priority GDE for the Hawkesbury to Hunter Coastal Sands Groundwater Source (BOM 2018a).

Terrestrial vegetation located to the west of the WWTW that has been identified as high potential terrestrial GDEs from regional studies include (1) PCT 1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast, which corresponds to Unit 37e as described by Bell (2016); and (2) PCT 1644 Coast Tea Tree – Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast (BOM, 2018a), which is related to PCT 772 (OEH, 2020b). Neither of these PCTs occur within the Project area, however PCT 1724 occurs directly to the south.

Whilst not considered to be a terrestrial GDE, PCT 783 Coastal freshwater swamps of the Sydney Basin Bioregion is likely to depend upon groundwater due to the swamp characteristic of the vegetation community. PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion is unlikely to be dependent on groundwater due to the ephemeral nature of the vegetation community and the lack of any flora species with deep root systems.

The Atlas mapped distribution of high potential terrestrial GDEs as it relates to the Project area is shown in Figure 6-2.

Paper Size ISO A4

0 140 280 420 560

Meters

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

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Hunter Water Corporation
Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

High potential GDEs mapped by the Groundwater Dependent Ecosystems Atlas

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 6-2

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Print date: 29 Jun 2020 - 07:36

Data source: DECCW: Aquatic/Terrestrial data, 2019. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. Created by: fmackay

6.4 Terrestrial fauna and fauna habitat

6.4.1 Fauna species

There was a low abundance and diversity of fauna species observed within the Project area, with only fifteen fauna species recorded during field surveys.

Species recorded included a small number of birds commonly found in coastal environments including Welcome Swallows (*Hirundo neoxena*) and White-breasted Woodswallows (*Artamus leucorynchus)* that were observed hawking for insects over the Bitou Bush Scrub. A couple of Australian Magpies (*Cracticus tibicen*) were recorded foraging on the ground for insects on the foredunes among *Carpobrotus glaucescens* (Pigface) and at the edges of the Bitou Bush Scrub. A Black-shouldered Kite (*Elanus axillaris*) was observed hovering over Bitou Bush Scrub in the existing WWTW grounds hunting for prey. A few Silver Gulls (*Chroicocephalus novaehollandiae*) were also observed flying in the distance on the seaward side of the foredunes within proximity of the Project area. One Grey Goshawk (*Accipiter novaehollandiae*) was observed briefly perched on power lines running through the Project area while a Southern Emu-wren (*Stipiturus malachurus*) was sighted flying from a dense thicket of Bitou Bush Scrub towards the WWTW. All of these species are common species associated with cleared areas on forested or woodland fringes, or with vacant lands of urban and coastal areas. None of the fauna species recorded are threatened species listed under the BC Act or EPBC Act.

During targeted frog surveys conducted in February 2020 a total of three frog species and three reptile species were recorded. These included Striped Marsh Frog (*Limnodynastes peronii*), Ornate Burrowing Frog (*Platyplectrum ornatum*), Dusky Toadlet (*Uperoleia fusca*), Diamond Python (*Morelia spilota spilota*), Golden-crowned Snake (*Cacophis squamulosus*) and Dark-flecked Garden Sunskink (*Lampropholis delicata*). Two introduced mammal species; Brown Hare (*Lepus capensis*) and Red Fox (*Vulpes vulpes*) were also observed on multiple occasions during the targeted frog surveys.

Of the fauna identified within the broader area over the 2018-2020 period during surveys by GHD for the associated pipeline project, a total of 54 species from 30 families were identified and include 50 native species and 4 introduced species (see Appendix C). This comprised three frog species, 40 bird species, seven mammal species and four reptile species. The faunal assemblage recorded was dominated by bird species. Bird species most frequently recorded include widespread and common species such as honeyeaters, pigeons and doves, and the Australian Magpie (*Cracticus tibicen*). The mammal assemblage was largely represented by microchiropteran bat species, most of which are common species. One of these microchiropteran bat species recorded within the wider locality, the Little Bent-winged Bat (*Miniopterus australis*) is a vulnerable species listed under the BC Act and is assessed further in Section 7.1.

6.4.2 Fauna habitats

The majority of Project area provides very limited habitat for native fauna, however native vegetation associated with the Belmont Wetland west of Ocean Park Road may provide suitable habitat for a range of frogs, reptile and wetland bird species.

The Project area lacks any mature or hollow-bearing trees and is therefore unlikely to provide any substantial habitat for hollow dependent fauna. The Project area also lacks many food resources such as nectar and blossoms provided by myrtaceous species that are utilised by many bird and arboreal mammal species.

East of Ocean Park Road, the vegetation is dominated by highly invasive high threat weed species *Chrysanthemoides monilifera* subsp*. rotundata* (Bitou Bush) and *Cenchrus clandestinus* (Kikuyu). These have respectively formed a scrub thicket and a dense matting grassland on the foredunes. These are likely to provide low quality habitat value for a range of common fauna species.

The Project area is connected to larger patches of habitat comprising a mixture of swamp sclerophyll forests, coastal woodland, coastal shrubland and wetlands. These surrounding habitats are associated with the Belmont Wetlands State Park and Belmont Lagoon and represent a larger network of fragmented vegetation patches along the coast.

Due to the modified nature of the Project area, fauna species that are likely to be observed within or flying over the Project area would be limited to those species capable of persisting in fragmented and modified landscapes, or wide-ranging highly mobile species capable of travelling throughout fragmented landscapes.

The following table (Table 6-11) provides a discussion of the fauna habitat values within the Project area.

Table 6-11 Description of relevant habitat types

Habitat type	Habitat description
Foredune scrub	In general, coastal dune shrublands are a treeless habitat with a moderate to high diversity of low shrubs, sedges and groundcovers. Coastal dune shrubland habitats would provide important food and nesting opportunities for a range of native fauna, including reptiles, shorebirds and passerine species. Coastal dune shrublands can also contain plants that flower in autumn and winter, thereby providing food resources for migratory and nomadic nectar and insect feeding birds. The coastal dune shrublands would also provide important movement corridors up and down the coast. The Coast Wattle Dune Scrub and Bitou Bush Scrub within the Project area has potential to provide sheltering habitat for small birds and reptiles. The litter cover in this habitat is also generally high. The native species diversity of the Coast Wattle Dune Scrub and Bitou Bush Scrub is relatively low and limits the value of the habitat for native species. Species like *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia), *Allocasuarina verticillata* (Drooping Sheoak) are generally missing from the midstorey, with occurrences of *Acacia longifolia* subsp. *sophorae* (Coastal Wattle), *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Leptospermum laevigatum* (Coast Teatree) present. These would provide some foraging habitat for common honeyeaters and other small birds. The understorey is largely absent under the thick Coast Wattle Dune Scrub Bitou Bush Scrub, with a diversity of saltbush, grass and forb species occurring in the understorey on the coastal foredunes where the mid-storey layer is absent.
Grassland (i.e. exotic grassland)	Native tussock grasslands are generally known to provide space and microsites between grass tufts to support a diversity of native forbs and herb species, foraging habitat for reptiles and skinks; and seeds for granivorous birds. The exotic grassland vegetation generally provides poor habitat values for native fauna as it is mat-forming rather than tussocky. The mat-forming Kikuyu grassland within the Project area is very deep, dense and would likely support common reptiles, snakes and birds such as the Diamond Python, Golden-crowned Snake and Australian Magpie recorded in the Project area. Furthermore, the grassland does not provide linkages between wetland ponds for frog species that would move between ponds over grassland.

Habitat type	Habitat description
Aquatic or wetland habitats	The Project area provides ephemeral aquatic and wetland habitats for native fauna, located in the western extent of the Project area. There are four identified wetlands and two ephemeral drainage lines within the buffered assessment area. These wetland areas containing wetland vegetation may provide suitable foraging habitat for species such as the Green and Golden Bell Frog (*Litoria aurea*), Mahony's Toadlet (*Uperoleia mahonyi*) and Wallum Froglet (*Crinia tinnula*), although it is noted that no records exist for Green and Golden Bell Frog or Mahony's Toadlet in the locality. Approximately 260 mm of rain fell in the days leading up to the targeted frog surveys conducted between 12 and 14 February 2020. Surface water was observed in the western side of the Project area during these targeted frog surveys however the water was below a dense mat of *Hydrocotyle bonariensis* (Pennywort) and would likely persist for only a short period after rain. Therefore these areas would not provide suitable breeding habitat for species such as the Green and Golden Bell Frog (*Litoria aurea*), Mahony's Toadlet (*Uperoleia mahonyi*) and Wallum Froglet (*Crinia tinnula*). Decommissioned evaporation ponds also occur within the Project area. Due to being located on sandy substrate, these areas are unlikely to hold substantial amounts of water for a sufficient period of time to support amphibious or aquatic species, and aside from a small patch of *Phragmites australis* (Common Reed) and the occasional occurrence of *Juncus kraussii* (Sea Rush), does not support wetland vegetation. This was confirmed during targeted frog surveys whereby the decommissioned evaporation ponds did not contain any surface water, indicating this area is not likely to be important breeding habitat for most amphibian species.

Habitat constraints and geographic features assessed under the BAM

Habitat constraints for individual threatened species are identified in the Threatened Biodiversity Data Collection (TBDC) and are automatically populated into the BAM calculator.

These habitat constraints were assessed in relation to the Project area for individual species in accordance with Section 6.4.1.9 – Section 6.4.1.16 of the BAM (OEH, 2017a). The habitat constraints assessed in this BDAR are listed in Table 6-12.

6.4.3 Koala habitat (SEPP Koala Habitat Protection)

The native vegetation to the west, north and south of the Project area includes swamp vegetation dominated by *Eucalyptus robusta* (Swamp Mahogany), which is a Koala feed tree listed under Schedule 2 of SEPP Koala Habitat Protection and a primary feed tree listed in the Koala Recovery Plan (DECC, 2008d) for the Central Coast Koala Management Area (which includes the Hunter-Central Rivers catchment management area). One Koala sighting was recorded in 2006 to the south of the Project area within the Belmont Golf Course wetland in Coastal Sand Swamp Forest (a Swamp Mahogany – Paperbark coastal swamp forest) (Bell, 2016; OEH, 2020a).

The vegetation east of Ocean Park Road within the Project area is generally treeless and dominated by non-native species. To the west of Ocean Park Road, vegetation within the Project area is comprised of Freshwater Wetlands and is adjacent to swamp forest dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Casuarina glauca* (Swamp Oak). There are no Koala feed tree species or supplementary tree species present in the Project area (i.e. SEPP Koala Habitat Protection Schedule 2 list for Central Coast koala management area), or tree species listed in the Koala Recovery Plan) and therefore the vegetation does not constitute core Koala habitat.

Table 6-12 Presence of habitat constraints in the Project area

Habitat constraint	Present	Absent	Threatened species
Fallen/standing dead timber including logs		x	Bush Stone-curlew (*Burhinus grallarius*)
Allocasuarina or *Casuarina* tree species		x	Glossy Black-cockatoo *Calyptorhynchus lathami*) (foraging)
Hollow bearing trees		x	Southern Myotis (*Myotis macropus*) Brush-tailed Phascogale (*Phascogale tapoatafa*) Glossy Black-cockatoo (*Calyptorhynchus lathami*) (breeding) Barking Owl (*Ninox connivens*)l (breeding) Powerful Owl (*Ninox strenua*) (breeding) Masked Owl (*Tyto novahollandiae*) (breeding)
Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground		x	Barking Owl (*Ninox connivens*)l (breeding)
Nest trees		x	Little Eagle (*Hieraaetus morphnoides*) Square-tailed Kite (*Lophoictinia isura*) (breeding) White-bellied Sea-eagle (*Haliaeetus leucogaster*) (breeding) Eastern Osprey (*Pandion cristatus*) (breeding)
Land containing associated PCTs within 100 m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds		x	Large-eared Pied Bat (*Chalinolobus dwyeri*)
Land within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels		x	Large-eared Pied Bat *Chalinolobus dwyeri*) Eastern Cave Bat (*Vespadelus troughtoni*)
Cave, tunnel, mine, culvert or other structures		x	Little Bent-winged Bat (*Miniopterus australis*) Large Bent-winged Bat (*Miniopterus orianae oceanensis*) (breeding) Southern Myotis (*Myotis macropus*) Eastern Cave Bat (*Vespadelus troughtoni*)
Dunes	x		*Euphorbia psammogeton* syn. *Chamaesyce psammogeton* (Sand Spurge)
Fore-dunes or exposed headlands	x		*Euphorbia psammogeton* syn. *Chamaesyce psammogeton* (Sand Spurge)
Semi-permanent/ephemeral wet areas	x		Green and Golden Bell Frog (*Litoria aurea*)
Land within 1 km of wet areas | swamps	x		Green and Golden Bell Frog (*Litoria aurea*)
Land within 1 km of swamp | waterbodies	x		Green and Golden Bell Frog (*Litoria aurea*)
Land within 1 km of a waterbody	x		Green and Golden Bell Frog (*Litoria aurea*)

Habitat constraint	Present	Absent	Threatened species
Land within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines	x		White-bellied Sea-eagle (*Haliaeetus leucogaster*) (foraging)
Land within 200 m of riparian zone[2]	x		Southern Myotis (*Myotis macropus*)
Land within 100 metres of estuarine areas and the ocean	x		Pied Oystercatcher (*Haematopus longirostris*)
Riparian areas/drainage lines, water ponding, man-made dams and drainage channels up to 1 m deep, semi permanent/ephemeral wet areas, swamps	x		*Maundia triglochinoides*
Shallow swamps up to 1 m deep	x		*Maundia triglochinoides*
Waterbodies		x	Cotton Pygmy-Goose *(Nettapus coromandelianus)* *Zannichellia palustris*
Deep permanent fresh waters on floodplains with floating and submergent vegetation		x	Cotton Pygmy-Goose *(Nettapus coromandelianus)*
Semi permanent/ephemeral wet areas	x		Tall Knotweed (*Persicaria elatior*)
Within 50 m of swamps	x		Tall Knotweed (*Persicaria elatior*)
Within 50 m of waterbodies		x	Tall Knotweed (*Persicaria elatior*)
Including wetlands or within 50 m of wetlands	x		Tall Knotweed (*Persicaria elatior*)
Land within 1 km of rocky escarpments, gorges , steep slopes, boulder piles, rock outcrops or clifflines		x	Brush-tailed Rock–wallaby (*Petrogale penicillata*)
Freshwater or slightly brackish estuarine areas (10%)		X	*Zannichellia palustris*

[2] A riparian zone is land alongside creeks, streams, gullies, rivers and wetlands

6.5 Aquatic biodiversity

6.5.1 Aquatic habitat

No permanent aquatic habitat occurs within the Project area. The Project area includes and is surrounded by ephemeral swamp and wetland vegetation associated with Belmont Lagoon and the greater Lake Macquarie Coastal Wetlands (NSW189. Estuarine habitats comprising mangroves, saltmarsh and seagrass meadows are located around the margins of Belmont Lagoon and Lake Macquarie to the west of the Project area. Belmont Lagoon is separated from the Project area by approximately 120 m of wetland and swamp vegetation.

6.5.2 Threatened freshwater fish distributions

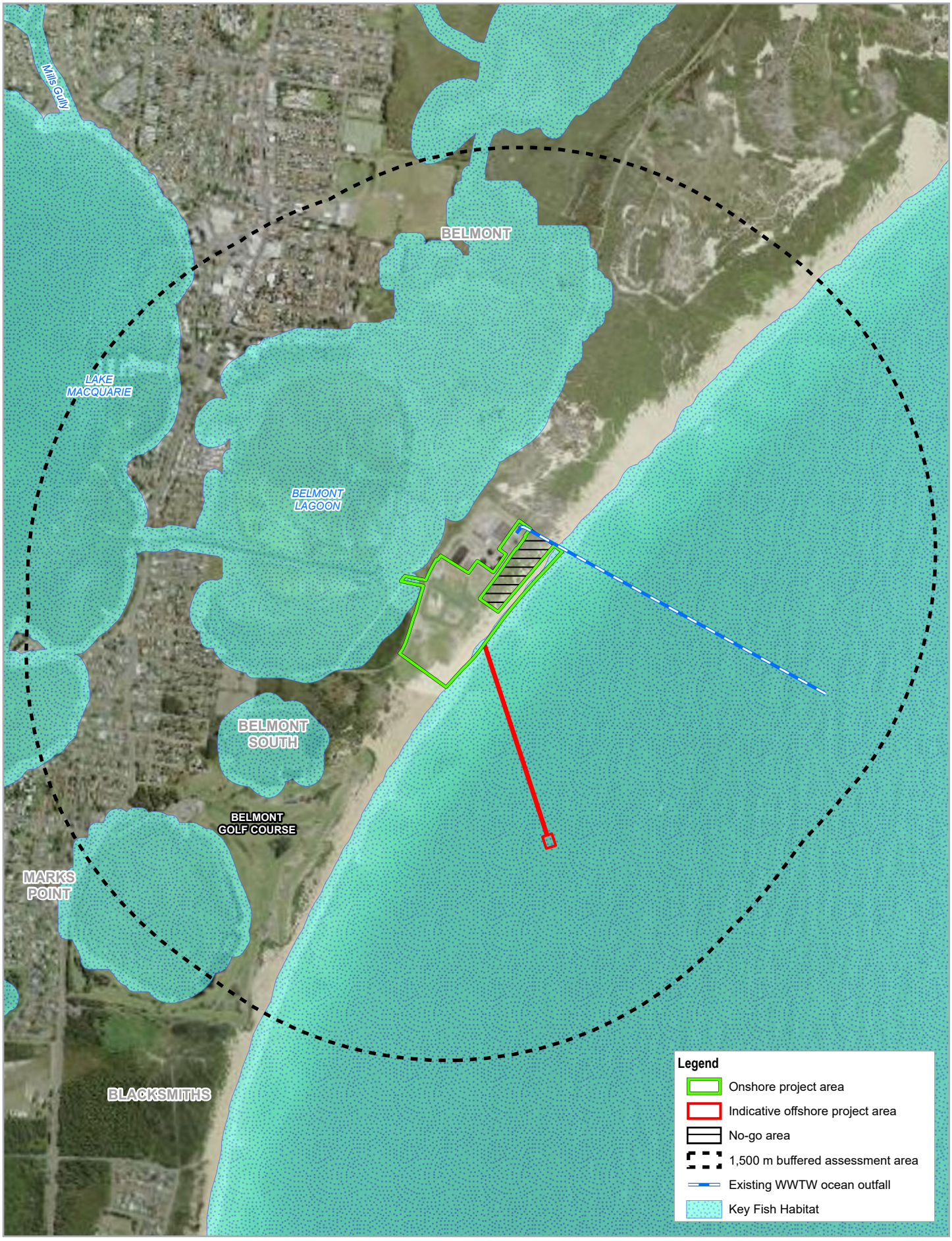
Indicative threatened freshwater fish distributions have been modelled across NSW using records collected over two decades (DPI, 2016). There are no threatened fish species that are modelled to occur within or near the Project area, with the closest modelled distributions for the threatened Purple Spotted Gudgeon (*Mogurnda adspersa*) located over 18 km away at Brunkerville Creek and also at South Channel Hunter River (DPI, 2018).

6.5.3 Key fish habitat

Key fish habitat areas are identified areas of aquatic and riparian habitat in NSW that are important to the maintenance of “fish” (including aquatic invertebrate) populations and communities, and the commercial and recreational fishing industries. Key fish habitat generally includes all marine and estuarine habitats, and most permanent and semi-permanent freshwater habitats. Key fish habitat is defined in the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013) according to (1) waterway class and/or (2) habitat sensitivity type. All SEPP Coastal Wetlands are classified as Type 1 – highly sensitive key fish habitat, and marine waterways are classified as major key fish habitat.

The NSW Department of Primary Industries (DPI) Key Fish Habitat mapping (DPI, 2007) maps key fish habitat on the seaward and landward side of the Project area, corresponding to the wetland and aquatic habitats associated with the wetlands around Belmont Lagoon and Lake Macquarie to the west, and the ocean to the east (Figure 6-3).

No mangrove or saltmarsh habitat is located within the Project area. No marine waterways are located within the Project area. Whilst the Project area occurs on the margins of mapped key fish habitat (DPI, 2007) no permanent waterbodies occur within the Project area to provide suitable habitat for fish species.



Paper Size ISO A4

0 140 280 420 560

Meters

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

N

GHD

Hunter Water Corporation
Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Key fish habitat and threatened fish distributions

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 6-3

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Print date: 29 Jun 2020 - 07:35

Data source: DPI: Fish habitat/Threatened fish species, 2019. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. Created by: fmackay

7. Conservation significance

7.1 Threatened species assessment under the BAM

Threatened species were assessed for ecosystem credits and species credits in accordance with Section 6.4.1.1 to Section 6.4.1.19 of the BAM (OEH, 2017a).

7.1.1 Background

Identifying threatened species for assessment

The BAM calculator automatically generates a list of threatened species that must be assessed for ecosystem or species credits (i.e. 'predicted' and 'candidate' threatened species respectively). These are species that are considered likely to occur within, or to use habitats within the Project area. This list is generated based on information entered into the landscape assessment component of the BAM calculator (e.g. IBRA subregion, percent native vegetation cover, patch size class) and information from the TBDC regarding species' geographic limitations.

Additional species not generated by the BAM calculator can be added to the list to be assessed for ecosystem and/or species credits if the species are considered likely to occur within, or to use habitats within the Project area (based on review of available ecology reports, environmental impact statements, scientific literature or detection on site during survey). For this reason, additional species identified through the desktop assessment (e.g. identified from database searches as occurring within, or having the potential to occur within 10 km of the Project area) were also considered for addition to the list of predicted and candidate species.

Refinement of list of threatened species for assessment

Once the list of potential predicted and candidate threatened species have been identified, this list can be further refined by undertaking an additional assessment of the habitat constraints or microhabitats within the Project area.

Predicted threatened species can be removed from assessment for ecosystem credits if any habitat constraints described for the species in the TBDC are absent from the site, otherwise the species must be retained for assessment of ecosystem credits. Targeted survey is not required for predicted threatened species (Section 6.2.1.1, OEH, 2017a).

Candidate threatened species can be removed from assessment for species credits if:

- Any habitat constraints described for the species in the TBDC are absent from the site
- Where habitat is determined to be significantly degraded
- Where vegetation is missing key structural elements

No targeted survey is required for species that are removed from the list of candidate threatened species. For species that are retained, targeted survey is required to determine presence on site in order to assess for species credits.

The following sections present the list of predicted and candidate species identified for the assessment of ecosystem and species credits. It also identifies and provides justifications for the exclusion of any threatened species from further assessment where applicable.

7.1.2 Predicted threatened species (ecosystem credit entities)

Based on the bioregional context for the assessment and the PCTs, patch size, vegetation cover and habitat resources present at the Project area, the BAM calculator generates a list of threatened fauna species that are predicted to utilise the site. The potential for these predicted species to occur within the Project area were further refined based on the desktop assessment, habitat resources observed during field surveys and the knowledge and experience of the assessor.

The suite of predicted threatened species associated with ecosystem credits required for the Project area and with relevant habitat resources present on the site are listed in Table 7-1. For each predicted threatened species a sensitivity class rating is also provided. Targeted surveys are not required for these species.

There are no habitat constraints described within the TBDC for the majority of the predicted threatened species listed in Table 7-1 and so these species have been retained to be assessed for ecosystem credits.

Three species (Glossy Black-cockatoo (*Calyptorhynchus lathami*), Black Bittern (*Ixobrychus flavicollis)* and Comb Crested Jacana (*Irediparra gallinacea*) were removed from the predicted species list as no *Allocasuarina* or *Casuarina* species were recorded within the Project area and the site does not contain an permanent waterbodies with floating vegetation). These species were therefore not assessed for ecosystem credits.

Additional threatened species that were considered for assessment for ecosystem credits based on known occurrences within the locality (particularly within 1 km of the Project area) are not considered likely to occur within, or to utilise habitats within the Project area (see likelihood of occurrence assessment, Appendix A).

Table 7-1 Predicted threatened species assessed for ecosystem credits

Common Name	Scientific Name	Vegetation Types(s)	Sensitivity to potential gain class^	Habitat constraint^	Excluded from further assessment	Justification for exclusion
Magpie Goose	*Anseranas semipalmata*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	-	No	n/a
Regent Honeyeater (foraging)	*Anthochaera phrygia*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a
Dusky Woodswallow	*Artamus cyanopterus*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion 1204 – Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	Moderate	-	No	n/a
Australasian Bitten	*Botaurus poiciloptilus*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	-	No	n/a
Curlew Sandpiper (Foraging)	*Calidris ferruginea*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	High	As per mapped areas outlined on maps provided by OEH	Yes	The Project area does not contain any mapped area of habitat for this species as per maps provided by OEH

Common Name	Scientific Name	Vegetation Types(s)	Sensitivity to potential gain class^	Habitat constraint^	Excluded from further assessment	Justification for exclusion
Great Knot (Foraging)	*Calidris tenuirostris*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	High	As per mapped areas outlined on maps provided by OEH	Yes	The Project area does not contain any mapped area of habitat for this species as per maps provided by OEH
Glossy Black-Cockatoo (foraging)	*Calyptorhynchus lathami*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	Presence of Allocasuarina and Casuarina species	Yes – not assessed for ecosystem credits.	Habitat constraint is determined to be absent from the Project area (i.e. no Allocasuarina or Casuarina species present)
Speckled Warbler	*Chthonicola sagittata*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a
Spotted Harrier	*Circus assimilis*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	-	No	n/a
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a

Common Name	Scientific Name	Vegetation Types(s)	Sensitivity to potential gain class^	Habitat constraint^	Excluded from further assessment	Justification for exclusion
Varied Sittella	*Daphoenositta chrysoptera*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1724- Broad-leaved Paperbark Swamp Oak-Saw Sedge swamp forest on coastal lowlands	Moderate	-	No	n/a
Spotted-tailed Quoll	*Dasyurus maculatus*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	High	-	No	n/a
Black-necked Stork	*Ephippiorhynchus asiaticus*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	-	No	n/a
White-fronted Chat	*Epthianura albifrons*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	-	No	n/a
Little Lorikeet	*Glossopsitta pusilla*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a

Common Name	Scientific Name	Vegetation Types(s)	Sensitivity to potential gain class^	Habitat constraint^	Excluded from further assessment	Justification for exclusion
White-bellied Sea-Eagle (foraging)	*Haliaeetus leucogaster*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	High	Within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines	No	Although the Project area lacks suitable foraging habitat (the species fishes over waterbodies), the Project area occurs within 1 km of foraging habitat and the species is likely to fly over if foraging in the area
Little Eagle (foraging)	*Hieraaetus morphnoides*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	-	No	n/a
Comb-crested Jacana	*Irediparrra gallinacea*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	Waterbodies Freshwater wetlands with a good surface cover of floating aquatic vegetation	Yes	Wetland and swamp areas within Project area are ephemeral and do not contain surface cover of floating aquatic vegetation

Common Name	Scientific Name	Vegetation Types(s)	Sensitivity to potential gain class^	Habitat constraint^	Excluded from further assessment	Justification for exclusion
Black Bittern	*Ixobrychus flavicollis*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	Land within 40 m of freshwater and estuarine wetlands in areas of permanent water and dense vegetation	Yes	Project area does not contain any permanent water bodies
Swift Parrot (foraging)	*Lathamus discolor*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	-	No	n/a
Broad-billed Sandpiper (foraging)	*Limicola falcinellus*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	High	As per mapped areas outlined on maps provided by OEH	Yes	The Project area does not contain any mapped area of habitat for this species as per maps provided by OEH
Black-tailed Godwit (foraging)	*Limosa*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	High	As per mapped areas outlined on maps provided by OEH	Yes	The Project area does not contain any mapped area of habitat for this species as per maps provided by OEH

Common Name	Scientific Name	Vegetation Types(s)	Sensitivity to potential gain class^	Habitat constraint^	Excluded from further assessment	Justification for exclusion
Square-tailed Kite (foraging)	*Lophoictinia isura*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	-	No	n/a
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	-	No	n/a
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis (syn. Mormopterus norfolkensis)*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	High	-	No	n/a
Little Bent-winged Bat (foraging)	*Miniopterus australis*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	High	-	No	n/a
Large Bent-winged Bat (foraging)	*Miniopterus orianae oceanensis*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 1204 Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a

Common Name	Scientific Name	Vegetation Types(s)	Sensitivity to potential gain class^	Habitat constraint^	Excluded from further assessment	Justification for exclusion
Barking Owl (foraging)	*Ninox connivens*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a
Powerful Owl (foraging)	*Ninox strenua*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a
Blue-billed Duck	*Oxyura australis*	1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	-	No	n/a
Eastern Osprey (foraging)	*Pandion cristatus*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion 1071–Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion 1204 Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	Moderate	-	No	n/a
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	-	No	n/a
Grey-headed Flying-fox (foraging)	*Pteropus poliocephalus*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a
Australian Painted Snipe	*Rostratula australis*	1071– Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	-	No	n/a

Common Name	Scientific Name	Vegetation Types(s)	Sensitivity to potential gain class^	Habitat constraint^	Excluded from further assessment	Justification for exclusion
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a
Diamond Firetail	*Stagonopleura guttata*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	-	No	n/a
Little Tern (foraging)	*Sternula albifrons*	1204 Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	Moderate	-	No	n/a
Freckled Duck	*Stictonetta naevosa*	1071– Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion 783- Coastal freshwater swamps of the Sydney Basin Bioregion	Moderate	-	No	n/a
Masked Owl (foraging)	*Tyto novaehollandiae*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	High	-	No	n/a
Terek Sandpiper	*Xenus cinereus*	783- Coastal freshwater swamps of the Sydney Basin Bioregion 1204 Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	High	Yes	The Project area does not contain any mapped area of habitat for this species as per maps provided by OEH	n/a

^From the Threatened Biodiversity Data Collection

7.1.3 Candidate threatened species (species credit entities)

The candidate threatened species that were generated by the BAM calculator to be considered for further assessment of species credits are listed in Table 7-2.

The majority of species listed in Table 7-2 were excluded from further assessment for species credits. The justifications for the exclusions are provided in Table 7-2 and include consideration of habitat constraints described in the TBDC, suitable micro-habitat sites favoured by species, and the current degradation of the habitats within the Project area.

Other threatened species that were considered for assessment for species credits based on known occurrences within the locality (particularly within 1 km of the Project area) were not considered likely to occur within, or to utilise habitats within the Project area (see likelihood of occurrence assessment, Appendix A).

A number of migratory species that are dual credit species (i.e. those that require offsets through ecosystem credits for foraging habitat and as species credits for breeding habitat) identified by the BAM credit calculator were excluded from further assessment as the Project area does not contain any areas of mapped habitat (as per mapping provided by BCD).

Table 7-2 Candidate threatened species assessed for species credits

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Species requiring survey	Habitat degraded	Excluded from further assessment	Justification for exclusion/results of targeted surveys
Charmhaven Apple	*Angophora inopina*	n/a	-	No	Yes	Yes	Not recorded during survey of the Project area. The habitat within the Project area is substantially degraded by Bitou Bush invasion. No trees were recorded except for a small number of *Melaleuca quinquenervia* trees in one stand.
Regent Honeyeater (breeding)	*Anthochaera phrygia*	High	Mapped important areas	No	Yes	Yes	Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and Sheoaks and can also nest in mistletoe haustoria. Breeding typically corresponds with flowering eucalypts. The Regent Honeyeater has not been recorded breeding in the Lake Macquarie area. The Project area does not contain breeding habitat for the species, as it lacks eucalypts and Sheoaks. In some years flocks converge on flowering coastal woodlands and forests containing Swamp Mahogany and Spotted Gum. The habitat within the Project area is substantially degraded by Bitou Bush invasion and does not contain foraging resources, although there is suitable foraging habitat in the native vegetation surrounding the Project area.
Bush Stone-curlew	*Burhinus grallarius*	High	Fallen/standing dead timber including logs	No	Yes	Yes	The Project area does not provide suitable fallen/standing timber and log habitat for this species. Habitat within the Project area is substantially degraded by Bitou Bush invasion and previous ground disturbance.
Thick Lip Spider Orchid	*Caladenia tessellata*	Moderate	-	No	Yes	Yes	The Project area does not contain heathy woodland or dry sclerophyll forest habitat with a native grass understorey, which is preferred by the species. Furthermore, habitat within the Project area is substantially degraded by Bitou Bush and exotic grasses.
Curlew Sandpiper	*Calidris ferruginea*	High	As per mapped areas	Yes	No	Yes	The project area does not occur within area of important habitat as mapped by OEH.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Species requiring survey	Habitat degraded	Excluded from further assessment	Justification for exclusion/results of targeted surveys
Great Knot	*Calidris tenuirostris*	High	As per mapped areas	No	Yes	Yes	The Project area does not occur within area of breeding habitat as mapped by OEH.
Glossy Black-Cockatoo (breeding)	*Calyptorhynchus lathami*	High	Living or dead tree with hollows greater than 15 cm diameter and greater than 5 m above ground.	No	Yes	Yes	Project area lacks *Allocasuarina* and *Casuarina* species, and lacks living or dead trees with hollows.
Eastern Pygmy Possum	*Cercartetus nanus*	High	-	No	Yes	Yes	The Project area is poor in foraging resources in the form of banksia, eucalypt and bottlebrush species. The Project area lacks sheltering habitat in the form of tree hollows and stumps.
Large-eared Pied Bat	*Chalinolobus dwyeri*	Very high	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. Potential breeding habitat is PCTs associated with the species within 100 m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat.	No	Yes	Yes	The Project area is not located within the described landscapes for this species (i.e. sandstone cliffs, fertile woodland valleys, sandstone outcrop country). The Project area does not support suitable roosting or breeding cave habitat, and is not located within 100 m of suitable breeding or roosting habitat. There are no known records within the locality for this species.
Sand Spurge	*Chamaesyce psammogeton*	High	-	Yes	Yes	No	Sand Spurge grows on dunes and sea strandlines. Targeted surveys within Project area undertaken at appropriate time of year did not record this species.
Wallum Froglet	*Crinia tinnula*	Moderate	-	Yes	No	No	There is suitable habitat for the species within the wetland habitats associated with Belmont Lagoon. This species was not recorded during targeted surveys completed at the site in February 2020.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Species requiring survey	Habitat degraded	Excluded from further assessment	Justification for exclusion/results of targeted surveys
White-flowered Wax Plant	*Cynanchum elegans*	High	-	No	Yes	Yes	There is no suitable habitat for this species within the Project area. The Project area would have originally supported suitable habitat characterised by Coast Banksia and Coastal Teatree but the habitat within the Project area is now substantially degraded by high threat weed species, Bitou Bush, which has formed a monocultural thicket on the foredunes. Searches around the edges of Bitou Bush Scrub were undertaken (within recommended survey months for this species as identified in the TBDC) and no individuals were recorded.
Pied Oystercatcher	*Haematopus longirostris*	High	Within 100 m of estuarine areas and the ocean	No	Yes	Yes	May occur as a visitor on the beach and frontal dunes to the east of the proposed temporary desalinisation plant site but habitats within the Project area are unlikely to be utilised by the species. There is no suitable foraging habitat within the site itself (i.e. exposed sand, mud and rock at low tide supporting molluscs, worms, crabs and small fish prey species). Furthermore, the habitat within the Project area is substantially degraded by Bitou Bush invasion. It is noted that the frontal dune habitat approaching the beach strand zone is the area most likely to be utilised by the species if it is present in the area; this area is unlikely to be disturbed by the proposed construction works. This area if also substantially disturbed as a result of 4WD utilising the area.
White-bellied Sea-Eagle (breeding)	*Haliaeetus leucogaster*	High	Living or dead mature trees within suitable vegetation within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines	No	Yes	Yes	The Project area lacks suitable breeding habitat in the form of living or dead mature trees.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Species requiring survey	Habitat degraded	Excluded from further assessment	Justification for exclusion/results of targeted surveys
Little Eagle (breeding)	*Hieraaetus morphnoides*	Moderate	Nest trees - live (occasionally dead) large old trees within vegetation	No	Yes	Yes	The Project area lacks suitable breeding habitat in the form of living or dead mature trees.
Pale-headed Snake	*Hoplocephalus bitorquatus*	High	-	No	Yes	Yes	The Project area lacks eucalypt forest and woodland habitat as well as hollow resources.
Swift Parrot (breeding)	*Lathamus discolor*	Moderate	Mapped important areas	No	Yes	Yes	In some years flocks converge on flowering coastal woodlands and forests containing Swamp Mahogany and Spotted Gum. A small part of the Project area is mapped as containing important habitat for Swift Parrot. The Project area however does not contain any foraging resources for Swift Parrot. It lacks mature trees and flowering eucalypts. The species has potential to visit habitat surrounding the Project area and be recorded flying over the Project area from time to time. Unlikely to occur within or utilise habitats within the Project area due to degraded habitat.
Broad-billed Sandpiper (breeding)	*Limicola falcinellus*	High	As per mapped areas	Yes	Yes	Yes	Does not occur within area of breeding habitat as mapped by OEH.
Black-tailed Godwit (breeding)	*Limosa*	High	As per mapped areas	Yes	Yes	Yes	Does not occur within area of breeding habitat as mapped by OEH.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Species requiring survey	Habitat degraded	Excluded from further assessment	Justification for exclusion/results of targeted surveys
Green and Golden Bell Frog	*Litoria aurea*	High	Within 1 km of semi-permanent/ephemeral wet areas, swamps and waterbodies	Yes	Yes	No	The species occupies marshes, dams and stream-sides that are relatively unshaded and will utilise adjacent tussock grasslands to travel between waterbodies. Although the Project area contains wetland habitat suitable for frog species, the Green and Golden Bell frog was not observed or heard calling during targeted surveys completed in February 2020. While the species was known to occur at Belmont in the 1970s (DEC, 2005), there have been no recent records of the species (OEH, 2020a). Only two key populations occur on the Central Coast, one at Avoca and one at Davistown, both near Gosford (DEC, 2005). The species is assumed extinct in the area. It is not included in the management plan for the Belmont Wetlands State Park (Andrews Neil Urban Design Group, 2010).
Green-thighed Frog	*Litoria brevipalmata*	Moderate	-	No	Yes	Yes	The Project area does not contain suitable rainforest, eucalypt forest or heathland habitat. This species was not recorded during frog surveys completed in February 2020.
Maundia triglochinoides	*Maundia triglochinoides*	High	Riparian areas/drainage lines, water ponding, man-made dams and drainage channels up to 1 m deep	Yes	No	No	Surveys completed within Project area at an appropriate time of year did not record species. Habitat considered marginal for this species and is highly degraded due to dense *Hydrocotyle bonariensis* ground cover.
Biconvex Paperbark	*Melaleuca biconvexa*	High	-	Yes	No	No	No tree species occur within the Project area. Surveys within Project area undertaken at appropriate time of year did not record species.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Species requiring survey	Habitat degraded	Excluded from further assessment	Justification for exclusion/results of targeted surveys
Mahony's Toadlet	*Uperoleia mahonyi*	High	-	Yes	Yes	No	This species occupies heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. This species breeds in waterbodies associated with permanent or semi-permanent swamps and ponds. Outside of breeding periods, the species has been recorded up to 400 m away from breeding sites in intact vegetation (NSW Scientific Committee, 2017). This species has also been reported to occur at disturbed sites, although all of these disturbed sites have intact native vegetation surrounding breeding habitat (NSW Scientific Committee, 2017). For this reason, intact vegetation adjacent to and within water bodies is likely to be an important habitat feature for this species. This species has not been recorded within the locality of the Project area (OEH, 2020a), although potential habitat is recognised to occur within the Lake Macquarie LGA (NSW Scientific Committee, 2017). The closest records are over 20 km to the north of the Project area and are from the wallum and wet heath habitats on the Tomago sandbeds (OEH, 2020a). There is suitable habitat for the species within the wetland habitats associated with Belmont Lagoon. This species was not recorded during targeted surveys completed at the site in February 2020.
Square-tailed Kite (breeding)	*Lophoictinia isura*	Moderate	Nest trees	No	Yes	Yes	The Project area lacks suitable breeding habitat as it does not contain any mature trees.
Little Bent-winged Bat (breeding)	*Miniopterus australis*	Very high	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	No	Yes	Yes	The Project area does not contain cave, tunnel, mine, culvert, stormwater pipes or other structures known or suspected to be used for breeding.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Species requiring survey	Habitat degraded	Excluded from further assessment	Justification for exclusion/results of targeted surveys
Large Bent-winged Bat (breeding)	*Miniopterus orianae oceanensis*	Very high	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	No	Yes	Yes	The Project area does not contain cave, tunnel, mine, culvert or other structures known or suspected to be used for breeding.
Southern Myotis	*Myotis macropus*	High	Hollow-bearing trees Land within 200 m of riparian zone Bridges, caves or artificial structures within 200 m of riparian zone	No	Yes	Yes	The Project area does not contain hollow-bearing trees or bridges, caves, stormwater pipes, culverts or artificial structures within 200 m of a riparian zone. While the Project area does constitute land within 200 m of a riparian zone this habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass.
Cotton Pygmy Goose	*Nettapus coromandelianus*	Moderate	Waterbodies, Deep permanent freshwaters on floodplains with floating and submergent vegetation	No	-	Yes	The Project area does not contain permanent freshwater bodies on floodplains with floating and submergent vegetation.
Barking Owl (breeding)	*Ninox connivens*	High	Hollow bearing trees, living or dead trees with hollows	No	-	Yes	The Project area does not contain living or dead trees with hollows suitable breeding.
Powerful Owl (breeding)	*Ninox strenua*	High	Living or dead trees with hollow greater than 20 cm diameter	No	Yes	Yes	The Project area does not contain living or dead trees with hollows suitable breeding.
Eastern Osprey (breeding)	*Pandion cristatus*	Moderate	Living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting	No	Yes	Yes	The Project area does not contain living or dead trees, or artificial structures suitable for nesting.
Squirrel Glider	*Petaurus norfolcensis*	High	-	No	Yes	Yes	Records within the locality are associated with forested habitat and not associated with foredune habitat or wetlands. The Project area does not contain suitable habitat for the species.
Brush-tailed Phascogale	*Phascogale tapoatafa*	High	Hollow-bearing trees.	No	Yes	Yes	The Project area does not contain any hollow-bearing trees.
Tall Knotweed	*Persicaria elatior*	High	Within 50 m of semi-permanent/ephemeral wet areas, swamps and waterbodies	Yes	No	No	Targeted surveys undertaken at appropriate time of year within Project area did not record species. Habitat degraded due to dense *Hydrocotyle bonariensis* ground cover.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Species requiring survey	Habitat degraded	Excluded from further assessment	Justification for exclusion/results of targeted surveys
Brush-tailed Rock-Wallaby	*Petrogale penicillata*	High	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines	No		Yes	The Project area does not occur within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines.
Common Planigale	*Planigale maculata*	High	-	No	Yes	Yes	The Project area does not include micro-habitats favoured by the species, such as hollow logs, under-bark habitat, rocks, cracks in soil, grass tussocks or building debris.
Grey-headed Flying-fox (breeding)	*Pteropus poliocephalus*	High	Breeding camps	No	Yes	Yes	The Project area does not support any camps, as confirmed during on-site survey. The nearest occupied camp (as surveyed in May 2018 under the national Flying-fox monitoring program) is located at Blackalls Park (91 Fennell Crescent), which is on the western side of Lake Macquarie near Toronto (DoE, 2019).
Coast Groundsel	*Senecio spathulatus*	Moderate	-	Yes	Yes	Yes	Bitou Bush is a key threat for this species, as it typically invades preferred foredune habitat and smothers the species. The foredune habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass. There are no records for the species within the locality of the Project area. Searches around the edges of Bitou Bush Scrub were undertaken (within recommended survey months for this species as identified in the TBDC) and no individuals were recorded.
Little Tern (breeding)	*Sternula albifrons*	High	As per mapped areas	Yes	Yes	Yes	Does not occur within area of important habitat as mapped by OEH.
Red-backed Button-quail	*Turnix maculosus*	High	-	No	Yes	Yes	This species inhabits grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas. The Project area does not contain any of these described habitats.
Masked Owl (breeding)	*Tyto novahollandiae*	High	Living or dead trees with hollows greater than 20 cm diameter.	No	Yes	Yes	The Project area does not contain living or dead trees for breeding.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Species requiring survey	Habitat degraded	Excluded from further assessment	Justification for exclusion/results of targeted surveys
Eastern Cave Bat	*Vespadelus troughtoni*	Very high	Caves, within two hundred meters of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles	No	Yes	Yes	Project area does not contain caves and is not located, within two hundred meters of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles.
Terek Sandpiper (breeding)	*Xenus cinereus*	High	As per mapped areas	Yes	Yes	Yes	The Project area does not occur within area of important habitat as mapped by OEH.
Zannichellia palustris	*Zannichellia palustris*	High	Waterbodies, freshwater or slightly brackish estuarine areas	No	Yes	Yes	Project area does not contain permanent waterbodies or freshwater or slightly brackish estuarine areas.

^From the Threatened Biodiversity Data Collection

7.2 Threatened ecological communities

One threatened ecological communities listed under the BC Act occur within the Project area.

PCT 1701 and PCT 783 both align Sydney Freshwater Wetlands in the Sydney Basin Bioregion, which is listed as Endangered under the BC Act.

7.3 Matters of national environmental significance

7.3.1 Threatened ecological communities

No threatened ecological communities listed under the EPBC Act occur within the Project area.

As discussed above, the Project area is surrounded by swamp and wetland vegetation associated with Belmont Lagoon and the greater Lake Macquarie Coastal Wetlands (NSW189). Some of these vegetation types conform to threatened ecological communities associated with coastal floodplains, namely:

- *Swamp Oak Floodplain Forest*, which is listed as Endangered under both the BC Act and EPBC Act
- *Coastal Saltmarsh*, which is listed as Endangered under the BC Act and Vulnerable under the EPBC Act

Neither of these vegetation communities were recorded within the Project area.

7.3.2 Threatened species

Database results indicate that there are approximately 46 threatened species listed under the EPBC Act that have been recorded, or are predicted to occur within the locality of the Project area (see Appendix A). This includes three frog species, 16 bird species, one invertebrate species, eight mammal species and 18 plant species. One threatened species, the White-throated Needletail (*Hirundapus caudacutus*) was recorded during previous surveys of the wider area.

The majority of these species are considered unlikely to utilise the habitats within the Project area for foraging, breeding or roosting. The White-throated Needletail forages aerially and is unlikely to roost within the Project area. Many of the bird species are associated with estuarine habitats (i.e. intertidal mudflats, mangroves, samphire, saltmarsh), rocky beach platforms or reefs, gravelly or coralline shoreline or large waterbodies (such as coastal lagoons or inlets), which are not present in the Project area. There is potential habitat within the wetland habitat that occurs within the Project area for one threatened frog species listed under the EPBC Act (Green and Golden Bell Frog (*Litoria aurea*)). This species is not known to occur in the Belmont area and was not recorded during targeted surveys.

Some of the species assessed have potential to occur in the native vegetation and coastal habitats within the wider locality of the Project area, including the estuarine and permanent freshwater habitats, swamp and wetland vegetation and intertidal habitats to the west of the Project area (Belmont Lagoon, Lake Macquarie, and connected waterbodies to the north and the south of these habitats).

The seaward side of the foredunes to the east of the Project area may provide suitable habitat for shorebirds that roost or nest above the high-tide mark on sandy beaches, although the frequent pedestrian and 4WD traffic through the dunes within the Project area to the beach is likely to deter nesting shorebirds from establishing at this beach front point. A large portion of this area is also the site of planned restoration works as described in Section 2.5, which would improve the habitat for these species as revegetation progresses and public access restrictions are put in place.

7.3.3 Migratory species

Twenty-four migratory species are known or predicted to occur in the locality. These species were assessed and the majority are considered unlikely to utilise the habitats within the Project area (see Appendix A).

The majority of wetland species predicted to occur in the locality are considered to have a low likelihood of utilising the wetland habitat within the Project area as these species prefer permanent wetlands with adjoining waterbodies. One species, Latham's Snipe (*Gallinago hardwickii*) is known to inhabit ephemeral wetlands and has been assessed as having moderate potential to occur in the Project area, although this species would be more likely to utilise the higher quality habitats located within the nearby Belmont Lagoon, Lake Macquarie and connected waterbodies to the north and south of the Project area.

Many migratory species do not breed in the southern hemisphere although a few species are known to nest on sandy beaches on the east coast of Australia (e.g. Little Tern and Hooded Plover). The seaward side of the foredunes to the east of the Project area may provide suitable habitat for shorebirds that roost or nest above the high-tide mark on sandy beaches, although the frequent pedestrian and 4WD traffic through the dunes within the Project area to the beach is likely to deter nesting shorebirds from establishing at this beach front point. Of the other migratory shorebirds that are known or predicted to occur in the locality the majority are typically associated with habitat features such as intertidal mudflats, estuarine environments, rock platforms, saltmarsh, mangroves or seagrasses, none of which are present within the Project area.

A number of migratory species associated with forested habitat were also assessed and discounted as occurring due to the absence of any forest habitat within the Project area.

The remaining migratory species assessed are almost exclusively aerial in habit, and are unlikely to utilise the habitats within the Project area. As noted above, the White-throated Needletail (also listed as a migratory species) forages aerially and is unlikely to roost within the Project area.

Important habitats for migratory species

Important habitats in Australia for migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important. The widely accepted and applied approach to identifying internationally important shorebird habitat throughout the world has been through the use of criteria adopted under the Ramsar Convention on Wetlands, which specifies that (DEE, 2017b):

- Internationally important habitats regularly support:
  - One per cent of the individuals in a population of one species or subspecies of waterbird OR
  - A total abundance of at least 20 000 waterbirds

- Nationally important habitats regularly support:
  - 0.1 per cent of the flyway population of a single species of migratory shorebird OR
  - 2000 migratory shorebirds OR
  - 15 migratory shorebird species

The EPBC Act significant impact guidelines (DotE, 2013) also define an area of important habitat for a migratory species as:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- Habitat that is of critical importance to the species at particular life-cycle stages, and/or
- Habitat utilised by a migratory species which is at the limit of the species range, and/or
- Habitat within an area where the species is declining:
  - The habitat within the Project area is unlikely to support migratory bird species (other than potentially Latham's Snipe) and does not constitute important habitat for any migratory species (as described above).

The BAM calculator identifies a number of migratory species that have potential to occur in the Project area. Offsets for these species are required if the Project occurs within areas mapped by OEH as being important habitat for these species. An enquiry was submitted to the BCD to determine if important habitat for any migratory species identified as potentially occurring has been mapped within the Project area. BCD confirmed that the Project area does not include any mapped important habitat for any migratory species and as such these species were removed as potential candidate species within the habitat suitability tab of the BAM credit calculator. Predicted and candidate migratory species that were removed from the BAM credit assessment owing to the absence of mapped important habitat include:

- Curlew Sandpiper (*Calidris ferruginea*)
- Great Knot (*Calidris tenuirostris*)
- Broad-billed sandpiper (*Broad-billed sandpiper*)
- Black-tailed Godwit (*Limosa limosa*)
- Terek Sandpiper (*Xenus cinereus*)

7.3.4 Wetlands of international importance (Ramsar wetlands)

No Ramsar wetlands have been identified to occur within the Project area or within the locality. The closest Ramsar wetland is the Hunter Estuary Wetlands, located over 15 km to the north of the Project area.

8. Impact assessment

8.1 Avoidance of impacts on biodiversity values

A number of potential locations were initially proposed as the location of the drought response desalination plant. After extensive workshopping and assessment, the Belmont WWTW site was determined to present the lowest level of technical, environmental, social, commercial and financial risk. In particular, the site is preferred given that:

- There is sufficient cleared land to accommodate the desalination plant.
- There is existing infrastructure including an access road and the WWTW ocean outfall.
- There would be a reduced cost given that the existing access road and WWTW ocean outfall can be utilised.
- There is an ecological benefit due to reduced overall construction and operational impacts that would otherwise result from the installation of new infrastructure.

The Project is located primarily in non-native vegetation comprising Bitou Bush Scrub and exotic grasslands. Construction of the Project would minimise direct clearing of native vegetation and threatened species habitat. Access to the Project area will be along Ocean Park Road and will not require clearing of native vegetation. The existing access road to the Project area has no formal drainage infrastructure.

No aquatic habitat will be directly impacted by the Project and aquatic habitats associated with Belmont Lagoon are unlikely to be impacted by the Project as they occur at a distance of at least 120 m from the Project area and are buffered by a corridor of swamp forest, wet heath and bushland vegetation.

Permanent impacts to wetland and swamp vegetation in the west of the Project area would be largely avoided as they would be limited to the removal of a very small area of vegetation to allow for the installation of three power poles. There may also be some temporary impacts to wetland vegetation associated with the connection of electricity cable between the new poles as this cable would be pulled by hand through a small area of wetland vegetation with may result it temporary disturbance associated with the trampling of vegetation.

8.2 Mitigation of impacts on biodiversity values

8.2.1 Key potential impacts

There is potential for construction of the Project to result in indirect impacts to native swamp forests and wetland vegetation adjacent to the Project area. This includes:

- Mobilisation of sands from the dunes due to onshore winds during the construction period, when vegetation would be removed and earthworks would take place. Deposition of sand to west of the Project area could smother some areas of native vegetation in adjacent/nearby wetland and swamp habitats associated with Belmont Lagoon.
- Further spread of highly invasive weed species along the foredunes and into adjacent native vegetation during construction, namely high threat weed species recorded within the Project area. This includes Bitou Bush, Lantana, Coolatai Grass, Kikuyu and Coastal Morning Glory.
- Unintended damage caused by construction plant and machinery to native vegetation adjacent to the Project area.

- Increased surface run-off from construction of hardstand areas into adjacent wetland and swamp vegetation, with potential to transport pollutants or contaminants from the Project area.
- Potential introduction, or further spread of pathogens into adjacent wetland and swamp vegetation, particularly Chytrid fungus (*Batrachochytrium dendrobatidis*) as it is found in soil and water.

8.2.2 Mitigation measures

A Construction Environmental Management Plan (CEMP) would be implemented for the construction phase of the Project. The CEMP would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures, including the procedures outlined below. The proposed mitigation measures would include environmental safeguards for protection of neighbouring areas and waterways in accordance with relevant policy documentation and Government guidelines.

In order to address the potential impacts of the Project on biodiversity as discussed above, the mitigation and management measures outlined in Table 8-1 would be implemented as part of the CEMP for the site.

Table 8-1 Mitigation measures (construction)

Hazard	Mitigation	Timing	Responsibility
General	Site induction: All workers will be provided with an environmental induction prior to starting working on-site. This will include information on the ecological values of the area surrounding the Project area, key weed threats and measures to be implemented to protect biodiversity, particularly focussing on erosion management, and potential weed and pathogen spread.	Prior to works commencing	Construction contractor
Proximity of adjacent native vegetation	Limit disturbance of vegetation to the minimum necessary to undertake the works.	Prior to works commencing	Construction contractor
	Prior to the commencement of any work adjoining areas of native vegetation, clearly delineate the construction area marking the limits of clearing to avoid unintended clearing of adjacent native vegetation. Fencing should be designed to allow fauna to exit the site during clearing activities.	Prior to clearing/daily inspections of exclusion zones during works in area.	Construction contractor and qualified ecologist
	Install appropriate temporary fencing during the construction phase to exclude native ground fauna from adjacent native habitat entering construction areas (whether they are recorded during pre-construction survey or not). Fencing should remain in place until the completion of all construction activities including revegetation.	After completion of clearing activities/ construction works	Construction contractor
	Stockpiles of fill or vegetation should be placed within existing cleared areas (and not within areas of adjoining native vegetation).	Prior to clearing/ construction works	Construction contractor
	Electrical cable would be hand pulled through wetland areas in the west of the Project area rather than utilising mechanical methods to roll out the cable.		
Soil erosion, sedimentation and runoff	Sediment fences should be installed to prevent transfer of sediments into adjacent vegetation.	Prior to clearing/ construction works	Construction contractor
	Minimise the generation of surface runoff on hard stand areas as described within the mitigation measures in the Stormwater Assessment (Appendix G of the Environmental Amendment Report).	Prior to clearing/ construction works	Construction contractor
	All stockpiled material should be stored in bunded areas or otherwise appropriately secured from unintentional movement into adjacent native vegetation.	During construction	Construction contractor
	Spill kits would be made available to construction vehicles.	During construction	Construction contractor
	A management protocol for accidental spills would be put in place. Mitigation measures including the preparation of an incident emergency spill plan would be developed and implemented.	Before construction	Construction contractor
	Soil erosion to be managed with standard erosion and sediment control measures in accordance with the Blue Book and as prescribed by the CEMP.	During construction	Construction contractor

Hazard	Mitigation	Timing	Responsibility
Acid sulfate soils	Additional Acid Sulphate Soil sampling would be completed during the detailed design phase to confirm the risk of exposure of acid sulphate soils due to drawdown. If this sampling identifies that there is a risk associated with an acid sulphate soil a management plan should be prepared as part of the CEMP in accordance with the Acid Sulfate Soil Laboratory Methods and Manual (Stone *et al.*, 1998). Include the following as a minimum: • Method for spoil material testing to confirm presence of ASS in excavated spoil during construction • Conduct laboratory testing to calculate and verify treatment of ASS spoil material if it is to be treated on-site • Locate ASS treatment area within the proposed drought response desalination plant side, which is already disturbed and is outside of flood liable land • Measures to manage any stockpiles of ASS materials, including bunding and cover to minimise leachate • Supervision and certification of treatment prior to removal from treatment areas for re-use	Prior to works commencing	Construction contractor
Introduction and/ or spread of weeds and pathogens	Develop a weed species management sub-plan as part of project CEMP to manage weeds and pathogens during the construction and operational phase of the proposal.	Prior to clearing/ construction works	Construction contractor
	The location and extent of any priority and/or high threat environmental weeds within the site will be identified by a suitably qualified ecologist during pre-clearance surveys. The introduction and spread of weed species will be minimised by restricting access to areas of native vegetation and communicating the responsibilities of all Project personnel at site inductions and during regular toolbox meetings. All priority weeds identified on the site will be controlled and removed in accordance with the requirements of the *Biosecurity Act 2015* and Council's relevant Weed Control Manuals: Appropriate pesticides will be applied if required and a record of such application made in the pesticide application register. All noxious and environmental weeds will be cleared and stockpiled separately to all other vegetation, removed from site and disposed of at an appropriately licenced disposal facility. When transporting weed waste from the site to the waste facility, trucks must be covered to avoid the spread of weed-contaminated material. Disposal must be documented, and evidence of appropriate disposal must be kept.	Prior to clearing/ construction works	Construction contractor and qualified ecologist
	All machinery entering the site must be appropriately inspected, and washed down and disinfected as required prior to work on site to prevent the potential spread of weeds, Cinnamon Fungus (*Phytophthora cinnamomi*) and Myrtle Rust (*Pucciniales fungi*) in accordance with the national best practice guidelines for Phytophthora (O'Gara *et al.*, 2005) and the Myrtle Rust factsheet (DPI, 2015) for hygiene control.	Prior to any plant or machinery being brought onto the site	Construction contractor
	Incorporate control measures in the design of the Project to limit the spread of weed propagules off site. Sediment control devices, such as sedimentation fences, would assist in reducing the potential for spreading weeds.	Prior to clearing/ throughout construction works	Construction contractor
	All machinery entering the site must be appropriately inspected, and washed down and disinfected to prevent introduction or spread of Chytrid fungus as per the Office of Environment and Heritage Hygiene protocol for the control of disease in frogs (DECC, 2008b).	Prior to clearing/ throughout construction works	Construction contractor

Hazard	Mitigation	Timing	Responsibility
	Personal equipment such as boots and tools of all workers undertaking work within the wetland vegetation must be inspected, and washed down and disinfected as required prior to work on site to prevent the potential spread of weeds, Cinnamon Fungus (*Phytophthora cinnamomi*) and Myrtle Rust (*Pucciniales fungi*) in accordance with the national best practice guidelines for Phytophthora (O'Gara *et al.*, 2005) and the Myrtle Rust factsheet (DPI, 2015) for hygiene control.	Prior to clearing/ throughout construction works	Construction contractor
	Personal equipment such as boots and tools of all workers on site must be inspected, and washed down and disinfected to prevent introduction or spread of Chytrid fungus as per the Office of Environment and Heritage Hygiene protocol for the control of disease in frogs (DECC, 2008b).	Prior to clearing/ throughout construction works	Construction contractor
Wind erosion	Establish all erosion and sediment control measures before ground disturbance work commences and these are to remain in place until all surfaces have been fully restored and/or stabilised.	Prior to construction commencing	Construction contractor
	Ensuring work areas a kept damp (not wet) to manage wind erosion.	During construction phase and after any significant rainfall event	Construction contractor
	Limiting traffic movements on disturbed areas.	During construction	Construction contractor
	Exposed areas that is susceptible to wind generated dust particles, shall be progressively vegetated and watered. Where vegetation is not yet possible, dust suppression by constant watering shall be provided.	During construction	Construction contractor
	Installation of a 40% porous, open weave barrier fence as a wind-break on the eastern side of the Project area.	Prior to construction commencing	Construction contractor
	Inspect and maintain controls regularly to ensure effectiveness over the entire duration of the project, and clean out before 30% capacity is remaining.	During construction	Construction contractor
	Provide a clean water diversion around disturbed areas.	Prior to construction commencing	Construction contractor
	Procedures for how any sediment laden water would be treated prior to leaving the Project area.	Prior to construction commencing	Construction contractor
	Outline of the process for stabilisation and successive revegetation of all disturbed areas.	Prior to construction commencing	Construction contractor
	Maintenance and inspection program and checklist including conditions that would trigger watering of revegetated areas and requirement for reseeding.	During construction	Construction contractor

Hazard	Mitigation	Timing	Responsibility
Fauna encounters during vegetation clearing	The construction contractor is to contact the Project ecologist for advice if any unexpected fauna are found during the construction period (i.e. before, during or following clearing of native vegetation where the Project ecologist is not on site).	During clearing	Construction contractor
	A procedure to manage unexpected threatened species finds will be included in the CEMP and is to be implemented in the event of any unexpected threatened species finds during clearing.	Prior to construction commencing	Construction contractor/Qualified ecologist
	A post-clearing report will be prepared documenting all animals that are handled, or otherwise managed, within the site. Data to be recorded includes: • Date and time of the sighting and details of the observer • Species • Number of individuals recorded • Adult/juvenile • Condition of the animal (living/dead/injured/sick) • Management action undertaken (e.g. captured, handled, taken to vet) • Results of any management actions (e.g. released, euthanised, placed with carer)	Post clearing	Construction contractor/Qualified ecologist

8.3 Residual impacts

8.3.1 Direct impacts

The Project would remove or disturb approximately 9.9 ha of vegetation, of which 0.51 ha is comprised of native vegetation and 9.39 ha is comprised of non-native vegetation, that includes Bitou Bush Scrub and exotic grassland (see Table 8-2).

The disturbance to native vegetation is likely to be an overestimate as it has been assumed that the entire Project area would be cleared when the removal of native vegetation would be more likely be limited to a very small area (approximately 5 m X 5 m) around the base of three power poles that will be installed to the west of Ocean Park Road. There would also be a relatively minor and temporary disturbance the wetland and swamp vegetation associated with the hand pulling of electricity cable between the proposed new poles.

Table 8-2 Direct clearing impacts within the Project area

Vegetation type	Extent within Project area (ha)
PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	0.08
PCT 1204 Spinifex Beach strand grassland of the Sydney Basin Bioregion and South East Corner Bioregion	0.29
PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	0.12
PCT 783 Coastal freshwater swamps of the Sydney Basin Bioregion	0.02
Bitou Bush Scrub	4.66
Exotic grassland	4.73
Total area (ha)	9.9

8.3.2 Indirect impacts

The Project has potential to have indirect impacts on adjacent native swamp and wetland vegetation during the construction of the Project. The adjacent vegetation includes community types that are threatened under the BC Act or EPBC Act.

The potential indirect impacts are largely associated with potential sediment and erosion, wind erosion hazards and disturbance, spread and/or introduction of high threat and priority weed species during vegetation clearing and earthworks and are discussed briefly in the following sections. Potential for impacts on aquatic habitats and injury to any native fauna that may be present during construction are also possible and are also discussed briefly below.

Erosion and sedimentation

As the Project area is located adjacent to the Belmont Wetland Complex there is potential for sedimentation to occur within these areas. The installation of the electricity poles within the Project area may mobilise the sandy sediments and enter the adjacent aquatic environments. This can cause smothering of native vegetation, as discussed below, and impact on aquatic fauna which may inhabit these wetland areas.

Measures to mitigate sedimentation within and adjacent to the Project area would be implemented, including those listed in Table 8-1.

Smothering of adjacent native vegetation due to mobilisation of sand from wind erosion

Dune vegetation acts to trap windblown sand and traps it on the foredune. The loss of dune vegetation often triggers dune erosion as beach sand is easily mobilised by high-speed winds, and large amounts of sand can be transported away from the foredune. Deposition of mobilised sands downwind of the foredunes can smother the surrounding vegetation.

Measures to limit wind erosion would be implemented, including those listed in Table 8-1. Furthermore, planned dune restoration works of the Belmont WWTW site would assist with the future protection of the WWTW and potential drought response desalination plant site as well as providing a valuable coastal ecosystem (see Section 2.5).

Introduction and spread of high threat or priority weeds and pathogens

Weed invasion

Weed species are effective competitors for food and habitat resources and have the potential to exclude native species and modify the composition and structure of vegetation communities.

The Project area is dominated by high threat weeds, identified in Section Table 6-9 of this BDAR. Disturbance associated with vegetation clearing, earthworks, vehicle traffic and general day to day operations of the Project during construction increases the potential for the spread, introduction and establishment of these high threat weed species.

To help mitigate the risk of weed spread to nearby native vegetation, measures would be implemented under a weed species management plan, which would form a sub-plan to the CEMP.

Pathogens

Construction activities within the Project area also have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into adjacent native vegetation through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can wipe out entire populations once introduced into an area.

The potential for impacts associated with these pathogens is relatively low, given the fairly disturbed and modified nature of the Project area. Diseases and pathogens can be introduced or spread to site via dirt or organic material attached to machinery, vehicles, equipment and employees. To help mitigate the risk of pathogens being brought onto and/or spread through the site all machinery brought to site will be washed down and inspected to be free of soils, seeds and other organic material in accordance with measures prescribed under the CEMP.

Potential impacts on aquatic habitats, including key fish habitat

Direct impacts on aquatic environments

The Project is unlikely to have direct impacts on aquatic habitats or riparian vegetation. There are no aquatic or riparian habitats within the Project area itself, either at the proposed desalination plant site or the power connection site.

Indirect impacts on water quality and adjacent sensitive receivers

The Project has potential to impact on water quality within wetland habitats and swamp vegetation during construction within and adjacent to the Project area. There is potential for accidental spillage or leaks of hydrocarbons or chemicals during works or from any stored hazardous materials in the compound areas, which could have adverse impacts on surrounding sensitive wetland habitats and aquatic environments, without appropriate pollution controls. Mitigation measures, including the preparation of an incident emergency spill plan, would be developed and implemented before any construction commences. Concrete bunds would be permanently established around chemical storage areas.

Sediment-laden runoff to low-lying wetland and swamp areas within and adjacent to the Project area can cause siltation of wetland areas, altering water quality and adversely affecting aquatic life as well as wetland habitats. The Project is located in an area considered to have a low erosion potential due to water (note this is differentiated from wind erosion potential). Topographically the Project area is in a relatively low lying flat area and the surface has been modified to form evaporation ponds (which are now decommissioned) and access tracks and roads. Runoff from the west of the Belmont WWTW access road (i.e. Ocean Park Road) generally drains to Belmont Lagoon, while runoff from the east of the Belmont WWTW access road is directed to the lowest point at the Belmont WWTW, at the base of the existing sand dunes along Nine Mile Beach where it infiltrates into the sandy soils (see Section 7.2 of the EIS main report). The low-lying topography and the proximity to drainage lines within the wetlands to the west, results in moderate sedimentation risks on sensitive receivers.

Potential sedimentation risks would be managed through the implementation of soil and water management measures, and include the use of appropriate erosion and sediment control devices and pollution control methods prescribed under a CEMP. The use of crushed gravel for hard stand areas would also limit sediment-laden runoff from leaving the site.

Acid sulfate soils

Disturbance of acid sulfate soils could also potentially impact aquatic habitats. The disturbance of acid sulfate soils can form sulphuric acid when soils react with oxygen in the air. Sulphuric acid can leach into surrounding environments, causing soils to become very acid and toxic and impacting waterways and soil health resulting in environmental and agricultural degradation.

Although no actual acid sulfate soil materials were recorded within the Project area, soils sampled presented some form of potential for acid sulfate soils (see Section 7.1 of the EIS main report). Due to the relatively close proximity of some areas of construction to drainage lines and coastal wetlands, acid leachate and toxic metals could be released into waterways with associated impacts. The acid and heavy metals can have damaging effects on the receiving environment, including reducing survival and growth rates for aquatic flora and fauna, corrosion of materials and health impacts to humans and animals from toxic water and dust. However, the effects this would have on the environment are governed by the volume of disturbance and the connection of acidic leachate with natural water bodies. As noted above, the flat topography of the Project area, as well as the lack of drainage lines flowing into the wetlands to the west, limits the risk of acidic leachate reaching wetland habitats to the west of the Project area. Potential risks from acid sulfate soils will be managed under an acid sulfate soil management plan prepared as part of the CEMP and as described in Section 7.1.4 of the EIS main report.

Potential for fauna injury and mortality during construction

As described in this BDAR, the Project area provides very limited habitat for native fauna. However common and mobile species may move through the Project area from time to time and most of the fauna species likely to be observed within the Project area are bird species.

The risk of injury or mortality of individual fauna during clearing activities is likely to be low. More mobile native fauna such as native birds that may be sheltering in the Bitou Bush Scrub within the Project area are likely to evade injury during construction activities. Less mobile fauna such as nestlings and terrestrial fauna such as lizards, frogs and snakes are more at risk of injury and mortality.

Notwithstanding, recommendations have been made in Table 8-1 above to minimise the risk of vegetation clearing activities resulting in the injury or mortality of any fauna encountered on site.

8.4 Prescribed impacts

The following prescribed biodiversity impacts of relevance to the Project have been considered in this BDAR with reference to Section 9.2 of the BAM as follows:

- 'Assessment of impacts on habitat of threatened species or ecological communities associated with non-native vegetation' through consideration of impacts associated with removal of Bitou Bush and exotic grassland.
- 'Assessment of the impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC' through consideration of impacts associated with potential injury or mortality of fauna during construction.
- 'Assessment of the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities' through consideration of indirect impacts on adjacent wetlands, swamp forests, and mapped Coastal Wetlands.
- 'Assessment of the impacts of the development on movement of threatened species that maintain their life cycle' through consideration of potential injury or mortality of fauna during construction.

Measures to minimise these prescribed impacts are described in Table 8-1 and Section 8.3.2.

Given the scale and context of the Project, there is unlikely to be any substantial impacts on threatened species and their habitats beyond those associated with the removal of a very small area of native vegetation and potential indirect impacts on adjacent vegetation. There is no evidence that the vegetation and other habitat resources in the Project area would have any particular value to any threatened biota. The Project is unlikely to result in any other significant direct or indirect impacts to threatened biota including impacts on aquatic habitat in the vicinity of the Project area.

8.5 Potential serious and irreversible impacts (SAII)

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles set up in Section 6.7 of the BC Regulation.

The principles are aimed at capturing impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales. These include impacts that will:

- Cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
- Further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
- Impact on the habitat of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
- Impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

A set of criteria have been developed and are included in the *OEH Guidelines to assist a decision-maker to determine a SAII* (OEH, 2017c). Threatened biota that meet the criteria under one or more of the above principles have been identified as SAII entities and are listed in the fore mentioned document. Each potential SAII entity has an impact threshold identified which can be used to help determine if a development will result in SAII.

The Project area intersects a small area that has been mapped as important habitat for Swift Parrot (draft mapping received from OEH on 1 March 2020) (refer to plate 1 below). Impacts to important habitat for the Swift Parrot could result in SAIIs.

Vegetation within the Project area mapped as important Swift Parrot habitat (draft) consists of a patch of PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion as well as thickets dense Bitou bush. Swift Parrots are migratory species that breed in Tasmania during spring and summer and migrate to south-eastern Australia in the autumn and winter months. On main land Australian winter flowering eucalypts from which they forage nectar and lerps, are important for helping to sustain the species during their migration back to Tasmania. There are no trees within the Project area and therefore no foraging resources for Swift Parrot. Assessor's judgement has therefore been used to classify the habitat within the Project area as significantly degraded and as such the Swift Parrot is not considered a candidate SAII species likely to occur within the Project area.

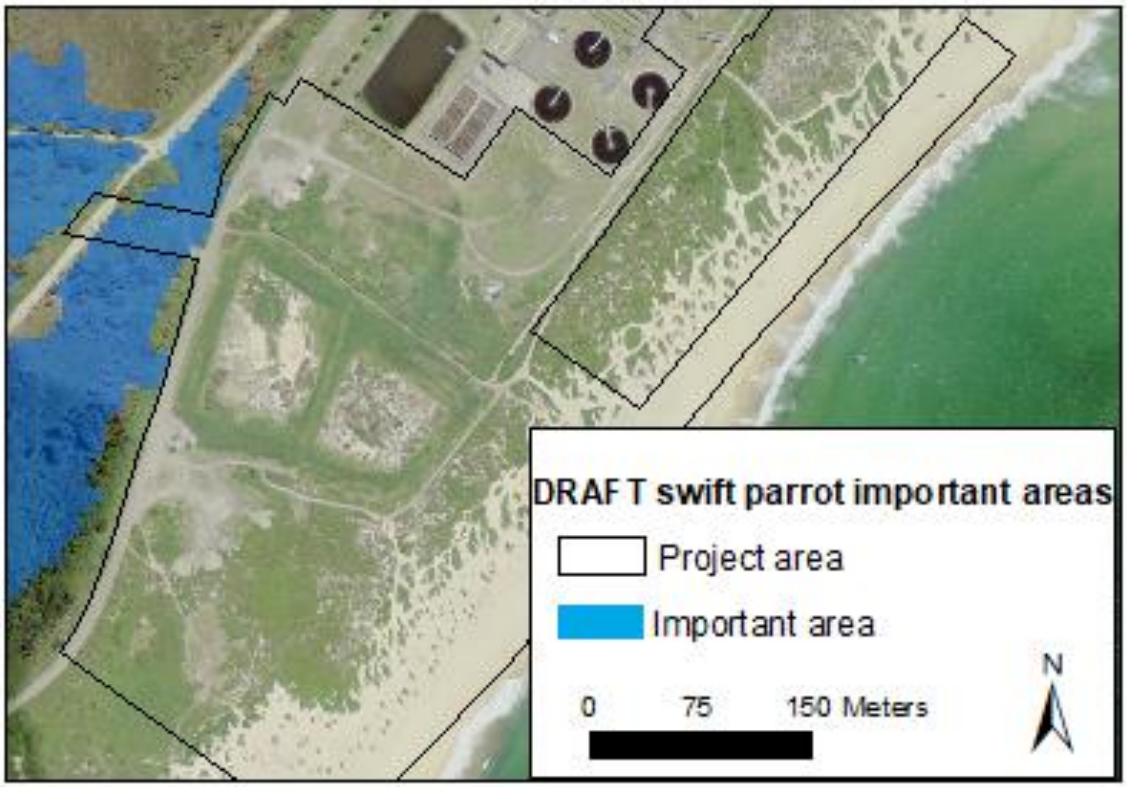


Plate 1 Draft Swift Parrot important areas mapped by OEH within the Project area

The Project area does not contain or support any other habitat for potential SAII entities and no further assessment is required under Section 10.2 of the BAM (OEH, 2017a).

8.6 Potential impacts on groundwater dependent ecosystems

Groundwater level monitoring data indicates that the water table levels in the Project area currently vary between 0.3 metres and 1.2 metres below ground level. Analytical groundwater calculations undertaken for this Project predicts that groundwater drawdown outside excavations would be minimal during construction due to the use of sheet piling or cut off walls. There is also no drawdown anticipated during operation. Any minor drawdown that may occur local to excavations during construction is unlikely to impact groundwater receptors, including registered bores and terrestrial and aquatic groundwater dependent ecosystems, due to the sufficient distance between these receptors and the proposed excavations.

The drawdown during construction has potential to affect the cover of the understorey vegetation for the period of the drawdown, as sedges and various ground ferns characterising coastal swamp and heath forests are generally influenced by the degree of waterlogging in the soils. However, the minor drawdown is considered unlikely to significantly impact on the composition or the persistence of such vegetation communities, particularly in relation to swamp forests, which have a widespread distribution in the locality and is likely to occur over a range of water table levels.

8.7 Consideration of MNES

As discussed in Section 7.3, there are no MNES entities (threatened ecological communities, threatened species, migratory species) considered likely to occur within the Project area. Direct impacts on MNES caused by the construction and operation of the Project are therefore considered to be unlikely.

The Project has the potential to indirectly impact MNES including native swamp forests and coastal saltmarsh adjacent to the proposed drought response desalination plant site. The Project would not affect any important habitat for migratory waders. Potential indirect impacts on beach and wetland habitat would have a negligible impact on potential habitat for these highly mobile species and other threatened fauna species that may occur in the locality from time to time. Potential indirect impacts include those discussed in Section 8.3.2 and are proposed to be mitigated through implementation of a number of measures during construction (see Section 8.2).

Given the degraded habitat present in the Project area, lack of habitat for MNES, and limited potential for indirect impacts on MNES, no assessments of significance were considered necessary. The Project is unlikely to have a significant impact on any MNES, and Referral of the project to the Commonwealth Minister for the Environment is not considered necessary.

9. Offset and credit summary

9.1 Impacts requiring offset

Impacts associated with the Project that will require offsetting include the removal or disturbance of 0.51 ha of native vegetation and associated habitat for threatened biota. Impacts within the Project area that require biodiversity offsets are shown on Figure 9-1.

9.2 Ecosystem credits

The data collected during fieldwork and GIS mapping was entered into version 1.2.2 of the BAM credit calculator as a 'Development Assessment' to determine the number and type of biodiversity credits that would be required to offset impacts of the Project. The Biodiversity credit report is included in Appendix F and is summarised below.

There are 0.51 hectares of native vegetation and threatened species habitat in the Project area will be impacted and require offsetting. We have assumed that all vegetation and habitat resources in the Project area would be removed and so the 'future vegetation integrity score' was entered as 0.

Ecosystem credits that would be required to offset the impacts of the Project are shown in Table 9-1.

Table 9-1 Ecosystem credits required to offset impacts of the Project

Plant community type	Area (ha)	Vegetation integrity loss	BC Act status	Ecosystem credits required
PCT 772 Coast Banksia-Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	0.08	19.1	Not listed as a TEC	1
PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	0.12	65.3	Not listed as a TEC	4
PCT 783 Coastal Freshwater Swamps of the Sydney Basin Bioregion	0.02	47.7	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	1
Total	**0.51**			**6**

9.3 Species credits

No species credits would be required to offset impacts of the Project.

9.4 Impacts not requiring offset

The impacts associated with the Project that require assessment but do not require offsetting include the removal of approximately 0.29 hectares of PCT 1204 Spinifex beach strand grassland of the Sydney Basin Bioregion and South East Corner Bioregion. The BAM calculator determined that this community has a vegetation integrity score of less than 17 and therefore does not require offsetting with ecosystem credits as outlined in Table 9-2.

Table 9-2 Impacts not requiring offset

Vegetation type	PCT name entered into BAM calculator	Area	Current vegetation integrity score	Future vegetation integrity score	Status	Ecosystem credits required
Grassland	PCT 1204 Spinifex beach strand grassland of the Sydney Basin Bioregion and South East Corner Bioregion	0.29	2.4	0	Not listed	0

9.4.1 Impacts not requiring further assessment

A total of 14. 68 ha, which includes 4.66 ha of Bitou Bush Scrub, 4.73 ha of exotic grassland and 5.29 ha of cleared land was not assessed for ecosystem or species credits.

9.5 EPBC Act offset requirements

DAWE administers an environmental offset policy under the EPBC Act (DSEWPaC, 2012). Environmental offsets are only required for controlled actions where residual impacts are considered to be significant.

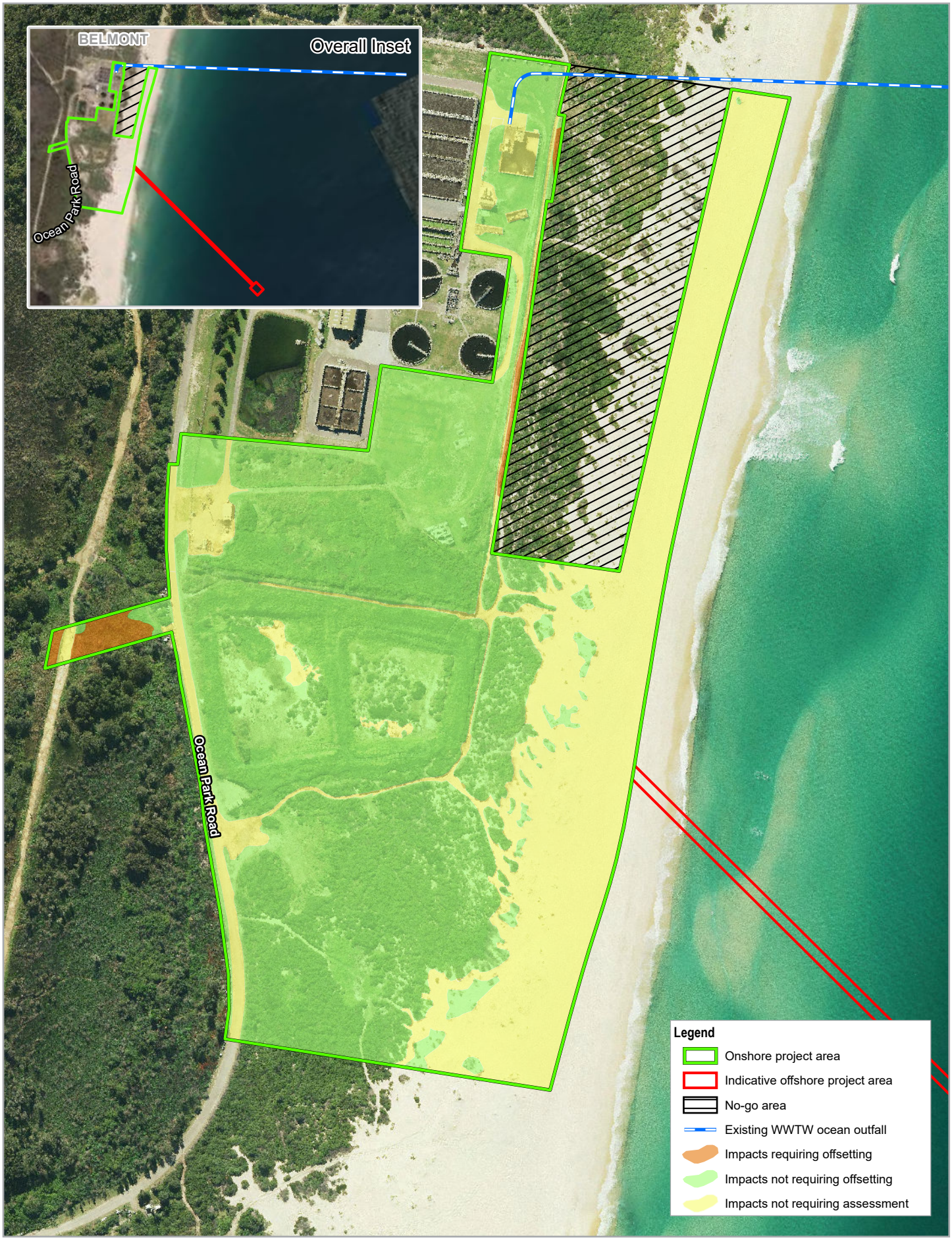
As discussed in Section 8.7, given the degraded habitat present in the Project area, lack of habitat for MNES, and limited potential for indirect impacts on MNES, the Project is unlikely to have a significant impact on any MNES, and no environmental offsets are required under the EPBC Act.

9.6 FM Act offset requirements

DPI generally enforces a ‘no net loss’ habitat policy as a permit condition or condition of consent. Achieving no net loss of key fish habitat may involve habitat rehabilitation or provision of habitat compensation on a minimum 2:1 basis.

As described in Section 6.5 the Project area does not contain freshwater or estuarine habitats, and does not contain key fish habitat as defined under the in the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013). Whilst the Project area occurs on the margins of mapped key fish habitat (DPI, 2007) no permanent waterbodies occur within the Project area and therefore there is no suitable habitat for fish species.

There are limited indirect impacts on key fish habitat to the east and west of the drought response desalination plant; these potential indirect impacts will be managed through the implementation of mitigation measures under a CEMP. Considering this, the Project is unlikely to result in a net loss of key fish habitat and no offsetting under the FM Act is required.



Paper Size ISO A4

0 25 50 75 100

Meters

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

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GHD

Hunter Water Corporation
Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Impact summary

Figure 9-1

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Data source: HWC: Aerial Imagery, 2018 public_NSW_Imagery: © Department of Customer Service 2020public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

10. Conclusion

Hunter Water is proposing to construct a drought response desalination plant at the Belmont WWTW, off Ocean Park Road in Belmont. The Project will be assessed as a State Significant Infrastructure (SSI) and this Biodiversity Development Assessment Report (BDAR) has been prepared to support an Environmental Impact Statement (EIS) and subsequent Environmental Amendment Report for the Project.

This BDAR has been completed in accordance with the Biodiversity Assessment Method (BAM) and includes:

- Desktop assessment to describe the existing environment and landscape features of the Project area and to identify the suite of threatened biota potentially affected by the Project.
- Field survey to describe the biodiversity values of the Project area and surrounding lands and to determine the likelihood of threatened biota and their habitats occurring in the Project area or being affected by the Project.
- BAM calculations using the credit calculator version 1.2.7.2 to quantify the biodiversity impacts of the Project following implementation of measures to avoid and minimise impacts and to determine the biodiversity credits that would be required to be retired to offset the residual impacts of the Project.

The BDAR also assesses potential impacts on MNES (threatened biota and migratory species) as well as freshwater biodiversity values.

The Project is located on the foredunes and hindunes of Nine Mile Beach and includes a very small area of wetland and native swamp habitat adjacent to Belmont Lagoon. These habitats are mapped as Coastal Wetlands under the Coastal Management SEPP and as Key Fish Habitat, and are identified as forming part of the nationally important wetland, Lake Macquarie Coastal Wetlands (NSW189). The swamp and wetland vegetation within Project area include threatened ecological communities listed under the BC Act and provides potential habitat for a small number of threatened species.

The majority of the Project area has been historically cleared and has previously been used for the WWTW evaporation ponds (now decommissioned but still visible). The Project area continues to be accessed by 4WD drives and pedestrians, including dog-walkers. The dune is presently in poor condition, containing hummocks caused by vehicle tracks. There has been a progressive loss of native vegetation on the dunes, and the native vegetation along the foredunes is now largely replaced by *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) scrub and exotic grassland. These species represent high threat and priority weed species and have substantially degraded the habitats within the Project area. Threatened biota and migratory species are assessed as being unlikely to occur within, or to utilise the habitats within the Project area.

The Project avoids direct disturbance of native vegetation and threatened species habitat other than a very small area of native vegetation that would need to be removed to install three electricity poles. The direct impacts of the Project would comprise the clearing of approximately 0.5 ha of native vegetation and 9.39 ha of non-native vegetation. Two of the PCTs that occur in the Project area are commensurate with the EEC listed under the BC Act as Sydney Freshwater Wetlands in the Sydney Basin Bioregion. The Project would impact on 0.12 ha of this EEC.

The Project also has potential to have indirect impacts on sensitive receivers in the surrounding land, particularly during construction. Potential indirect impacts include:

- Mobilisation of sands from the dunes due to onshore winds during the construction period, when vegetation would be removed and earthworks would take place. Deposition of sand to west of the Project area could smother native vegetation in adjacent/nearby wetland and swamp habitats associated with Belmont Lagoon.
- Further spread of highly invasive weed species along the foredunes and into adjacent native vegetation during construction, namely high threat weed species recorded within the Project area. This includes *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush), *Lantana camara* (Lantana), *Hyparrhenia hirta* (Coolatai Grass), *Cenchrus clandestinus* (Kikuyu) and *Ipomoea cairica* (Coastal Morning Glory).
- Increased surface run-off from construction of hardstand areas into adjacent wetland and swamp vegetation, with potential to transport pollutants or contaminants from the Project area.
- Potential introduction, or further spread of pathogens into adjacent wetland and swamp vegetation, particularly Chytrid fungus (*Batrachochytrium dendrobatidis*) as it is found in soil and water.

To mitigate the potential indirect impacts of the Project on adjacent biodiversity values, a number of mitigation and management measures have been identified, which would be implemented as part of the construction environmental management plan for the site. These mitigation measures would be augmented by dune restoration works that do not form part of the Project but would benefit the Project by assisting to manage and minimise wind erosion risks and improve habitat for native species.

The biodiversity credits that are required to be retired to offset the impacts of the proposal include:

- One (1) ecosystem credit to offset impacts to 0.08 ha of PCT 772 Coast Banksia- Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion
- Four (4) ecosystem credits to offset impacts to 0.12 ha of PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
- One (1) ecosystem credit to offset r impacts to 0.02 ha of PCT 783 Coastal Freshwater Swamps of the Sydney Basin Bioregion

No key fish habitat would be directly impacted, and no offsets are therefore required under the FM Act.

The proposal will not result in a significant impact on threatened biota or migratory species listed under the EPBC Act and assessed in this report and Referral of the proposal to the Australian Minister for the Environment is not considered necessary.

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Appendices

Appendix A – Consistency with minimum information requirements for Biodiversity Development Assessment Reports

The minimum requirements for Biodiversity Development Assessment Reports have been addressed in this report as outlined below.

The minimum requirements for Biodiversity Development Assessment Reports

Report section	Information	Where addressed in this BDAR	Maps and data	Where addressed in this BDAR
Introduction	Identification of development site footprint Operational footprint and construction footprint General description of the site Sources of information used in the assessment	Section 1.1 Section 2.1 Section 4.1	• Site and location maps (Section 4.2) • Digital shape files for all maps and spatial data	Figure 2-1 Figure 2-2 Table 4-1
Landscape features	IBRA bioregions and subregions, NSW landscape region and area Native vegetation extent in the buffer area Cleared areas Evidence to support difference between mapped vegetation extent and aerial imagery Rivers and streams classified to stream order Wetlands in or near the site Connectivity Geological significant areas and soil hazard features Site context components: Identification of Method applied Percent native vegetation cover in the landscape	Section 4 Section 5.1 Section 5.2 Section 5.3 Section 6.1.2	• IBRA bioregions and subregions (as described in Paragraphs 4.2.1.3–4.2.1.4) • NSW landscape regions (as described in Paragraph 4.2.1.5) • Rivers and streams (as described in Paragraph 4.2.1.6) • Wetlands (as described in Paragraph 4.2.1.7) • Connectivity (as described in Paragraphs 4.2.1.8–4.2.1.11) • Areas of geological significance and soil hazard features (as described in Paragraphs 4.2.1.12–4.2.1.15) • Native vegetation extent (as described in Subsection 4.3.2)	Figure 5-1 Figure 5-3 Figure 5-4 Figure 5-5 Figure 5-6 Figure 5-8 Figure 6-1 Table 5-1
Native vegetation	Identify native vegetation extent within the site Describe PCTs Vegetation class, type and area Species relied on for identification of vegetation type Justification of evidence used to identify a PCT (as outlined in Paragraph 5.2.1.12)	Section 4.3 Section 5.3 Section 6.1 Section 7.2 Appendix D Table 6-1 Table 6-3 to Table 6-7	• Map of native vegetation extent within the development/biodiversity stewardship site (as described in Section 5.1) • Map of PCTs (as described in Section 5.2) • Map of plot locations • Map of TECs	Section 5.3 Figure 4-1 Figure 6-1 Appendix D Table 9-1

Report section	Information	Where addressed in this BDAR	Maps and data	Where addressed in this BDAR
	TEC status (as outlined in Paragraphs 5.2.1.14–5.2.1.15) Map vegetation zones, patch size Estimate of percent cleared value of PCT (as outlined in Paragraph 5.2.1.16) Perform a vegetation integrity assessment Mapping vegetation zones (Subsection 5.3.1) Patch Size Assess vegetation integrity using benchmark data (Subsection 5.3.3) Survey effort (Subsection 5.3.4) Determine the vegetation integrity score Composition Structure Function Vegetation integrity Where use of local data is proposed: identify relevant vegetation type identify source of information for local benchmark data justify use of local data in preference to database values		• Plot field data (MS Excel format/field sheets) • Patch size (as described in Subsection 5.3.2) • Table of current vegetation integrity scores	
Threatened Species	Identify ecosystem credit species List of species and justification for exclusion of any predicted species Identify species credit species List of species and justification for inclusions and exclusions based on habitat Indication of presence based on targeted surveys or expert report Details of targeted survey technique Species polygons	Section 4.3 Section 7.1 Appendix B	• Table of habitats or habitat components and their sensitivity classes • Table listing species credit species and presence status as determined by targeted survey. Indicating also where presence was assumed and/or where presence was determined by expert report • Species credit species polygons (as described in Paragraph 6.4.1.33)	Table 7-1 Table 7-2 Plate 1

Report section	Information	Where addressed in this BDAR	Maps and data	Where addressed in this BDAR
	Biodiversity risk weightings Threatened species survey Requirements for wind farm developments Where local data is proposed: Identify relevant species, aspects of species data and source of information for local data Justify use of local data Where expert reports are used: Identify relevant species Justify the use of an expert report Indicate the likelihood of presence, and information considered in making this assessment Estimate the number of individuals or area of habitat – include description of how estimate was made Identify the expert		• Table of species and habitat features associated with species and its abundance (as described in Paragraph 6.4.1.34) • Table of biodiversity risk weighting for species (as described in Section 6.6) • For wind farm developments: maps of habitual flight paths for nomadic and migratory species and maps of likely habitat for threatened aerial species	
Avoid and minimise impacts	Demonstration of efforts to avoid and minimise impact on biodiversity values Assessment of direct and indirect impacts unable to be avoided (Sections 9.1 and 9.2.) assessment should include: Type Frequency Intensity Duration Consequence of impact For major projects: details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain (Section 9.4).	Section 8.1 Section 8.2 Section 8.3	• Table of measures to be implemented before, during and after construction, including action, outcome, timing and responsibility • Map of final project footprint, including construction and operation • Maps demonstrating indirect impact zones	Table 8-1 Figure 2-2 Figure 9-1

Report section	Information	Where addressed in this BDAR	Maps and data	Where addressed in this BDAR
Impact summary	Identification and an assessment of the impacts which are potential serious and irreversible impacts (Subsections 10.2.2 for impacts on CEECs and 10.2.3 for threatened species) Identification of impacts requiring offset (Section 10.3) Identification of impacts not requiring offset (Paragraph 10.3.2.2) Identification of areas not requiring assessment (Section 10.4)	Section 8.5 Section 9.1 Section 9.4	• Map showing the location of potential serious and irreversible impacts • Map of impacts requiring offset • Map of impacts not requiring offset • Map of areas not requiring assessment	Not applicable. Figure 9-1
Impact summary	Ecosystem credits and species credits that measure the impact of the development on biodiversity values, including: Future vegetation integrity score Change in vegetation integrity score (Subsection 9.1.3) Number of required ecosystem credits for the impact of development on each vegetation zone (Subsection 11.2.3)	Section 9.2 Section 9.3	• Table of PCTs requiring offset and the number of ecosystem credits required • Table of threatened species requiring offset and the number of species credits required	Section 9.3 Table 9-1
Biodiversity credit report	Credit classes for ecosystem credits and species credits	Appendix F	• Table of credit class and matching credit profile	Appendix F

Appendix B – Threatened species assessment tables

Table B.1 Assessment of potential Predicted Species to determine further assessment for ecosystem credits

Group	Family	Scientific Name	Common Name	Status		Input Source			Credit Type		SAII Entity	Habitat constraints		Habitat Association	Likelihood of ocurrence	Justification	Include as Predicted Species for assessment of ecosystem credits.
				BC Act	EPBC Act	EPBC Act Protected Matters Report (DEE, 2020)	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2020)	Generated by BAM Calculator	Ecosystem	Species		Foraging	Breeding				
Aves	Acanthizidae	*Chthonicola sagittata*	Speckled Warbler	V	-	-	0	Yes	Ecosystem	-	no	-	-	Patchily distributed on and inland of the Great Dividing Range, from level with Mackay in Qld, to the Grampians National Park in Victoria. Rare on the coast. Lives in dry sclerophyll forests and woodlands (woodlands have fewer trees than forests) dominated by eucalypts. It is mostly seen on the grassy ground layer, when it is foraging. Prefers scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Feeds on the ground, probing the leaf litter for insects. It will also eat seeds. It feeds in pairs or small parties up to 6 in number. Occasionally it is seen in mixed feeding flocks with several types of thornbills.	Low or unlikely	Rare on the coast. Project area lacks grassy ground cover characterised by native tussock grasses. Unlikely to forage for insects among the litter in the Bitou Bush Scrub, as it is scrubby and not grassy. Unlikely to forage for seed or insects in the exotic grassland, which is not tussocky or species rich. Not previously recorded in the locality.	Yes
Aves	Accipitridae	*Circus assimilis*	Spotted Harrier	V	-	-	1	Yes	Ecosystem	-	no	-	-	Occurs throughout Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). Most commonly in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).	Moderate	Known to utilise agricultural land or over open habitats at the edges of wetlands, even though it is more commonly associated with grassy woodland habitats and native grasslands.	Yes
Aves	Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V	Ma	Species or species habitat known to occur within area	35	Yes	Foraging	Breeding	no	Within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Distributed along the Australian coastline and well inland along rivers and wetlands, it's widespread in eastern NSW. Foraging habitat consists of coastal seas, rivers, fresh and saline lakes, lagoons, reservoirs and terrestrial habitats such as grasslands. Diet consists of waterbirds, turtles and fish. Resident pairs are territorial and occupy nesting territories of hundreds of hectares. Breeding habitat consists of large trees within mature open forest, gallery forest or woodland and reported that they avoid nesting near urban areas. 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.	Low or unlikely	Project area lacks turtles, fish or waterbird prey species, although suitable habitat occurs in the surrounding land in association with Lake Macquarie and Belmont Lagoon. The species may flyover the Project area from time to time but is unlikely to utilise the Project area. No breeding habitat within the Project area in the form of large trees.	Yes
Aves	Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V	-	-	0	Yes	Foraging	Breeding	no	-	Nest trees - live (occasionally dead) large old trees within vegetation.	Distribution throughout New South Wales is in the densely forested part of the Dividing Range. Occupies open eucalypt forest, woodland or open woodland. *Acacia* , Sheoak and riparian woodlands are favourable. Seen over woodland and forested lands and open country, extending into the arid zone. It tends to avoid rainforest and heavy forest. Feeds on birds, reptiles and mammals. Searches for prey on the wing or from a high exposed perch, taking prey from the ground, the shrub layer or the canopy. Prey includes rabbits, other live mammals and insects. Nests in tall mature trees in remant patches in winter and lays eggs in spring.	Moderate	Project area lacks eucalypt forest or woodland but is surrounded by woodland and forest habitat. No trees within the Project area on which to perch and search for prey, however, may flyover from time to time if in the area. Not previously recorded in the locality.	Yes
Aves	Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V	-	-	0	Yes	Foraging	Breeding	no	-	Nest trees	Distribution is along coastal and subcoastal areas from Queensland to Victoria. Found in timbered habitats including dry woodlands, timbered watercourses and open forests with ground cover of grasses and *Acacia* scrub. Feeds on passerines like honeyeaters. Breeds from July to February and nests are located near watercourses in tree forks.	Moderate	Project area lacks eucalypt forest or woodland but is surrounded by woodland and forest habitat. No trees within the Project area on which to perch build nests, however, may flyover from time to time if in the area. Not previously recorded in the locality.	Yes
Aves	Accipitridae	*Pandion cristatus*	Eastern Osprey	V	M, Ma	Species or species habitat known to occur within area	16	Yes	Foraging	Breeding	no	-	Living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting .	Found around the Australian coastline, except Victoria and Tasmania. They are common around the northern coast, especially on rocky shores. Favour areas along the coast like river mouths, lagoons and lakes. Feed on fish in clear, open water. Nests in crowns of dead trees a kilometre from the ocean.	Low or unlikely	Project area lacks fish prey species, although suitable habitat occurs in the surrounding land in association with Lake Macquarie and Belmont Lagoon. The species may flyover the Project area from time to time but is unlikely to utilise the Project area. No breeding habitat within the Project area in the form of large trees.	Yes
Aves	Artamidae	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	V	-	-	3	Yes	Ecosystem	-	no	-	-	Distributed across mainland Australia, ranging from Queensland to South Australia and Tasmania. Preferred habitat is open eucalypt forests and woodlands. Associated with eucalypt saplings and *Acacia* species, and a ground cover of sedges and woody debris. Feeds on insects and occasionally nectar, fruit and seed. Breeding and nesting occurs in shrubs or low trees, living or dead in branch forks, hollows or behind loose bark.	Low or unlikely	The Project area does not provide eucalypt forest and woodland habitats with regenerating eucalypts or a rich ground cover of sedges for foraging. The Project area does not provide breeding or nesting habitat in the form of shrubs and trees. Bitou Bush scrub is unlikely to provide suitable nesting habitat for the species.	Yes
Aves	Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V	-	-	28	Yes	Foraging	Breeding	no	Presence of *Allocasuarina* and *Casuarina* species	Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground.	Distributed from the east coast to the southern tablelands and central western plains. Occurs in woodland and open forests, rarely away from *Allocasuarina* . Feeds almost exclusively on the seeds of *Allocasuarina* species. Requires sufficient extent of forage within home range to support breeding. Roosts in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approximately 20cm) eucalypt hollows (Higgins, 1999).	Low or unlikely	Project area lacks *Allocasuarina* and *Casuarina* species. No breeding habitat available as no trees present to provide hollows.	No - habitat constraints absent from Project area.
Aves	Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V	-	-	1	Yes	Ecosystem	-	no	-	-	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	Low or unlikely	Not common on the coast. Project area does not support eucalypt woodlands with rough-barked trees as preferred by the species. Bitou Bush areas are too shrubby to support the species. The groundcover stratum does not provide an abundance of fallen timber for foraging.	Yes
Aves	Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V	-	-	0	Yes	Ecosystem	-	no	-	-	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Appears to be sedentary, though some populations move locally, especially those in the south. Has been recorded in some towns and near farm houses.	Low or unlikely	Project area lacks grassy ground cover characterised by native tussock grasses. Unlikely to forage for insects among the litter in the Bitou Bush Scrub, as it is scrubby and not grassy. Unlikely to forage for seed or insects in the exotic grassland, which is not tussocky or species rich. Not previously recorded in the locality.	Yes

Group	Family	Scientific Name	Common Name	Status		Input Source			Credit Type		SAII Entity	Habitat constraints		Habitat Association	Likelihood of ocurrence	Justification	Include as Predicted Species for assessment of ecosystem credits.
				BC Act	EPBC Act	EPBC Act Protected Matters Report (DEE, 2020)	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2020)	Generated by BAM Calculator	Ecosystem	Species		Foraging	Breeding				
Aves	Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	CE	CE	Species or species habitat known to occur within area	9	Yes	Foraging	Mapped important areas	Breeding	-	Mapped important areas	Distribution extends from south-east Queensland to central Victoria. Preferred habitat is dry open forests and woodlands, particularly box-ironbark eucalypt woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes. Also uses remnant patches including travelling stock routes and roadside reserves when moving between habitat and areas of flowering eucalypt. Feeds on invertebrates and nectar from mistletoe and eucalypts. Breeding corresponds with flowering Eucalypts. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and Sheoaks. Also nest in mistletoe haustoria. Nest is an open cup-shaped nest is constructed of bark, grass, twigs and wool by the female.	Low or unlikely	The Project area is poor in foraging resources. It lacks mature trees, flowering eucalypts and mistletoes. Could visit habitat surrounding the Project area and be recorded flying over the Project area from time to time. Unlikely to occur within or utilise habitats within the Project area.	Yes
Aves	Meliphagidae	*Epthianura albifrons*	White-fronted Chat	V	-	-	8	Yes	Ecosystem	-	no	-	-	The species occurs across the southern half of Australia. Found in temperate to arid climates, in foothills and lowlands, along waterways in predominantly saltmarsh vegetation, but sometimes open grasslands and low shrubs bordering wetlands. Predominantly associated with saltmarsh habitats and other damp areas with low vegetation such as swampy farmland and roadside verges. Sometimes occurs on beaches and the edges of lakes. Congregate in areas where there are temporary outbreaks of insects. They run along the ground, picking up small insects, usually less than 5 mm long. Midges, kelp-flies, plant bugs and beetles are popular food items.	Moderate	Likely to occur in surrounding vegetation if present, as there is suitable saltmarsh and swamp vegetation nearby associated with Belmont Lagoon. Could forage for insects within the Project area from time to time, within the swamp vegetation within the Project area. Records exists near mangrove vegetation at the eastern edge of Belmont Lagoon.	Yes
Aves	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V	-	-	4	Yes	Ecosystem	-	no	-	-	Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	Low or unlikely	Project area does not support eucalypt woodlands with rough-barked trees as preferred by the species. Project area does not provide suitable abundance of trees as habitat.	Yes
Aves	Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V	-	-	0	Yes	Ecosystem	-	no	-	-	In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW (OEH 2012). It may be extinct in the southern, central and New England tablelands. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains (OEH 2012). The species is typically found in open forests and woodlands, favouring inland plains with an open shrub layer, little ground cover and plenty of fallen timber and leaf litter. Feed on insects and other invertebrates and sometimes eat seeds. They forage in groups of two to fifteen birds on the ground among leaf litter, around fallen trees and from the bark of shrubs and trees (they tend to use trees more than other babblers). May be seen along roadsides and around farms.	Low or unlikely	Project area lacks suitable woodland habitat and is not located in the preferred areas on the slopes or alluvial plains. The Project area also lacks fallen timber debris; the species is unlikely to forage among the litter in the Bitou Bush Scrub, as it is thick scrub and not open. Unlikely to forage for seed or insects in the exotic grassland.	Yes
Aves	Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V	-	-	22	Yes	Ecosystem	-	no	-	-	Wide distribution across coastal and Great Divide regions of eastern Australia, from South Australia to Cape York. Forages in the canopy of open eucalypt forest and woodlands. Sometimes found foraging in *Angophora* , *Melaleuca* and other tree species. Riparian habitats used for high soil fertility. Feeds on flowers and fruit, especially nectar from bloodwoods and melaleucas.	Low or unlikely	Project area contains very little myrtaceous trees (only a few individuals of stunted *Melaleuca quiquenervia*). No Eucalypt species present within the Project area.	Yes
Aves	Psittacidae	*Lathamus discolor*	Swift Parrot	E	CE	Species or species habitat known to occur within area	37	Yes	Foraging	Mapped important areas	Breeding	-	Mapped important areas	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inlad slopes and plains. *Eucalyptus robusta* , *Corymbia maculata* and *C. gummifera* dominated coastal forests are also important habitat.	Low or unlikely	The Project area is poor in foraging resources. It lacks Eucalypt species. Could visit habitat surrounding the Project area and be recorded flying over the Project area from time to time. Unlikely to occur within or utilise habitats within the Project area.	Yes
Aves	Strigidae	*Ninox strenua*	Powerful Owl	V	-	-	135	Yes	Foraging	Breeding	no	-	Living or dead trees with hollow greater than 20cm diameter	Endemic to eastern and south-eastern Australia, from Mackay to south-western Victoria. Resides in a wide range of vegetation types, from woodland and open sclerophyll forest, to tall open wet forest and rainforest. Solitary and sedentary species. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Roosts in species like Turpentine, Black Sheoak, Blackwood, Rough-barked Apple and Cherry Ballart. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas. Very large territory.	Moderate	The Project area does not contain suitable habitat for breeding or roosting. The species may forage over the Project area as part of a much larger foraging range; there are numerous records in the locality.	Yes
Aves	Tytonidae	*Tyto novahollandiae*	Masked Owl	V	-	-	19	Yes	Foraging	Breeding	no	-	Living or dead trees with hollows greater than 20cm diameter.	Ranges from east coast of NSW to the western plains. Its range makes up 90% of NSW. The species lives in dry eucalypt forests and woodlands. Hunts along the edge of forests and roadsides. Eats tree-dwelling and ground mammals. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Moderate	The Project area does not contain suitable habitat for breeding or roosting. The species may forage over the Project area as part of a much larger foraging range. There is a moderate number of records in the locality.	Yes
Mammalia	Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E	Species or species habitat known to occur within area	7	Yes	Ecosystem	-	no	-	-	Inhabits a range of environments including rainforest, open forest, woodland, coastal health and inland riparian forest, from the sub-alpine zone to the coastline. Den subject sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, which are usually traversed along immensely vegetated creek lines. Use communal 'latrine sites', often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Such sites may be visited by multiple individuals and can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals. Generalist predator with a preference for medium-sized (500g-5kg) mammals. Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits, reptiles and insects. Also eats carrion and takes domestic fowl.	Low or unlikely	No den sites in the form of hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields or rocky cliff faces. Species has large foraging range and is known from locality as recently as August 2017 (recorded in Redhead). Could potentially move in the surrounding habitats to the Project area but the Project area itself does not provides suitable vegetated creek lines for movement.	Yes
Mammalia	Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V	-	-	0	Yes	Ecosystem	-	no	-	-	Found throughout northern and eastern Australia. Habitat type ranges from eucalypt forests to open areas. It roosts in groups of up to six in tree hollows and buildings. Will forage for insects in open and closed forests, in a wide range of habitat types. Breeding occurs from December to mid-march.	Low or unlikely	The Project area does not contain suitable forested habitat above which the species would forage. However, suitable habitat occurs in the land surrounding the Project area and the species may flyover on occasion, being highly mobile. There is no suitable roosting habitat within the Project area. The species is unlikely to utilise the habitats within the Project area and not previously recorded in the locality.	Yes

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Mammalia	Molossidae	*Micronomus norfolkensis* (syn. *Mormopterus norfolkensis*)	Eastern Coastal Free-tailed Bat	V	-	-	16	Yes	Ecosystem	-	no	-	-	Found along the east coast of Australia between southern QLD and southern NSW. Occurs in dry sclerophyll forest, woodland, mangroves and swamp forests. Roosts in tree hollows, but will also roost in man-made structures.	Low or unlikely	The Project area does not contain suitable forested habitat above which the species would forage. However, suitable habitat occurs in the land surrounding the Project area and the species may flyover on occasion, being highly mobile. There is no suitable roosting habitat within the Project area. The species is unlikely to utilise the habitats within the Project area.	Yes
Mammalia	Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	Species or species habitat known to occur within area	22	No	Foraging	Breeding	no	-	Areas identified via survey as important habitat. 'Important' habitat (however this is not a mapped important habitat area) is defined by the density of koalas and quality of habitat determined by on-site survey.	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares. Breeds from August to February.	Low or unlikely	No primary feed tree species or any Eucalypt species within the Project area; however, there are primary feed tree species within the surrounding native vegetion in swamp sclerophyll habitats dominated by *Eucalyptus robusta* (Swamp Mahogany). The species was not predicted by the BAM Calculator but has been included for consideration as there is one record within 1 km of the Project area (at Belmont Golf Course wetlands in swamp sclerophyll forest). However, the species is unlikely to utilise the habitats within the Project area.	Yes
Mammalia	Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Roosting known to occur within area	202	Yes	Foraging	Breeding	no	-	Breeding camps	Roosts in camps within 20km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby & Law, 2008). Will also forage in urban gardens and cultivated fruit crops.	Low or unlikely	The Project area is poor in foraging resources. It lacks mature trees, eucalypt species and mistletoes. Could visit habitat surrounding the Project area and be recorded flying over the Project area from time to time. Unlikely to occur within or utilise habitats within the Project area.	Yes
Mammalia	Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V	-	-	5	No	Ecosystem	-	no	-	-	Occurs on the south east coast of Australia, from southern QLD to Tasmania. Prefers moist habitats with trees taller than 20m. Roosts in eucalypt hollows, and hunts small flying insects like moths and beetles just below the tree canopy.	Low or unlikely	The Project area does not contain suitable forested habitat above which the species would forage or breed. However, suitable habitat occurs in the land surrounding the Project area and the species may flyover on occasion, being highly mobile. There is no suitable roosting habitat within the Project area. The species has been considered as records exist within 250 m of the Project area. However, the species is unlikely to utilise the habitats within the Project area.	Yes
Mammalia	Vespertilionidae	*Miniopterus australis*	Little Bent-winged Bat	V	-	-	65	Yes	Foraging	Breeding	Breeding	-	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	East coast distribution from Cape York to Wollongong. Prefers moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, *Melaleuca* swamps, dense coastal forests and banksia scrub. Roosts in confined spaces such as caves, tunnels and tree hollows.	Low or unlikely	The Project area does not contain suitable eucalypt or *Melaleuca* forests, or *Banksia* scrub habitat. However, suitable habitat occurs in the land surrounding the Project area and the species may flyover on occasion, being highly mobile. There is no suitable roosting habitat within the Project area. Although there are large numbers of records within the locality, the species is unlikely to utilise the habitats within the Project area.	Yes
Mammalia	Vespertilionidae	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V	-	-	45	Yes	Foraging	Breeding	Breeding	-	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500	Occurs along the east coast and north-west coast of Australia. Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony. Hunts in forested areas for insects like moths and flying insects.	Low or unlikely	The Project area does not contain suitable forested habitat above which the species would forage. However, suitable habitat occurs in the land surrounding the Project area and the species may flyover on occasion, being highly mobile. There is no suitable roosting habitat within the Project area. Although there are large numbers of records within the locality, the species is unlikely to utilise the habitats within the Project area.	Yes
Mammalia	Vespertilionidae	*Scoteanax rueppelli*	Greater Broad-nosed Bat	V	-	-	8	No	Ecosystem	-	no	-	-	Occurs in gully and river systems that drain into the great dividing range. Found throughout NSW but not in altitudes over 500m. Utilises a variety of habitat from woodland to moist and dry eucalypt forest, but mostly inhabits tall wet forest. Roosts in tree hollows and buildings. Open woodland and dry open forest is used for foraging for beetles and flying insects.	Moderate	The Project area does not contain suitable forested habitat above which the species would forage. However, suitable habitat occurs in the land surrounding the Project area and the species may flyover on occasion, being highly mobile. There is no suitable roosting habitat within the Project area. The species has been considered as records exist within 250 m of the Project area. However, the species is unlikely to utilise the habitats within the Project area.	Yes
Aves	Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern	E	E	Species or species habitat known to occur within area	0	Yes	Ecosystem	-	no	-	Brackish or freshwater wetlands	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly *Typha spp.* and *Eleocharis spp.* , with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	Low or unlikely	Project area may provide occasional marginal foraging habitat within wetland and swamp areas	Yes
Aves	Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	E	CE; Mi	Species or species habitat known to occur within area	6	Yes	Ecosystem	Breeding	Breeding	Mapped important areas	-	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Low or unlikely	Project area does not contain areas of mapped by OEH a important habitat	No
Aves	Scolopacidae	*Calidris tenuirostris*	Great Knot	V	CE; Mi	-	3	Yes	Ecosystem	Breeding	Breeding	Mapped important areas	-	Breeds in northern hemisphere. In Australia, prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, mangroves, saltwork ponds, near-coastal swamps, saltlakes and non-tidal lagoons. Rarely occurs on inland lakes and swamps. Roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding areas.	Low or unlikely	Project area does not contain areas of mapped by OEH a important habitat	No
Aves	Anseranatidae	*Anseranas semipalmata*	Magpie Goose	V	-	-	0	Yes	Ecosystem	-	no	-	-	Occurs in the tropics, increasing numbers in central and northern NSW and vagrants to south-east NSW. Inhabits shallow wetlands containing dense rushes or sedges, and nearby dry land used for grazing. It feeds on grasses, bulbs and rhizomes and roosts in tall vegetation within wetland areas. Breeding is occurs predominately in monsoonal areas and is unlikely in SE NSW. Nests are formed in trees over deep water.	Low or unlikely	Project area may provide foraging habitat. No nesting habitat present	Yes

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Aves	Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked Stork	E	-	-	0	Yes	Ecosystem	-	no	-	Within 300 m of swamps (shallow, open freshwater or saline wetlands or shallow edges of deeper wetlands) or waterbodies (shallow lakes, lake margins and estuaries)	In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north-east. Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. Breeds during summer, nesting in or near a freshwater swamp.	Low or unlikely	Project area may provide occasional marginal foraging habitat within wetland and swamp areas	Yes
Aves	Jacanidae	*Irediparra gallinacea*	Comb-crested Jacana	V	-	-	0	Yes	Ecosystem	-	no	-	Freshwater wetlands with a good surface cover of floating aquatic vegetation	Occurs on freshwater wetlands in northern and eastern Australia, mainly in coastal and subcoastal regions, from the north-eastern Kimberley Division of Western Australia to Cape York Peninsula then south along the east coast to the Hunter region of NSW – some recorded in south-eastern NSW potentially in response to unfavourable conditions (OEH 2012).	Low or unlikely	Project area does not contain freshwater wetlands with a good surface cover of floating aquatic vegetation	No
Aves	Ardeidae	*Ixobrychus flavicollis*	Black Bittern	V	-	-	6	Yes	Ecosystem	-	no	-	Land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation	Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	Low or unlikely	Project area does not include any permenant water. No roosting habitat is present within the Project area.	No
Aves	Scolopacidae	*Limicola falcinellus*	Broad-billed Sandpiper	V	Mi	-	0	Yes	Ecosystem	-	no	Mapped important areas	-	Breds in the northern hemisphere. In the non-breeding season most common in north and north west of Australia, but is a regular visitor in small numbers to the NSW coast from Ballina to Shoalhaven Heads. Occurs on sheltered parts of the coast, favouring estuarine mudflats but also occasionally in saltmarshes, freshwater lagoons, saltworks and sewerage farms. Forage on exposed mudflats or wet sand.	Low or unlikely	Project area does not contain areas of mapped by OEH a important habitat	No
Aves	Scolopacidae	*Limosa limosa*	Black-tailed Godwit	V	Mi	-	0	Yes	Ecosystem	-	no	Mapped important areas	-	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.	Low or unlikely	Project area does not contain areas of mapped by OEH a important habitat	No
Aves	Meliphagidae	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subspecies)	V	-	-	0	Yes	Ecosystem	-		-	-	Widespread in NSW, but rarely recorded east of Great Dividing Range except in Richmond and Clarence River areas and scattered sites in the Hunter, Central Coast and Illawarra regions. Mostly in upper levels of drier open forests /woodlands dominated by box and ironbark eucalypts, or less commonly smooth-barked gums, stringybarks and tea-treas. Forage over home range of >5 ha. Tend to occur within largest woodland patches in the landscape. They forage for insects, nectar and honeydew. The nest is hidden by foliage high in the crown of a tree.	Low or unlikely	Project area does not contain woodland areas or dry forest.	No
Aves	Strigidae	*Ninox connivens*	Barking Owl	V	-	-	4	Yes	Ecosystem	Breeding	Breeding	-	Hollow-bearing trees- Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including *Eucalyptus camaldulensis , Eucalyptus albens , Eucalyptus polyanthemos* and *Eucalyptus blakelyi* . Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	Low or unlikely	May occasionally forage within Project area	Yes
Aves	Anatidae	*Oxyura australis*	Blue-billed Duck	V	-	-	0	Yes	Ecosystem	-	no	-	-	Partly migratory, travels short distances between breeding swamps and over-wintering lakes. Young birds disperse in April-May from breeding swamps in inland NSW to Murray River system and coastal lakes. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Nests in Cumbungi over deep water or in trampled Lignum, sedges or spike-rushes. Completely aquatic, swimming along the edge of dense cover.	Low or unlikely	Project area does not contain any permanent wetland areas. Project area may provide some marginal foraging habitat in wetland areas	Yes
Aves	Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E	E	Species or species habitat likely to occur within area	0	Yes	Ecosystem	-	no	-	-	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Low or unlikely	Project area does not contain any permanent wetland areas. Species may occasionally forage within Project area	Yes
Aves	Laridae	*Sternula albifrons*	Little Tern	E	Mi	Breeding likely to occur within area	5	Yes	Ecosystem	Breeding	Breeding	Mapped important areas	-	In eastern Australia, many breeding colonies lie within conservation reserves, or within Ramsar-listed wetlands, or both. Little Terns occur in two Ramsar listed sites in NSW, Towra Point Nature Reserve and Hunter Estuary Wetlands (including Kooragang Nature Reserve). Inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches.	Low or unlikely	Project site does not contain areas of mapped by OEH a important habitat	No
Aves	Anatidae	*Stictonetta naevosa*	Freckled Duck	V	-	-	0	Yes	Ecosystem	-	no	-	-	Breeds in large, ephemeral swamps in the Murray-Darling, particularly along the Paroo and Lachlan Rivers and other Riverina rivers. In drier times moves to more permanent waters. Disperses during extensive inland droughts and may be found in coastal areas during such times. Prefers freshwater swamps/ccreeks with dense Cumbungi, Lignum or tea-tree. Nests in dense vegetation at or near water level.	Low or unlikely	May occasionally forage within Project area	Yes
Aves	Scolopacidae	*Xenus cinereus*	Terek Sandpiper	V	Mi	-	1	Yes	Ecosystem	Breeding	Breeding	Mapped important areas	-	The two main sites for this species in NSW are the Richmond River and Hunter River estuaries. Inhabits coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks near mangroves, also observed on rocky pools and reefs and up to 10 km inland around brackish pools. Roost communally in mangroves or dead trees. Forages in open intertidal mudflats.	Low or unlikely	Project site does not contain areas of mapped by OEH a important habitat	No
Aves	Columbidae	*Ptilinopus superbus*	Superb Fruit-Dove	V	-	-	1	No	Ecosystem	-	no	-	-	Occurs from north-eastern Queensland to north-eastern NSW. Inhabits rainforest and closed forests, eating fruit from trees like figs and palms. Also forages in eucalypt or acacia woodland with fruit bearing trees. Breeds in September to January in rainforest edge and shrub species.	Low or unlikely	Fruiting vegetation of preferred food is not present in the Project area. Wet forests don't occur within the Project area.	No
Aves	Columbidae	*Ptilinopus regina*	Rose-crowned Fruit-Dove	V	-	-	2	No	Ecosystem	-	no	-	-	Occurs from Newcastle north to Cape York, with vagrants occasionally as far south as Victoria. Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Thought to be locally nomadic in response to fruit availability.	Low or unlikely	Fruiting vegetation of preferred food is not present in the Project area. Wet forests don't occur within the Project area.	No

Group	Family	Scientific Name	Common Name	Status		Input Source			Credit Type		SAII Entity	Habitat constraints		Habitat Association	Likelihood of ocurrence	Justification	Include as Predicted Species for assessment of ecosystem credits.
				BC Act	EPBC Act	EPBC Act Protected Matters Report (DEE, 2020)	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2020)	Generated by BAM Calculator	Ecosystem	Species		Foraging	Breeding				
Aves	Petroicidae	*Petroica boodang*	Scarlet Robin	V	-	-	1	No	Ecosystem	-	no	-	-	The Scarlet Robin is found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. Lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat.Breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. Paddock trees are used for roosting and foraging.	Low or unlikely	The Project area has a lack of fallen timber and debris for foraging. No breeding habitat occurs within the Project area.	No
Aves	Psittacidae	*Neophema pulchella*	Turquoise Parrot	V	-	-	1	No	Ecosystem	-	no	-	-	Occurs from southern Queensland to northern Victoria, along the western side of the Great Dividing Range. The species lives on the edges of eucalypt woodland and clearings nearby, timbered ridges and creeks on farmland. Nests in tree hollows, logs or posts, from August to December. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter.	Low or unlikely	No breeding habitat occurs within the Project area. There is marginal suitable habitat for foraging within the Project area, however no mature trees or Eucalypt species occur within the Project area.	No
Aves	Charadriidae	*Charadrius mongolus*	Lesser Sand-plover	V	E, Mi	Species or species habitat known to occur within area	7	Yes	Ecosystem	Foraging	no	Mapped important areas	-	Found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW (OEH 2012). Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms (OEH 2012).	Low or unlikely	Project area does not contain areas of mapped by OEH a important habitat	No
Aves	Scolopacidae	*Charadrius leschenaultii*	Greater Sand-plover	V	V, Mi	Species or species habitat known to occur within area	2	Yes	Ecosystem	Foraging	no	Mapped important areas	-	Does not breed in Australia. In NSW, recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; forage on wet ground at low tide. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks (OEH 2012).	Low or unlikely	Project area does not contain areas of mapped by OEH a important habitat	No
Aves	Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	V	-	-	2	No	Ecosystem	Breeding	no	no	Eucalypt tree species with hollows greater than 9 cm diameter	Distributed from southern Victoria to central-eastern NSW. Occurs in tall highland forests and woodlands, particularly wet sclerophyll forests throughout summer and in drier, more open eucalypt forests- like box-gum and box-ironbark communities in winter. Forages in eucalypt trees and acacia shrubs as it feeds on eucalypt or wattle seeds. Nesting occurs in hollows in trunks, limbs or dead spouts of tall living trees. often near water.	Low or unlikely	No hollow-bearing trees exists within the Project area. Marginal foraging habitat exists within the Project area, however no Eucalypt species occur.	No
Aves	Tytonidae	*Tyto tenebricosa*	Sooty Owl	V	-	-	4	No	Foraging	Breeding	no	On sites where the species is determined to be present AND suitable caves are present AND breeding has been detected/ proven	Hollow-bearing trees: Living or dead trees with hollows greater than 20cm diameter.	Occurs along the east of NSW, along the coast and eastern tablands. Occupies dry, subtropical and warm temperate rainforest, and moist eucalypt forests. Roosts in hollows of tall forest trees, or in heavy vegetation. Feeds on small mammals like the Common Ringtail Possum (Psuedocheirus peregrinus) and the sugar glider (Petaurus breviceps).	Low or unlikely	Project area does not meet habitat constraints for foraging or breeding. No hollow-bearing trees or Eucalypt species exist within the Project area.	No

Table B.2 Assessment of potential Candidate Species to determine further assessment for targeted survey and species credits

Group	Family	Scientific Name	Common Name	Status		Input Source			Credit Type		SAII Entity	SAII threshold type	SAII threshold	Habitat constraints		Habitat Association	Likelihood of ocurrence	Justification	Include as Candidate Species for targeted survey and assessment for species credits
				BC Act	EPBC Act	EPBC Act Protected Matters Report (DEE, 2020)	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2020)	Generated by BAM Calculator	Ecosystem	Species				Foraging or roosting	Breeding				
Amphibia	Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E	V	Species or species habitat known to occur within area	0	Yes	-	Species	no	n/a	n/a	-	Within 1 km of semi permenent/ephemeral wet areas, swamps and waterbodies	Found in differing habitat throughout NSW and Victoria. Likely to occur in areas where *Juncus kraussii* , *Schoenoplectus litoralis* and *Sporobolus virginicus* are present (Pyke et. al, 2002). Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available but can occupy disturbed habitat. Breeds in permanent or ephemeral ponds during late winter to early autumn, but generally during September–February with a peak around January–February after heavy rain or storms (Daly 1995; White 2001).	Moderate	The species occupies marshes, dams and stream-sides that are relatively unshaded and will utilise adjacent tussock grasslands to travel between waterbodies. The Project area includes a small area of wetland /swamp habitat that would provide suitable habitat for this species. It should be noted however that Green and Golden Bell Frogs have not been recorded in the Belmont area since the 1970's	Yes
Amphibia	Hylidae	*Litoria brevipalmata*	Green-thighed Frog	V	-	-	0	Yes	-	Species	no	n/a	n/a	-	-	Isolated localities along the coast and ranges from just north of Wollongong to south-east Queensland. Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter 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 frogs are thought to forage in leaf-litter.	Low or unlikely	The Project area does not contain suitable rainforest, eucalypt forest or heathland habitat.	No
Amphibia	Myobatrachidae	*Crinia tinnula*	Wallum Froglet	V	-	-	11	Yes	-	Species	no	n/a	n/a	-	-	Found along the coastal margin from Litabella National Park in south-east Queensland to Kurnell in Sydney in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands or along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. Breeding peaks in the cooler months but can occur throughout the year following rain.	Moderate	There are records of the species to the north and south of the Project area. Two records to the south are within the Belmont Golf Course wetland (recorded in 1998). Multiple records to the north are from Redhead and Whitebridge areas and are located over 1.5 km away. Records were generally made within paperbark or *Banksia* (i.e. Wallum) wet heath or sedgelands. There is suitable habitat for the species within the wetland habitats located to the west of Ocean Park road. Surveys conducted after rainfall resulted in no sighting of the species.	Yes
Amphibia	Myobatrachidae	*Uperoleia mahonyi*	Mahony's Toadlet	E	-	-	0	Yes	-	Species	no	n/a	n/a	-	-	Mahony's Toadlet is endemic to the mid-north coast of New South Wales (NSW) and to date has been found between Kangy Angy and Seal Rocks. Current observations indicate Mahony's Toadlet inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range. Known records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. Commonly associated with acid paperbark swamps, Mahony's Toadlet also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species.	Moderate	Mahony's Toadlet has not been recorded within the locality of the Project area, although potential habitat is recognised to occur within the Lake Macquarie LGA. The closest records are over 20 km to the north of the Project area and are from the wallum and wet heath habitats on the Tomago Sandbeds. This species breeds in waterbodies associated with permanent or semi-permanent swamps and ponds. Outside of breeding periods the species has been recorded up to 400 m away from breeding sites in intact vegetation. This species has been reported to occur at disturbed sites, although all of these disturbed sites have intact native vegetation surrounding breeding habitat. There is suitable habitat for the species within the wetland habitats located to the west of Ocean Park drive. Surveys conducted after rainfall resulted in no sighting of the species.	Yes
Aves	Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V	Ma	Species or species habitat known to occur within area	35	Yes	Foraging	Breeding	no	n/a	n/a	Within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Distributed along the Australian coastline and well inland along rivers and wetlands, it's widespread in eastern NSW. Foraging habitat consists of coastal seas, rivers, fresh and saline lakes, lagoons, reservoirs and terrestrial habitats such as grasslands. Diet consists of waterbirds, turtles and fish. Resident pairs are territorial and occupy nesting territories of hundreds of hectares. Breeding habitat consists of large trees within mature open forest, gallery forest or woodland and reported that they avoid nesting near urban areas. 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.	Low or unlikely	Project area lacks turtles, fish or waterbird prey species, although suitable habitat occurs in the surrounding land in association with Lake Macquarie and Belmont Lagoon. The species may flyover the Project area from time to time but is unlikely to utilise the Project area. No breeding habitat within the Project area in the form of large trees.	No
Aves	Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V	-	-	0	Yes	Foraging	Breeding	no	n/a	n/a	-	Nest trees - live (occasionally dead) large old trees within vegetation.	Distribution throughout New South Wales is in the densely forested part of the Dividing Range. Occupies open eucalypt forest, woodland or open woodland. *Acacia* , Sheoak and riparian woodlands are favourable. Seen over woodland and forested lands and open country, extending into the arid zone. It tends to avoid rainforest and heavy forest. Feeds on birds, reptiles and mammals. Searches for prey on the wing or from a high exposed perch, taking prey from the ground, the shrub layer or the canopy. Prey includes rabbits, other live mammals and insects. Nests in tall mature trees in remant patches in winter and lays eggs in spring.	Low or unlikely	The Project area lacks suitable breeding habitat in the form of living or dead mature trees.	No
Aves	Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V	-	-	0	Yes	Foraging	Breeding	no	n/a	n/a	-	Nest trees	Distribution is along coastal and subcoastal areas from Queensland to Victoria. Found in timbered habitats including dry woodlands, timbered watercourses and open forests with ground cover of grasses and *Acacia* scrub. Feeds on passerines like honeyeaters. Breeds from July to February and nests are located near watercourses in tree forks.	Low or unlikely	The Project area lacks suitable breeding habitat in the form of nest trees.	No
Aves	Accipitridae	*Pandion cristatus*	Eastern Osprey	V	M, Ma	Species or species habitat known to occur within area	16	Yes	Foraging	Breeding	no	n/a	n/a	-	Living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting .	Found around the Australian coastline, except Victoria and Tasmania. They are common around the northern coast, especially on rocky shores. Favour areas along the coast like river mouths, lagoons and lakes. Feed on fish in clear, open water. Nests in crowns of dead trees a kilometre from the ocean.	Low or unlikely	The Project area does not contain living or dead trees, or artificial structures suitable for nesting	No
Aves	Burhinidae	*Burhinus grallarius*	Bush Stone-curlew	E	-	-	1	Yes	-	Species	no	n/a	n/a	Fallen/standing dead timber including logs	Fallen/standing dead timber including logs	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch.	Low or unlikely	The Project area does not provide suitable fallen/standing timber and log habitat for this species. Habitat within the Project area is substantially degraded by Bitou Bush invasion. Open forests do not occur within the Project area.	No
Aves	Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V	-	-	28	Yes	Foraging	Breeding	no	n/a	n/a	Presence of *Allocasuarina* and *Casuarina* species	Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground.	Distributed from the east coast to the southern tablelands and central western plains. Occurs in woodland and open forests, rarely away from *Allocasuarina* . Feeds almost exclusively on the seeds of *Allocasuarina* species. Requires sufficient extent of forage within home range to support breeding. Roosts in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approximately 20cm) eucalypt hollows (Higgins, 1999).	Low or unlikely	Project area lacks *Allocasuarina* and *Casuarina* species. No breeding habitat available as no trees present to provide hollows.	No

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				BC Act	EPBC Act	EPBC Act Protected Matters Report (DEE, 2020)	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2020)	Generated by BAM Calculator	Ecosystem	Species				Foraging or roosting	Breeding				
Aves	Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	E	-	-	20	Yes	-	Species	no	n/a	n/a	Within 100m of estuarine areas and the ocean	Within 100m of estuarine areas and the ocean	Occurs along the Australian coastline. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. 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.	Low or unlikely	May occur as a visitor on the beach and frontal dunes to the east of the proposed temporary desalinisation plant site but habitats within the Project area are unlikely to be utilised by the species. There is no suitable foraging habitat within the site itself (i.e. exposed sand, mud and rock at low tide supporting molluscs, worms, crabs and small fish prey species). Furthermore, the habitat within the Project area east of Ocean Park Rd is substantially degraded by Bitou Bush invasion. It is noted that the frontal dune habitat approaching the beach strand zone is the area mostly likely to be utilised by the species if it is present in the area; this area is unlikely to be disturbed by the proposed construction works.	No
Aves	Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	CE	CE	Species or species habitat known to occur within area	9	Yes	Foraging	Mapped important areas	Breeding	Description	Mapped important areas	-	Mapped important areas	Distribution extends from south-east Queensland to central Victoria. Preferred habitat is dry open forests and woodlands, particularly box-ironbark eucalypt woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes. Also uses remnant patches including travelling stock routes and roadside reserves when moving between habitat and areas of flowering eucalypt. Feeds on invertebrates and nectar from mistletoe and eucalypts. Breeding corresponds with flowering Eucalypts. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and Sheoaks. Also nest in mistletoe haustoria. Nest is an open cup-shaped nest is constructed of bark, grass, twigs and wool by the female.	Low or unlikely	The Project area does not contain breeding habitat or any necter produsing feed trees that would provide suitable foraging habitat for this species	No
Aves	Psittacidae	*Lathamus discolor*	Swift Parrot	E	CE	Species or species habitat known to occur within area	37	Yes	Foraging	Mapped important areas	Breeding	Description	Mapped important areas	-	Mapped important areas	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inlad slopes and plains. *Eucalyptus robusta* , *Corymbia maculata* and *C. gummifera* dominated coastal forests are also important habitat.	Low or unlikely	The Project area does not contain any winter foraging resources. It lacks mature trees and flowering eucalypts. Could visit habitat surrounding the Project area and be recorded flying over the Project area from time to time. Unlikely to occur within or utilise habitats within the Project area.	No
Aves	Strigidae	*Ninox strenua*	Powerful Owl	V	-	-	135	Yes	Foraging	Breeding	no	n/a	n/a	-	Living or dead trees with hollow greater than 20cm diameter	Endemic to eastern and south-eastern Australia, from Mackay to south-western Victoria. Resides in a wide range of vegetation types, from woodland and open sclerophyll forest, to tall open wet forest and rainforest. Solitary and sedentary species. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Roosts in species like Turpentine, Black Sheoak, Blackwood, Rough-barked Apple and Cherry Ballart. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas. Very large territory.	Low or unlikely	The Project area does not contain living or dead trees for breeding.	No
Aves	Tytonidae	*Tyto novahollandiae*	Masked Owl	V	-	-	19	Yes	Foraging	Breeding	no	n/a	n/a	-	Living or dead trees with hollows greater than 20cm diameter.	Ranges from east coast of NSW to the western plains. Its range makes up 90% of NSW. The species lives in dry eucalypt forests and woodlands. Hunts along the edge of forests and roadsides. Eats tree-dwelling and ground mammals. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Low or unlikely	The Project area does not contain living or dead trees for breeding.	No
Flora	Apocynaceae	*Cynanchum elegans*	White-flowered Wax Plant	E	E	Species or species habitat known to occur within area	2	Yes	-	Species	no	n/a	n/a	-	-	Distributed from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and *Melaleuca* scrub. Occurs in association with Small-fruited mock-olive *Notelaea microcarpa* and Acacia species inland, and coastally with Coast Banksia *Banksia integrifolia* , Morton Bay Fig *Ficus macrophylla* and Coast Tea-tree *Leptospermum laevigatum* and Rough-fruit Pittosporum *Pittosporum revolutum* . Soil and geology types are not limiting.	Low or unlikely	The Project area would have originally supported habitat characterised by Coast Banksia and Coastal Teatree but the habitat within the Project area is now substantially degraded by high threat weed species, Bitou Bush, which forms a monocultural thicket on the foredunes.	No
Flora	Asteraceae	*Senecio spathulatus*	Coast Groundsel	E	-	-	1	Yes	-	Species	no	n/a	n/a	-	-	Coast Groundsel occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah). In Victoria there are scattered populations from Wilsons Promontory to the NSW border. Coast Groundsel grows on frontal dunes.	Moderate	The foredune habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass. Project area is also subject to disturbance by 4WD traffic. Closest record within 3.5 km of the Project area. Bitou Bush is a key threat for this species, as it typically invades habitat and smothers the species. Plot surveys found no sightings of the species.	Yes
Flora	Elaeocarpaceae	*Tetratheca glandulosa*	-	V	-	-	1	No	-	Species	no	n/a	n/a	-	-	Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gymea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam. Stony lateritic fragments are also common in the soil profile on many of these ridgetops. Vegetation structure varies from heaths and scrub to woodlands/open woodlands, and open forest. Vegetation communities correspond broadly to Benson & Howell's Sydney Sandstone Ridgetop Woodland (Map Unit 10ar). Common woodland tree species include: Corymbia gummifera, C. eximia, Eucalyptus haemastoma, E. punctata, E. racemosa, and/or E. sparsifolia, with an understorey dominated by species from the families Proteaceae, Fabaceae, and Epacridaceae.	Low or unlikely	No suitable habitat within the Project area, which is not associated with shale-sandstone transitional soils.	No
Flora	Elaeocarpaceae	*Tetratheca juncea*	Black-eyed Susan	V	V	Species or species habitat known to occur within area	1986	No	-	Species	no	n/a	n/a	-	-	Restricted to north of the Sydney Basin bioregion, in the Local Government Areas of Newcastle, Wyong, Lake Macquarie, Port Stephens and the Great Lakes. Usually found in low open forest and woodland, with a mixed shrub understorey and grassy groundcover. Associated species include Smooth-Barked Apple Angophora costada, Red Bloodwood Corymbia gummifera, Scribbly Gum Eucalyptus haemastoma and Brown Stringybark Eucalyptus capitellata (Gardner and Murray, 1992) . Mostly occur on low nutrient soils.	Low or unlikely	No habitats associated with Smooth-barked Apple or Scribbly Gum forests within the Project area, although the species is known from the locality. Targeted surveys in the vicinity of the Project area resulted in no sightings of the species.	No
Flora	Ericaceae	*Epacris purpurascens var. purpurascens*	-	V	-	-	1	No	-	Species	no	n/a	n/a	-	-	Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence. Killed by fire and re-establishes from soil-stored seed.	Low or unlikely	The Project area does not contain suitable forest habitat on shale soils.	No
Flora	Euphorbiaceae	*Chamaesyce psammogeton*	Sand Spurge	E	-	-	1	Yes	-	Species	no	n/a	n/a	-	-	Sand Spurge is found sparsely along the coast from south of Jervis Bay to Queensland. Populations have been recorded in Wamberal Lagoon Nature Reserve, Myall Lakes National Park, Moonee Beach Nature Reserve and Bundjalung National Park. Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (*Spinifex sericeus*) and Prickly Couch (*Zoysia macrantha*)	Moderate	Bitou Bush is a key threat for this species, as it typically invades preferred foredune habitat and smothers the species. The foredune habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass. There are no records for the species within 1 km of the Project area and only 1 record within the locality of the Project area.	Yes

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Flora	Fabaceae (Faboideae)	*Pultenaea maritima*	Coast Headland Pea	V	-	-	6	No	-	Species	no	n/a	n/a	-	-	Occurs in New South Wales and Queensland. Within NSW, the species has been recorded from Newcastle north to Byron Bay on 16 headlands. Five sites occur within conservation reserves. Occurs in grasslands, shrublands and heath on exposed coastal headlands and adjoining low coastal heath. Found on clay or sandy loam or clay loam over sandstone at altitude 5–30 m. Associated with Banksia integrifolia and Themeda australis. Flowers from (June) August to March; fruit occurs from January to March.	Low or unlikely	The Project area does not occur on coastal headlands or support adjoining coastal heath habitat. The habitat within the Project area is substantially degraded by Bitou Bush invasion.	No
Flora	Fabaceae (Mimosoideae)	*Acacia bynoeana*	Bynoe's Wattle	E	V	Species or species habitat known to occur within area	11	No	-	Species	no	n/a	n/a	-	-	Found in central eastern NSW, from the Hunter to the Southern Highlands to west of the Blue Mountains. Occurs in dry sclerophyll forest or heathlands on sandy soils. Associated with Red Bloodwood Corymbia gummifera, Scribbly Gum Eucalyptus haemastoma and Parramatta Red Gum Eucalyptus parramattensis.	Low or unlikely	Not recorded during survey of the Project area. There is no dry sclerophyll forest or heathland in the Project area. Dunal vegetation present within the Project area is substantially degraded by Bitou Bush invasion. No trees were recorded except for a few regenerating *Melaleuca quinquenervia* trees	No
Flora	Myrtaceae	*Angophora inopina*	Charmhaven Apple	V	V	Species or species habitat known to occur within area	31	Yes	-	Species	no	n/a	n/a	-	-	Endemic to the Central Coast of NSW, from Karuah to Charmhaven. Occurs in wet heath with Scribbly Gum Eucalyptus haemastoma and Red Bloodwood Corymbia gummifera, sedge woodland with River Bottlebrush Melaleuca sieberi and Red Mahogany Eucalyptus resinifera, and woodland/forest with Brown Stringybark Eucalyptus capitellata and Red Bloodwood Corymbia gummifera. Flowers between mid-December and mid-January.	Low or unlikely	Not recorded during survey of the Project area. The habitat east of Ocean Park Rd within the Project area is substantially degraded by Bitou Bush invasion. No trees occur within the Project area.	No
Flora	Myrtaceae	*Callistemon linearifolius*	Netted Bottle Brush	V	-	-	12	No	-	Species	no	n/a	n/a	-	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park. Grows in dry sclerophyll forest on the coast and adjacent ranges. Flowers spring – summer.	Low or unlikely	No dry sclerophyll forest occurs in the Project area. Not recorded during survey of the Project area.	No
Flora	Myrtaceae	*Eucalyptus camfieldii*	Camfield's Stringybark	V	V	Species or species habitat known to occur within area	2	No	-	Species	no	n/a	n/a	-	-	Distributed from Raymond Terrace to Waterfall NSW. Exists in coastal heath on exposed sandy ridges. Associated species frequently include stunted species of Narrow-leaved Stringybark Eucalyptus oblonga, Brown Stringybark Eucalyptus capitellata and Scribbly Gum Eucalyptus haemastoma. It grows in shallow sandy soils overlying Hawkesbury sandstone.	Low or unlikely	No trees occur in the Project area. Furthermore the habitat within the Project area is not associated with heathy woodland or forest vegetation.	No
Flora	Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	CE	-	-	7	No	-	Species	Yes	Not described	Not described	-	-	Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of R. rubescens typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	Low or unlikely	No wet sclerophyll forest, littoral or subtropical rainforest habitat within the Project area. No trees occur in the project area.	No
Flora	Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E	V	Species or species habitat known to occur within area	17	No	-	Species	no	n/a	n/a	-	-	Found only in NSW, from Lansdowne to Conjola State Forest. Found in littoral rainforest on sand or subtropical rainforest. Associated species include Small-leaved Fig Ficus obliqua, Plum Pine Podocarpus elatus and Lilly Pilly Syzygium smithii. Preferred soils are sandy and derived from sandstone.	Low or unlikely	No littoral or subtropical rainforest habitat within the Project area.	No
Flora	Orchidaceae	*Caladenia tessellata*	Thick Lip Spider Orchid	E	V	Species or species habitat likely to occur within area	0	Yes	-	Species	Yes	Description	Under development	-	-	The Thick-lip Spider-orchid Caladenia tessellata is a perennial terrestrial orchid emerging annually from an underground tuber. About 19 populations are known, containing about 450 plants. The species has suffered a major decline in abundance throughout much of its range, largely due to loss of habitat. The Thick-lip Spider-orchid is endemic to mainland south-eastern Australia, where it is distributed from the central coast of New South Wales to the Westernport region of southern Victoria (Figure 1), in the South East Coastal Plain, South East Corner, and Sydney Basin bioregions (sensu DEH 2000). The species usually occurs on or near the coast, but in southern New South Wales, extends well inland to Braidwood. In New South Wales, the species is generally found in grassy dry sclerophyll woodland (for example *Kunzea* woodland) on clay loam or sandy soils, less commonly in heathland on sandy loam soils.	Low or unlikely	The Project area does not contain heathy woodland or dry sclerophyll forest habitat preferred by the species. No previous records within the locality	No
Flora	Orchidaceae	*Corybas dowlingii*	Red Helmet Orchid	E	-	-	3	No	-	Species	no	n/a	n/a	-	-	Corybas dowlingii is restricted to the central coast and Hunter regions of New South Wales where it is currently known from the Port Stephens, Bulahdelah, Lake Macquarie and Freemans Waterhole areas. It is known from the local government areas of Cessnock, Great Lakes, Lake Macquarie and Port Stephens. Sheltered areas such as gullies and southerly slopes in tall open forest on well-drained gravelly soil at elevations of 10-200 m. Flowering occurs from June to August	Low or unlikely	The Project area does not support sheltered gully habitats or tall open forests on gravelly soils. The species was considered because records exist within the locality of the Project area but the species is considered unlikely to occur within the Project area.	No
Flora	Orchidaceae	*Cryptostylis hunteriana*	Leafless Tongue-orchid	V	V	Species or species habitat known to occur within area	9	No	-	Species	no	n/a	n/a	-	-	Distributed from East Gippsland in Victoria throughout coastal NSW, and up to the Tin Can Bay area in Southern QLD. Habitats include heathlands, heathy woodlands, sedgelands, dry sclerophyll forests, forested wetlands, freshwater wetlands, grassland and wet sclerophyll rainforests. Associated with Scribbly Gum *Eucalyptus haemastom* a, Silvertop Ash *Eucalyptus sieberi* , Red Bloodwood *Corymbia gummifera* and Black Sheoak *Allocasuarina littoralis.* Preferred soils are moist sands, moist to dry clay loam soils. Species flowers from November to Februarv.	Low or unlikely	The Project area does not support heathy open forest, woodland or heathland habitat . The species was considered because records exist within the locality of the Project area but the species is considered unlikely to occur within the Project area.	No
Flora	Orchidaceae	*Diuris praecox*	Newcastle Doubletail	V	V	Species or species habitat known to occur within area	1554	No	-	Species	no	n/a	n/a	-	-	Distributed between Ourimbah and Nelson Bay, NSW. Grows on hills and slopes near the coast, in heathy open forest which have a dense grassy understorey. Distributed on well drained soil. Produces leaves and flowering stems in winter, with flowers previously recorded in July to early September.	Low or unlikely	The Project area does not contain suitable heathy forest habitat characterised by Smooth-barked Apple, Scribbly Gum or Red Bloodwood. The large number of previous records within the locality occur from a population over 5.5 km from the Project area.	No
Flora	Proteaceae	*Grevillea parviflora subsp. parviflora*	Small-flower Grevillea	V	V	Species or species habitat known to occur within area	60	No	-	Species	no	n/a	n/a	-	-	Distributed between Moss Vale/Bargo and lower Hunter Valley. Broad habitat range including heath, shrubby woodland and open forest and often in distributed areas on the fringes of tracks or roads. Associated species include Earp's Gum Eucalyptus parramattensis subsp. decadens, Narrow-leaved Apple Angophora bakeri, Swamp Wattle Acacia elongata and Thyme Honey-myrtle Melaleuca thymifolia. Distributed on light clay or sandy soils.	Low or unlikely	Records in the locality are associated with heathy open forests on higher elevations to the north of the Project area and on the western side of Lake Macquarie. This habitat is absent from the Project area	No
Flora	Zannichelliaceae	*Zannichellia palustris*	-	V	-	-	1	Yes	-	Species	no	n/a	n/a	Freshwater or slightly brackish estuarine areas (10%)	Freshwater or slightly brackish estuarine areas (10%)	Known from the lower Hunter and in Sydney Olympic Park. Grows in fresh or slightly saline stationary or slowly flowing water. Flowers during warmer months. NSW populations behave as annuals, dying back completely every summer.	Low or unlikely	No records within 1 km of the Project area and only 1 record within the locality. The species is associated with permeant wetland areas of slightly brackish to estuarine, slow-moving waters, which is absent from the Project area.	No

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				BC Act	EPBC Act	EPBC Act Protected Matters Report (DEE, 2020)	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2020)	Generated by BAM Calculator	Ecosystem	Species				Foraging or roosting	Breeding				
Mammalia	Burramyidae	*Cercartetus nanus*	Eastern Pygmy Possum	V	-	-	2	Yes	-	Species	no	n/a	n/a	-	-	Found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extents from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. 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 and insects. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) 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.	Low or unlikely	The Project area does not contain foraging resources in the form of banksia, eucalypt and bottlebrush species. The Project area lacks sheltering habitat in the form of tree hollows and stumps.	No
Mammalia	Dasyuridae	*Phascogale tapoatafa*	Brush-tailed Phascogale	V	-	-	0	Yes	-	Species	no	n/a	n/a	-	Hollow-bearing trees.	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occassional records west ot the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. foraging preferentially in rough barked trees of 25 cm DBH or greater. Feeds mostly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates. Nest and shelter in tree hollows with entrances 2.5 - 4 cm wide and use many different hollows over a short time span.	Low or unlikely	The Project area does not contain and sclerophyll open forest. There is no mature trees or trees containing hollows within the Project area.	No
Mammalia	Dasyuridae	*Planigale maculata*	Common Planigale	V	-	-	0	Yes	-	Species	no	n/a	n/a	-	-	Coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its confirmed southern distribution limit on the NSW lower north coast however there are reports of its occurrence as far south as the central NSW coast west of Sydney. Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. preying on insects and small vertebrates. Habitat includes hollow logs, under bark, rocks, cracks in soil, grass tussocks or building debris	Low or unlikely	The Project area does not include micro habitat such as hollow logs, bark habitat, rocks, cracks in soil, grass tussocks or building debris.	No
Mammalia	Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V	-	-	97	Yes	-	Species	no	n/a	n/a	-	-	Species widely distributed throughout Australia, from Queensland to western Victoria. Occurs in mature Box-Ironbark woodland, and River Red Gum in areas west of the great dividing range, and in Blackbutt-Bloodwood first with heathy understorey in coastal regions. Prefers mixed species forest composition, with an Acacia midstorey. Requires abundant tree hollows for refuge and nest sites. Diet includes Acacia gum, eucalypt sap, nectar and manna, as well as invertebrates and pollen.	Low or unlikely	Records within the locality are associated with forested habitat not associated with foredunes. The Project area does not contain suitable forest habitat for the species. Project area does not contain any mature or hollow bearing trees that would provide habitat for this species.	No
Mammalia	Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Roosting known to occur within area	202	Yes	Foraging	Breeding	no	n/a	n/a	-	Breeding camps	Roosts in camps within 20km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby & Law, 2008). Will also forage in urban gardens and cultivated fruit crops.	Low or unlikely	The Project area does not support any Grey-headed Flying Fox camps. No trees occur within the Project area, which does not support foraging habitat.	No
Mammalia	Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	Species or species habitat likely to occur within area	0	Yes	-	Species	Breeding	Description	Breeding habitat identified by survey	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.	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. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat.	Sandstone cliffs and fertile woodland valley habitat within close proximity of each other is roosting habitat of importance to the Large-eared Pied Bat. Rainforest and moist eucalypt forest habitats on other geological substrates (rhyolite, trachyte and basalt) at high elevation are of similar importance to the species for roosting. In NSW this species has been recorded from a large range of vegetation types including: dry and wet sclerophyll forest; Cyprus Pine (*Callitris glauca*) dominated forest; tall open eucalypt forest with a rainforest sub-canopy; sub-alpine woodland; and sandstone outcrop country.	Low or unlikely	The Project area is not located within the described landscapes for this species (i.e. sandstone cliffs, fertile woodland valleys, sandstone outcrop country). The Project area does not support suitable roosting or breeding cave habitat, and is not located within 100m of suitable breeding or roosting habitat. There are no known records within the locality for this species.	No
Mammalia	Vespertilionidae	*Miniopterus australis*	Little Bent-winged Bat	V	-	-	65	Yes	Foraging	Breeding	Breeding	Description	Any breeding habitat as identified by survey	-	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	East coast distribution from Cape York to Wollongong. Prefers moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, *Melaleuca* swamps, dense coastal forests and banksia scrub. Roosts in confined spaces such as caves, tunnels and tree hollows.	Low or unlikely	The Project area does not contain cave, tunnel, mine, culvert or other structures known or suspected to be used for breeding.	No
Mammalia	Vespertilionidae	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V	-	-	45	Yes	Foraging	Breeding	Breeding	Description	Any breeding habitat as identified by survey	-	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500	Occurs along the east coast and north-west coast of Australia. Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony. Hunts in forested areas for insects like moths and flying insects.	Low or unlikely	The Project area does not contain cave, tunnel, mine, culvert or other structures known or suspected to be used for breeding.	No
Mammalia	Vespertilionidae	*Myotis macropus*	Southern Myotis	V	-	-	3	Yes	-	Species	no	n/a	n/a	-	Hollow-bearing trees. Land within 200m of riparian zone. Bridges, caves or artificial structures within 200 m of riparian zone.	Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water. Breeds November or December.	Low or unlikely	The Project area does not contain hollow-bearing trees or bridges, caves, or artificial structures within 200m of a riparian zone. However the Project area does constitute land within 200 m of a riparian zone but habitat within the Project area is ephemeral, providing marginal foraging fly-over habitat. The species is unlikely to utilise the habitats within the Project area.	No

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Mammalia	Vespertilionidae	*Vespadelus troughtoni*	Eastern Cave Bat	V	-	-	6	Yes	-	Species	Breeding	Description	Breeding habitat identified by survey	'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.	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. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat.	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest.	Low or unlikely	The Project area does not contain potential breeding habitat represented by associated PCTs within 100m of rocky areas, caves, overhangs, crevices, cliffs, escarpments, old mines, tunnels, old buildings or sheds. The Project area is unlikely to occur within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds. The Project area does not contain foraging habitat in the form of dry open forests and woodland, with the vegetation on site considered to be substantially degraded and largely represented by monocultures of high threat weed species. However, suitable habitat occurs in the land surrounding the Project area and the species has been detected within 1 km of the Project area. The species may flyover on occasion, being highly mobile. The species was considered on this basis, however, it is unlikely to utilise the habitats within the Project area.	No
Reptilia	Elapidae	*Hoplocephalus bitorquatus*	Pale-headed Snake	V	-	-	0	Yes	-	Species	no	n/a	n/a	-	-	A patchy distribution from north-east Queensland to the north-eastern quarter of NSW. In NSW it has historically been recorded from as far west as Mungindi and Quambone on the Darling Riverine Plains, across the north west slopes, and from the north coast from Queensland to Sydney. A small number of historical records are known for the New England Tablelands from Glenn Innes and Tenterfield; however, the majority of records appear to be from sites of relatively lower elevation. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest, the species can spend weeks at a time hidden in tree hollows. The species shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees.	Low or unlikely	The Project area lacks eucalypt forest and woodland habitat as well as hollow resources.	No
Plantae	Maundiaceae	*Maundia triglochinoides*	Maundia triglochinoides	V	-	-	-	Yes	-	Species	no	n/a	n/a	Riparian areas/drainage lines, water ponding, man-made dams and drainage channels up to 1 m deep	-	Coastal NSW: current southern limit at Wyong, former populations near Sydney now extinct. Grows on heavy clay, low nutrient soil in swamps, lagoons, dams, channels, creeks or shallow freshwater 30-60 cm depth.	Low/Unlikely	No suitable habitat within the Project area. Soils within the Project area are sandy with no clay subsoils present.	No
Plantae	Myrtaceae	*Melaleuca biconvexa*	Biconvex Paperbark	V	V	Species or species habitat known to occur within area	-	Yes	-	Species	no	n/a	n/a	-	-	Distributed from coastal areas in NSW, from Jervis Bay to Port Macquarie (Harden, 1991). Associated with Eucalypt open forest with Sydney Blue Gum Eucalyptus saligna, Swamp Mahogany Eucalyptus robusta and Mountain Cedar Wattle Acacia elata. Grows in damp areas, often near watercourses, on alluvium soils over shale. Flowers in Summer.	Low or unlikely	Location of study area does not align with the species described distribution. No previous records within the locality.	No
Plantae	Polygonaceae	*Persicaria elatior*	Tall Knotweed	V	V	Species or species habitat likely to occur within area	-	Yes	-	Species	no	n/a	n/a	Within 50 m of semi-permanent or ephermeral wet areas, swamps and waterbodies	-	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low or unlikely	Despite disturbance within the Project area, no swamp forests are present. No previous records have been recorded within the locality. The Project area is located approximately 29 km south of Raymond Terrace.	Yes
Aves	Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	E	CE; Mi	Species or species habitat known to occur within area	6	Yes	Ecosystem	Species	yes	Description	Mapped important areas	Mapped important areas	-	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Low or unlikely	The Project area does not occur in an area of mapped by OEH as important habitat for this species	No
Aves	Scolopacidae	*Calidris tenuirostris*	Great Knot	V	CE; Mi	-	3	Yes	Ecosystem	Species	yes	Description	Mapped important areas	Mapped important areas	-	Breeds in northern hemisphere. In Australia, prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, mangroves, saltwork ponds, near-coastal swamps, saltlakes and non-tidal lagoons. Rarely occurs on inland lakes and swamps. Roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding areas.	Low or unlikely	The Project area does not occur in an area of mapped by OEH as important habitat for this species	No
Aves	Anatidae	*Nettapus coromandelianu*	Cotton Pygmy Goose	E	-	-	-	Yes	-	Species	no	n/a	n/a	Deep permanent fresh waters on floodplains with floating and submergent vegetation.	-	Small surface-feeding duck with a goose-like bill. Prefers freshwater lakes, lagoons, swamps and dams, particularly those vegetated with waterlilies and other floating and submerged aquatic vegetation. Uses standing dead trees with hollows close to water for roosting and breeding.	Low or unlikely	The Project area does not contain any permanent fresh waters on floodplains with submergent vegetation. No previous records within the locality	No
Aves	Strigidae	*Ninox connivens*	Barking Owl	V	-	-	4	Yes	Ecosystem	Species	no	n/a	n/a	-	Hollow-bearing trees- Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including *Eucalyptus camaldulensis* , *Eucalyptus albens* , *Eucalyptus polyanthemos* and *Eucalyptus blakelyi* . Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	Low or unlikely	The Project area does not contain any suitable breeding sites in the form of hollow bearing trees	No
Mammalia	Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-Wallaby	E	V	Species or species habitat may occur within area	-	Yes	-	Species	yes	Area	0	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines	-	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Low or unlikely	The Project area is not within 1 km of rocky escarpments, gorges, steep slopes, boulder piles rock outfrops of cliflines. No previous records within the locality.	No
Aves	Laridae	*Sternula albifrons*	Little Tern	E	Mi	Breeding likely to occur within area	5	Yes	Ecosystem	Species	no	n/a	n/a	Mapped important areas	-	In eastern Australia, many breeding colonies lie within conservation reserves, or within Ramsar-listed wetlands, or both. Little Terns occur in two Ramsar listed sites in NSW, Towra Point Nature Reserve and Hunter Estuary Wetlands (including Kooragang Nature Reserve). Inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches.	Low or unlikely	The Project area does not occur in an area of mapped by OEH as important habitat for this species	No
Aves	Turnicidae	*Turnix maculosus*	Red-backed Button-quail	V	-	-	-	Yes	-	Species	no	n/a	n/a	-	-	Occurs from the Kimberleys in Western Australia, to the top end of the Northern Territory, through to eastern Queensland and north-eastern NSW. The species inhabits grasslands, heath and crops. Prefers sites close to water when breeding with nests made in a shallow depression sparsely lined with grass and ground litter. Time of breeding is not very well known. It has been observed associated with the following grasses (in various vegetation formations): speargrass Heteropogon, Blady Grass (*Imperata cylindrical*), Triodia, Sorghum, and Buffel Grass (*Cenchrus ciliaris*)	Low or unlikely	The Project area foes not contain suitable grassland, heaths or crop habitat for this species. No previous records within the locality.	No

Group	Family	Scientific Name	Common Name	Status		Input Source			Credit Type		SAII Entity	SAII threshold type	SAII threshold	Habitat constraints		Habitat Association	Likelihood of ocurrence	Justification	Include as Candidate Species for targeted survey and assessment for species credits
				BC Act	EPBC Act	EPBC Act Protected Matters Report (DEE, 2020)	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2020)	Generated by BAM Calculator	Ecosystem	Species				Foraging or roosting	Breeding				
Aves	Scolopacidae	*Xenus cinereus*	Terek Sandpiper	V	Mi	-	1	Yes	Ecosystem	Species	no	n/a	n/a	Mapped important areas	-	The two main sites for this species in NSW are the Richmond River and Hunter River estuaries. Inhabits coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks near mangroves, also observed on rocky pools and reefs and up to 10 km inland around brackish pools. Roost communally in mangroves or dead trees. Forages in open intertidal mudflats.	Low or unlikely	The Project area does not occur in an area of mapped by OEH as important habitat for this species	No
Aves	Laridae	*Onychoprion fuscata*	Sooty Tern	V	-	-	1	No	-	Breeding	no	n/a	n/a	-	-	Occurs over tropical and subtropical seas and islands around northern NSW. Occasionally seen along coastal NSW, especially after cyclones. Breeds in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	Low or unlikely	No breeding or foraging habitat within the Project area is present.	No
Invertebrate	Petaluridae	*Petalura gigantea*	Giant Dragonfly	E	-	-	1	No	-	Species	yes	Description	Only proposals that will result in disturbances to swamp hydrology	-	Within 500 m of swamps	The Giant Dragonfly is found along the east coast of NSW from the Victorian border to northern NSW. It is not found west of the Great Dividing Range. There are known occurrences in the Blue Mountains and Southern Highlands, in the Clarence River catchment, and on a few coastal swamps from north of Coffs Harbour to Nadgee in the south. Live in permanent swamps and bogs with some free water and open vegetation. Adults emerge from late October and are short-lived, surviving for one summer after emergence.	Low or unlikely	Whilst the Project area may contain potential habitat, the swamp habitat is not permanently inundated with water. The hydrology of this ephermeral habitat is unlikely to be impacted by the Project. Not observed during surveys.	No
Amphibia	Myobatrachidae	*Pseudophryne australis*	Red-crowned Toadlet	V	-	-	1	No	-	Species	no	n/a	n/a	-	-	Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	Low or unlikely	No breeding habitat occurs within the Project area. The Project area is not located within 100 m of any ridgelines.	No

Table B.3 Assessment of likelihood of occurrence of MNES threatened and migratory species not considered candidate or predicted species

Group	Family	Scientific Name	Common Name	Status		Input Source		Habitat Association	Likelihood of ocurrence	Justification	Assessment with due reference to Significant Impact Guidelines 1.1 required
				BC Act	EPBC Act	EPBC Act Protected Matters Report	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)				
Amphibia	Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E	V	Species or species habitat known to occur within area	0	Found in differing habitat throughout NSW and Victoria. Likely to occur in areas where *Juncus kraussii* , *Schoenoplectus litoralis* and *Sporobolus virginicus* are present (Pyke et. al, 2002). Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (G*ambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available but can occupy disturbed habitat. Breeds in permanent or ephemeral ponds during late winter to early autumn, but generally during September–February with a peak around January–February after heavy rain or storms (Daly 1995; White 2001).	Low or unlikely	The species occupies marshes, dams and stream-sides that are relatively unshaded and will utilise adjacent tussock grasslands to travel between waterbodies. The Project area includes a small area of wetland /swamp habitat that would provide suitable habitat for this species. It should be noted however that Green and Golden Bell Frogs have not been recorded in the Belmont area since the 1970's	No
Amphibia	Hylidae	*Litoria littlejohni*	Littlejohn's Tree Frog	V	V	Species or species habitat may occur within area	0	Littlejohn's Tree Frog has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. The majority of records are from within the Sydney Basin Bioregion with only scattered records south to the Victorian border and this species has not been recorded in southern NSW within the last decade. Records are isolated and tend to be at high altitude. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	Low or unlikely	The Project area is not situated in high elevation landscapes and does not contain forests and woodland habitat. The species is highly unlikely to occur.	No
Amphibia	Myobatrachidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	Species or species habitat may occur within area	0	Occurs along the eastern slopes of the Dividing Range in hanging swamps on sandstone shelves and beside creeks. Also occurs in ephemeral sand or rock based streams with a sandy silt or clay base. Has a generalist diet and studies to date indicate that they eat mainly invertebrates including ants, beetles, cockroaches, spiders, centipedes and scorpions. Breeding habitat is generally soaks or pools within first or second order streams or 'hanging swamp' seepage lines and where small pools form from the collected water. Breeds mainly in	Low or unlikely	The Project area is not located in the known range of the species and does not contain hanging swamps, seepages, ephemeral creeks on silt or clay. The species is highly unlikely to occur.	No
Aves - Migratory	Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V	Ma	Species or species habitat known to occur within area	35	Distributed along the Australian coastline and well inland along rivers and wetlands, it's widespread in eastern NSW. Foraging habitat consists of coastal seas, rivers, fresh and saline lakes, lagoons, reservoirs and terrestrial habitats such as grasslands. Diet consists of waterbirds, turtles and fish. Resident pairs are territorial and occupy nesting territories of hundreds of hectares. Breeding habitat consists of large trees within mature open forest, gallery forest or woodland and reported that they avoid nesting near urban areas. 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.	Low or unlikely	Project area lacks turtles, fish or waterbird prey species, although suitable habitat occurs in the surrounding land in association with Lake Macquarie and Belmont Lagoon. The species may flyover the Project area from time to time but is unlikely to utilise the Project area. No breeding habitat within the Project area in the form of large trees.	No
Aves - Migratory	Accipitridae	*Pandion cristatus*	Eastern Osprey	V	Mi, Ma	Species or species habitat known to occur within area	16	Found around the Australian coastline, except Victoria and Tasmania. They are common around the northern coast, especially on rocky shores. Favour areas along the coast like river mouths, lagoons and lakes. Feed on fish in clear, open water. Nests in crowns of dead trees a kilometre from the ocean.	Low or unlikely	Project area lacks fish prey species, although suitable habitat occurs in the surrounding land in association with Lake Macquarie and Belmont Lagoon. The species may flyover the Project area from time to time but is unlikely to utilise the Project area. No breeding habitat within the Project area in the form of large trees.	No
Aves - Migratory	Apodidae	*Apus pacificus*	Fork-tailed Swift	-	Mi, Ma	Species or species habitat likely to occur within area	3	Recorded in all regions of NSW. Non- breeding, and almost exclusively aerial while in Australia. Occurs over urban and rural areas as well as areas of native vegetation.	Low or unlikely	May fly over the Project area but unlikely to occur within or utilise the habitats in the Project area	No
Aves - Migratory	Charadriidae	*Pluvialis fulva*	Pacific Golden Plover	-	Mi, Ma	Species or species habitat known to occur within area	5	Widespread in coastal regions, though there are also a number of inland records (in all states), sometimes far inland and usually along major river systems, especially the Murray and Darling Rivers and their tributaries. Most Pacific Golden Plovers occur along the east coast, and are especially widespread along the Queensland and NSW coastlines. Breeds mostly in northern Siberia as well as in western Alaska. In Australia this species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. The Pacific Golden Plover is found on muddy, rocky and sandy wetlands, shores, paddocks, saltmarsh, coastal golf courses, estuaries and lagoons. Eats molluscs, insects, worms, crustaceans, lizards and is known to eat birds' eggs and small fish.	Low or unlikely	Project area does not contain any permanent wetland areas. Species may occasionally forage within Project area, however this occurs marginally. No muddy or rocky wetlands and saltmarsh occur within the Project area.	No

Group	Family	Scientific Name	Common Name	Status		Input Source		Habitat Association	Likelihood of ocurrence	Justification	Assessment with due reference to Significant Impact Guidelines 1.1 required
				BC Act	EPBC Act	EPBC Act Protected Matters Report	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)				
Aves - Migratory	Cuculidae	*Cuculus optatus*	Oriental Cuckoo	-	Mi	Species or species habitat may occur within area	0	The Oriental cuckoo has an extremely large range, breeding from Siberia to the Himalayas, across Southeast Asia, southern China, Korea, Japan and Taiwan. Over winter this species migrates to the Malay Peninsula, Indonesia, the Philippines, New Guinea, the Solomon Islands, northern and eastern Australia, and occasionally as far as New Zealand. It has a large breeding range in northern Eurasia. It feeds mainly on insects and their larvae, foraging for them in trees and bushes as well as on the ground.	Low or unlikely	There are no sclerophyll forest habitats within the Project area, although potential habitat could occur outside of the Project area in surrounding vegetation. Not likely to utilise the habitats within the Project area.	No
Aves - Migratory	Laridae	*Sternula albifrons*	Little Tern	-	Mi, Ma	Breeding likely to occur within the area	5	Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire east coast from Tasmania to northern Queensland, and is seen until May, with only occasional birds seen in winter months. Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). The Little Tern eats small fish, insects, crustaceans and other invertebrates. It prefers to feed over shallower coastal waters and can hover briefly with the body horizontal and the bill pointing down, before plunging into the water to catch prey. Breeds on sandy shores above the high tide mark.	Low or unlikely	Project area lacks foraging habitat, although suitable habitat occurs in the surrounding land in association with Lake Macquarie and Belmont Lagoon. The species may flyover the Project area from time to time but is unlikely to utilise the Project area. Potential breeding habitat occurs to the east of the Project area on the seaward side of the foredunes. The species is unlikely to occur within the Project area.	No
Aves - Migratory	Laridae	*Thalasseus bergii*	Crested Tern		Mi, Ma	Breeding known to occur within area	0	Distributed around the Australian coast, including Tasmania. It occurs on ocean beaches, estuaries and coastal lagoons and occasionally on salt lakes. The species is known to rest on sand spits, low points and reefs along coastal beaches and inlets. It rarely flies far from shore out to sea or inland on bodies of fresh water.	Low or unlikely	The Project area is located on beach habitat however no sand spits, reefs or inlets occur. Unlikley to provide the microhabitat associated for this species. No previous records within the locality.	No
Aves - Migratory	Monarchidae	*Monarcha melanopsis*	Black-faced Monarch	-	Mi, Ma	Species or species habitat known to occur within area	0	The Black-faced Monarch is found along the coast of eastern Australia, becoming less common further south. The Black-faced Monarch is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Low or unlikely	No forested habitats within the Project area and the habitats on the foredunes are substantially degraded by Bitou Bush and exotic grassland. Coastal dune scrub may provide marginal habitat to the species in the north-east of the Project area	No
Aves - Migratory	Monarchidae	*Myiagra cyanoleuca*	Satin Flycatcher	-	Mi, Ma	Species or species habitat known to occur within area	0	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally not in rainforests.	Low or unlikely	No suitable eucalypt forest habitat or woodlands within the Project area. No mangrove habitats present. Not likely to utilise the habitats within the Project area.	No
Aves - Migratory	Monarchidae	*Symposiarchus trivirgatus*	Spectacled Monarch		Mi, Ma	Species or species habitat known to occur within area	0	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. It is also found in Papua New Guinea, the Moluccas and Timor. The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Low or unlikely	No forested habitats or suitable vegetation within the Project area.	No
Aves - Migratory	Motacillidae	*Motacilla flava*	Yellow Wagtail	-	Mi, Ma	Species or species habitat likely to occur within area	0	An extremely widespread species, the yellow wagtail occurs across Europe, Africa and Asia, to Alaska and northern Australia. A migratory species, its breeds at northern latitudes and travels southwards before the onset of winter. It inhabits open country near water, such as wet meadows and nests in tussocks.	Low or unlikely	No wetland meadows or tussock grasslands within the Project area as would be found on coastal floodplains.	No
Aves - Migratory	Rhipiduridae	*Rhipidura rufifrons*	Rufous Fantail	-	Mi, Ma	Species or species habitat known to occur within area	0	The Rufous Fantail is found in northern and eastern coastal Australia, being more common in the north. It is also foind in New Guinea, the Solomon Islands, Sulawesi and Guam. The Rufous Fantail is found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas. The Rufous Fantail feeds on insects, which it gleans from the middle and lower levels of the canopy. It is a very active feeder and constantly fans tail and flicks wings and body while foraging. Breeding The Rufous Fantail builds a small compact cup nest, of fine grasses bound with spider webs, that is suspended from a tree fork about 5 m from the ground. The bottom of the nest is drawn out into a long stem. Both sexes share nest-building, incubation and feeding of the young. One or two broods may be raised in a season.	Low or unlikely	There is no suitable habitat for this species to forage or breed within. The Project area lacks canopy vegetation where it likes to forage, and lacks trees within which to build nests.	No

Group	Family	Scientific Name	Common Name	Status		Input Source		Habitat Association	Likelihood of ocurrence	Justification	Assessment with due reference to Significant Impact Guidelines 1.1 required
				BC Act	EPBC Act	EPBC Act Protected Matters Report	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)				
Aves - Migratory	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	-	Mi, Ma	Species or species habitat known to occur within area	1	Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.	Low or unlikely	Project area does not contain any permanent wetland areas. Species may occasionally forage within Project area, however this occurs marginally.	No
Aves - Migratory	Scolopacidae	*Arenaria interpres*	Ruddy Turnstone	-	Mi, Ma	Species or species habitat known to occur within area	3	Widespread within Australia during its non-breeding period of the year (Bamford et al. 2008), including from Tasmania in the south to Darwin in the north and many coastal areas in between. It is found in most coastal regions, with occasional records of inland populations (Higgins & Davies 1996). It strongly prefers rocky shores or beaches where there are large deposits of rotting seaweed (C.D.T. Minton 2002, pers. comm.). Mainly found on coastal regions with exposed rock coast lines or coral reefs. It also lives near platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches. It can, however, be found on sand, coral or shell beaches, shoals, cays and dry ridges of sand or coral. It has occasionally been sighted in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed beds of seagrass, around sewage ponds and on mudflats.	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is potential habitat in the form of estuarine tidal mudflat habitats as well as seagrass beds and saltmarsh habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The beach habitat to the east of the Project area does not feature rocky platforms, shallow tidal pools, and is not rocky or gravelly. The species has potential to occur further to the west of the Project area but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Migratory	Scolopacidae	*Calidris acuminata*	Sharp-tailed Sandpiper	-	Mi, Ma	Species or species habitat known to occur within area	4	Migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats; many inland records are of birds on passage (Cramp 1985; Higgins & Davies 1996). Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Low or unlikely	No wetland habitats within the Project area featuring mudflats, fringing sedge habitat, saltmarsh, emergent vegetation etc., although there is potential suitable habitat within the wider area. Unlikely to utilise the habitats within the Project area.	No
Aves - Migratory	Scolopacidae	*Calidris melanotos*	Pectoral Sandpiper	-	Mi, Ma	Species or species habitat likely to occur within area	0	Widespread but scattered records across NSW, east of the divide and in the Riverina and Lower Western regions. Breeds in the northern hemisphere. In Australasia, prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually in coastal or near-coastal habitats, and prefers wetlands with open mudflats and low emergent or fringing vegetation such as grass or samphire.	Low or unlikely	No wetland habitats within the Project area featuring mudflats, fringing sedge habitat, samphire, emergent vegetation etc., although there is potential suitable habitat within the wider area. Unlikely to utilise the habitats within the Project area.	No
Aves - Migratory	Scolopacidae	*Callidris ruficollis*	Red-necked Stint	-	Mi, Ma	Species or species habitat known to occur within area	5	It is distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. The Red-necked Stint has been recorded in all coastal regions, and found inland in all states when conditions are suitable. It may occur in sheltered inlets, bays, lagoons, estuaries, intertidal mudflats and protected sandy or coralline shores.	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is potential habitat in the form of estuarine tidal mudflat habitats as well as seagrass beds and saltmarsh habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The beach habitat to the east of the Project area does not feature protected sandy or coralline shores. The species has potential to occur further to the west of the Project area but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Migratory	Scolopacidae	*Charadrius bicinctus*	Double-banded Plover	-	Mi, Ma	Species or species habitat known to occur within area	0	Found in both coastal and inland areas; eastern and southern Australia, mainly between the Tropic of Capricorn and western Eyre Peninsula, with occasional records in northern Queensland and Western Australia (Marchant & Higgins 1993). The greatest numbers are found in Tasmania and Victoria, but numbers diminish to the north and west of these regions (C.D.T. Minton, 2002 pers. comm.) Found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture.	Low or unlikely	Marginal wetland habitat within the Project area although this lacks saltmarsh, native grassland or pasture habitat. No previous records within the locality.	No
Aves - Migratory	Scolopacidae	*Gallinago hardwickii*	Latham's Snipe	-	Mi, Ma	Species or species habitat may occur within area	1	Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabit permanent and ephemeral wetlands up to 2000 m asl. Typically in open, freshwater wetlands with low, dense vegetation (incl. swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.	Moderate	A small area of suitable habitat within the project area however species is more likely to utilise higher quality habitats present in the nearby Belmont Lagoon, Lake Maquarie and connected waterbodies).	No

Group	Family	Scientific Name	Common Name	Status		Input Source		Habitat Association	Likelihood of ocurrence	Justification	Assessment with due reference to Significant Impact Guidelines 1.1 required
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Aves - Migratory	Scolopacidae	*Limicola falcinellus*	Broad-billed Sandpiper	V	Mi, Ma	Species or species habitat known to occur within area	0	The Broad-billed Sandpiper breeds in the northern hemisphere, moving south for the non-breeding season. The Broad-billed Sandpiper occurs in sheltered parts of the coast, favouring estuarine mudflats but also occasionally occur on saltmarshes, shallow freshwater lagoons, saltworks and sewage farms, and in areas with large soft intertidal mudflats, which may have shell or sandbanks nearby.	Low or unlikely	There are no estuarine mudflats or salmarsh habitat within the Project area. The decommissioned evaporation ponds are dry and do not contain wetland habitats for the species. Unlikely to occur. No previous records within the locality.	No
Aves - Migratory	Scolopacidae	*Numenius phaeopus*	Whimbrel	-	Mi, Ma	Species or species habitat known to occur within area	3	A regular migrant to Australia and New Zealand, with a primarily coastal distribution. There are also scattered inland records in all regions. It is found in all states but is more common in the north. It is found along almost the entire coast of Queensland and NSW. Breeds in north and west Alaska, Eurasia and Iceland. Often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms.	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is potential habitat in the form of estuarine tidal mudflat habitats as well as seagrass beds and saltmarsh habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The beach habitat to the east of the Project area does not feature rocky platforms, shallow tidal pools, and is not rocky or gravelly. The species has potential to occur further to the west of the Project area but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Migratory	Scolopacidae	*Tringa brevipes*	Grey-tailed Tattler	-	Mi, Ma	Species or species habitat known to occur within area	1	In NSW the Grey-tailed Tattler is distributed along most of the coast from the Queensland border, south to Tilba Lake. It is more heavily distributed along coastal regions north of Sydney. It can be found on sheltered coasts with reefs and rock platforms or with intertidal mudflats, at intertidal rocky, coral or stony reefs that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats. (DoE 2019).	Low or unlikely	No intertidal mudflats, rock platforms, stony or coral reef habitats within the Project area.	No
Aves - Migratory	Scolopacidae	*Tringa nebularia*	Common Greenshank	-	Mi, Ma	Species or species habitat known to occur within area	2	Does not breed in Australia, but occurs in all types of wetlands. In NSW has been recorded in most coastal regions and is widespread west of the Great Dividing Range, particularly in the north-west, Macquarie Marshes and areas between the Lachlan and Murray Rivers and Darling River drainage basin. The Hunter River estuary is an internationally important site for the species. In coastal areas typically occurs in sheltered habitats with large mudflats and saltmarsh,mangroves or seagrass.	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is potential habitat in the form of estuarine tidal mudflat habitats as well as seagrass beds and saltmarsh habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The species has potential to occur further to the west of the Project area but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Migratory	Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper, Little Green Shank	-	Mi, Ma	Species or species habitat known to occur within area	0	Recorded in all regions of NSW but especially the central and south coasts and (inland) on the western slopes of Great Divide and western plains. Lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes.	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is potential habitat in the form of estuarine tidal mudflat habitats as well as seagrass beds and saltmarsh habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The species has potential to occur further to the west of the Project area but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species. The decommissioned evaporation ponds are dry and do not contain wetland habitats for the species. Unlikely to occur.	No
Aves - Threatened	Apodidae	*Hirundapus caudacutus*	White-throated Needletail	-	V, Mi, Ma	Species or species habitat known to occur within area	7	White-throated Needletails often occur in large numbers over eastern and northern Australia. White-throated Needletails are aerial birds and for a time it was commonly believed that they did not land while in Australia. It has now been observed that birds will roost in trees, and radio-tracking has since confirmed that this is a regular activity. The species does not breed in Australia	Low or unlikely	Could flyover the Project area as this species is an aerial hawker and will drink on the wing as well. Although recorded in the surrounding area during surveys for the pipeline project, there are no trees presenting roosting habitat for the species within the Project area. The species is highly unlikely to utilise the habitats within the Project area.	No

Group	Family	Scientific Name	Common Name	Status		Input Source		Habitat Association	Likelihood of ocurrence	Justification	Assessment with due reference to Significant Impact Guidelines 1.1 required
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Aves - Threatened	Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern	E	E	Species or species habitat known to occur within area	0	When in Australia, distributed from Queensland to South Australia and Tasmania. Preferred habitat is permanent freshwater wetlands with tall, dense reedbeds particularly *Typha* spp. and *Eleocharis* spp., with adjacent shallow, open water for foraging. Feeds on wetland animals including fish, eels, crayfish and frogs. Roosts amongst dense reeds or rushes. Breeds from spring to summer in solitary and territorial pairs.	Low or unlikely	There are no permanent freshwater wetland habitats within the Project area for this species which would provide the prey species for the Australasian Bittern. Suitable habitat occurs in the wider locality, within the Belmont Wetlands State Park and in wetland vegetation associated with Belmont Lagoon.	No
Aves - Threatened	Charadriidae	*Charadrius mongolus*	Lesser Sand-plover	V	E, Mi, Ma	Species or species habitat known to occur within area	7	Found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW (OEH 2012). Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms (OEH 2012).	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is preferred estuarine tidal mudflat habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The species has potential to occur either on the beach to the east of the Project area or further to the west but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Threatened	Charadriidae	*Thinornis rubricollis rubricollis*	Hooded Plover	-	V, Ma	Species or species habitat likely to occur within area	0	The hooded plover (eastern) is a small Australian beach nesting bird. It mainly occurs on wide beaches backed by dunes with large amounts of seaweed and jetsam, creek mouths and inlet entrances. Nests are found above the high water mark on flat beaches, on stony terraces, or on sparsely vegetated dunes. As the hooded plover occurs on beaches, it is easily disturbed by human activities, particularly off-leash domestic dogs. Its diet includes insects, sandhoppers (*Orchestia* sp.), small bivalves, and soldier crabs (*Mictyris platycheles*). It forages at all levels of the beach during all tide phases. It is most usually seen in pairs or small groups, darting about at the water's edge as waves recede, bobbing and pecking along the shore. Excavates a shallow scrape in sand or fine gravel situated above the high-tide mark on ocean beaches or among dunes. This nest may be encircled or lined with pebbles, seaweed and other beach debris.	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. The species is not known from the locality, with no records in BioNet or in the Birdlife Birdata database. Only one record from July 2016 exists and is located on the northern end of Stockton Beach near Anna Bay. Furthermore, the presence of regular pedestrian and 4WD traffic would discourage the species. If present, the species would be expected to occur nearby to the east of the desalination plant site where there is a sparse cover of spinifex and pigface vegetation on sandy substrate in view of the water. Within the Project area itself, there is sub-optimal habitat that is substantially degraded by Bitou Bush invasion and exotic grasses.	No
Aves - Threatened	Dasyornithidae	*Dasyornis brachypterus*	Eastern Bristlebird	E	E	Species or species habitat likely to occur within area	0	Three main populations, in south-eastern Queensland, Central NSW and southern NSW. The species prefers open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone. Feeds on a variety of insects, particularly ants. Nests are elliptical domes constructed on or near the ground amongst dense vegetation and eggs are laid between August to Februrary.	Low or unlikely	There is no open forest habitats with tussock grass understorey within the Project area.	No
Aves - Threatened	Laridae	*Sternula nereis nereis*	Australian Fairy Tern	-	V	Species or species habitat may occur within area	0	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from New South Wales (NSW) in the past, but it is unknown if it persists there. Nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night. They nest in clear view of the water and on sites where the substrate is sandy and the vegetation sparse. Given the exposed nature of its nesting and roosting sites, the species is vulnerable to extreme weather events such as storms, floods, high tides and windblown sand which can put an entire breeding season at risk. Fishes over open water.	Low or unlikely	The Project area occurs on foredunes on the landward side of Nine Mile Beach. The species is not known from the locality and the presence of regular pedestrian and 4WD traffic would discourage the species. If present, the species would be expected to occur nearby to the east of the desalination plant site where there is a sparse cover of spinifex and pigface vegetation on sandy substrate in view of the water. Within the Project area itself, there is sub-optimal habitat that is substantially degraded by Bitou Bush invasion and exotic grasses.	No
Aves - Threatened	Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	CE	CE	Species or species habitat known to occur within area	9	Distribution extends from south-east Queensland to central Victoria. Preferred habitat is dry open forests and woodlands, particularly box-ironbark eucalypt woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes. Also uses remnant patches including travelling stock routes and roadside reserves when moving between habitat and areas of flowering eucalypt. Feeds on invertebrates and nectar from mistletoe and eucalypts. Breeding corresponds with flowering Eucalypts. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and Sheoaks. Also nest in mistletoe haustoria. Nest is an open cup-shaped nest is constructed of bark, grass, twigs and wool by the female.	Low or unlikely	The Project area is poor in foraging resources. It lacks mature trees, flowering eucalypts and mistletoes. Could visit habitat surrounding the Project area and be recorded flying over the Project area from time to time. Unlikely to occur within or utilise habitats within the Project area.	No

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Aves - Threatened	Meliphagidae	*Grantiella picta*	Painted Honeyeater	V	V	Species or species habitat may occur within area	0	Nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Inhabits Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests. Specialist forager on the fruits of mistletoes, preferably of the Amyema genus. Nests in outer tree canopy.	Low or unlikely	The Project area is poor in foraging resources. It lacks mature trees, flowering eucalypts and mistletoes. Could visit habitat surrounding the Project area and be recorded flying over the Project area from time to time, although no records exist for the locality and the species is considered rare on the coast. The Project area does not occur within the breeding range of the species. Unlikely to occur within or utilise habitats within the Project area.	No
Aves - Threatened	Psittacidae	*Lathamus discolor*	Swift Parrot	E	CE	Species or species habitat known to occur within area	37	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inlad slopes and plains. *Eucalyptus robusta* , *Corymbia maculata* and *C. gummifera* dominated coastal forests are also important habitat.	Low or unlikely	The Project area is poor in wintering foraging resources. It lacks mature trees and flowering eucalypts. Could visit habitat surrounding the Project area and be recorded flying over the Project area from time to time. Unlikely to occur within or utilise habitats within the Project area. The majority of habitat within the Project area is substantially degraded by BItou Bush invasion.	No
Aves - Threatened	Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E	E, Ma	Species or species habitat likely to occur within area	0	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Low or unlikely	There is no permenant wetland habitats within the Project area featuring mudflats, or native lignum and grass cover, or scrub and open timber cover. Suitable habitat occurs in the wider locality, within the Belmont Wetlands State Park and in wetland vegetation associated with Belmont Lagoon. The species is unliklely to occur in the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Threatened	Scolopacidae	*Calidris canutus*	Red Knot	-	E, Mi, Ma	Species or species habitat known to occur within area	0	The Red Knot is commonly found in most parts of coastal Australia except in the Great Australian Bight. Typical habitat includes intertidal mudflats, sandflats and sandy beaches on the coast, estuaries, bays, inlets and harbours. Forage on substrate near the edge of the water on low tide. Have been recorded foraging on eelgrass. Breeds in Arctic areas. Preferred habitat is sandy estuaries with tidal mudflats.	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is preferred estuarine tidal mudflat habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The species has potential to occur either on the beach to the east of the Project area or further to the west but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Threatened	Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	E	CE, Mi, Ma	Species or species habitat known to occur within area	6	Distributed around the Australian coast and widespread inland during their non-breeding season. Mainly reside on intertidal mudflats in sheltered coastal areas, like estuaries, bays, inlets and lagoons. Forage on mudflats, and amongst vegetation like saltmarsh and feeds on seagrass, seaweed, algae and waterweed. Roost on dry shingle, shell or sand beaches, sandspits and islets around wetlands or lagoons. Breeding occurs in Siberia (TSSC, 2015).	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is preferred estuarine tidal mudflat habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The species has potential to occur either on the beach to the east of the Project area or further to the west but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Threatened	Scolopacidae	*Charadrius leschenaultii*	Greater Sand-plover	V	V, Mi, Mar	Species or species habitat known to occur within area	2	Does not breed in Australia. In NSW, recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; forage on wet ground at low tide. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks (OEH 2012).	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is preferred estuarine tidal mudflat habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The species has potential to occur either on the beach to the east of the Project area or further to the west but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No

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Aves - Threatened	Scolopacidae	*Limosa lapponica baueri*	Bar-tailed Godwit (baueri)	-	V, Mi, Ma	Species or species habitat known to occur within area	14	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. It is rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips, although it is commonly recorded in paddocks at some locations overseas (Marchant & Higgins 1993).	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is preferred estuarine tidal mudflat habitats as well as seagrass beds and saltmarsh habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The species has potential to occur either on the beach to the east of the Project area or further to the west but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Threatened	Scolopacidae	*Limosa lapponica menzbieri*	Northern Siberian Bar-tailed Godwit	-	CE, Mi, Ma	Species or species habitat may occur within area	0	The Northern Siberian Bar-tailed Godwit is a large Migratory shorebird which breeds in northern Siberia, Russia between the Khatanga River and the delta of the Kolyma River. During the non-breeding period, the distribution of L. l. menzbieri is predominantly in the north and north-west of Western Australia and in south-eastern Asia.	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is preferred estuarine tidal mudflat habitats as well as seagrass beds and saltmarsh habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The species has potential to occur either on the beach to the east of the Project area or further to the west but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Aves - Threatened	Scolopacidae	*Numenius madagascariensis*	Eastern Curlew	-	CE, Mi, Ma	Species or species habitat known to occur within area	8	The Curlew is a migratory bird that travels from Australia to Russia. In Australia it is primarily coastal, residing in estuaries, bays, harbours, inlets and coastal lagoons. Forages on crabs and molluscs on mudflats.	Low or unlikely	The Project area occurs on hind and foredunes on the landward side of Nine Mile Beach. There is preferred estuarine tidal mudflat habitats as well as seagrass beds and saltmarsh habitats to the west of the Project area associated with the margins of Belmont Lagoon and Lake Maquarie. The species has potential to occur further to the west of the Project area but is unlikely to utilise the habitats within the Project area as it lacks the microhabitat sites preferred by the species	No
Flora	Apocynaceae	*Cynanchum elegans*	White-flowered Wax Plant	E	E	Species or species habitat known to occur within area	2	Distributed from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and *Melaleuca* scrub. Occurs in association with Small-fruited mock-olive *Notelaea microcarpa* and Acacia species inland, and coastally with Coast Banksia *Banksia integrifolia* , Morton Bay Fig *Ficus macrophylla* and Coast Tea-tree *Leptospermum laevigatum* and Rough-fruit Pittosporum *Pittosporum revolutum* . Soil and geology types are not limiting.	Low or unlikely	The Project area would have originally supportedhabitat characterised by Coast Banksia and Coastal Teatree but the habitat within the Project area is now substantially degraded by high threat weed species, Bitou Bush, which forms a monocultural thicket on the foredunes.	No
Flora	Asteraceae	*Rutidosis heterogama*	Heath Wrinklewort	V	V	Species or species habitat likely to occur within area	0	Distributed on the North Coast and Northern Tablelands of NSW. This species mostly inhabits heath, and is often found along disturbed roadsides. It occurs on moist sites in open forest and in sedgeland/heathland within shrubby open forest and woodland, at 860–1040 m above sea level, on granitic substrates in podsolic and lithosolic soils.	Low or unlikely	No suitable shrubby heath or sedge woodlands and / or open forests within the Project area. This species is not typically associated within foredune habitats and is not likely to occur.	No
Flora	Elaeocarpaceae	*Tetratheca juncea*	Black-eyed Susan	V	V	Species or species habitat known to occur within area	1986	Restricted to north of the Sydney Basin bioregion, in the Local Government Areas of Newcastle, Wyong, Lake Macquarie, Port Stephens and the Great Lakes. Usually found in low open forest and woodland, with a mixed shrub understorey and grassy groundcover. Associated species include Smooth-Barked Apple Angophora costada, Red Bloodwood Corymbia gummifera, Scribbly Gum Eucalyptus haemastoma and Brown Stringybark Eucalyptus capitellata (Gardner and Murray, 1992) . Mostly occur on low nutrient soils.	Low or unlikely	No habitats associated with Smooth-barked Apple or Scribbly Gum forests within the Project area, although the species is known from the locality. The majority of the Project area also contains habitat that is substantially degraded by Bitou Bush invasion.	No
Flora	Fabaceae (Mimosoideae)	*Acacia bynoeana*	Bynoe's Wattle	E	V	Species or species habitat known to occur within area	11	Found in central eastern NSW, from the Hunter to the Southern Highlands to west of the Blue Mountains. Occurs in dry sclerophyll forest or heathlands on sandy soils. Associated with Red Bloodwood Corymbia gummifera, Scribbly Gum Eucalyptus haemastoma and Parramatta Red Gum Eucalyptus parramattensis.	Low or unlikely	Not recorded during survey of the Project area. The habitat within the Project area is substantially degraded by Bitou Bush invasion. No trees were recorded except for a few regenerating *Melaleuca quinquenervia* trees in one stand.	No

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Flora	Myrtaceae	*Angophora inopina*	Charmhaven Apple	V	V	Species or species habitat likely to occur within area	31	Endemic to the Central Coast of NSW, from Karuah to Charmhaven. Occurs in wet heath with Scribbly Gum Eucalyptus haemastoma and Red Bloodwood Corymbia gummifera, sedge woodland with River Bottlebrush Melaleuca sieberi and Red Mahogany Eucalyptus resinifera, and woodland/forest with Brown Stringybark Eucalyptus capitellata and Red Bloodwood Corymbia gummifera. Flowers between mid-December and mid-January.	Low or unlikely	Not recorded during survey of the Project area. The habitat east of Ocean Park Rd within the Project area is substantially degraded by Bitou Bush invasion. No trees occur within the Project area.	No
Flora	Myrtaceae	*Eucalyptus camfieldii*	Camfield's Stringybark	V	V	Species or species habitat likely to occur within area	2	Distributed from Raymond Terrace to Waterfall NSW. Exists in coastal heath on exposed sandy ridges. Associated species frequently include stunted species of Narrow-leaved Stringybark Eucalyptus oblonga, Brown Stringybark Eucalyptus capitellata and Scribbly Gum Eucalyptus haemastoma. It grows in shallow sandy soils overlying Hawkesbury sandstone.	Low or unlikely	No trees occur in the Project area. Furthermore the habitat within the Project area is not associated with heathy woodland or forest vegetation.	No
Flora	Myrtaceae	*Eucalyptus parramattensis subsp. decadens*	Earp's Gum	V	V	Species or species habitat likely to occur within area	0	There are two separate meta-populations of E. parramattensis subsp. decadens. The Kurri Kurri meta-population is bordered by Cessnock-Kurri Kurri in the north and Mulbring-Aberdare in the south. Large aggregations of the subspecies are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. The species generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant.	Low or unlikely	Not recorded within the Project area, which is treeless and highly degraded by Bitou Bush and exotic grasses. The original vegetation on the foredune would also have been unlikely to support this species, being foredune scrub rather than open forest or heathy woodlands subject to periodic inundation. The area to the west of Ocean Park Rd would also have been unlikely to support this species due to the lack of sclerophyll woodland and heathland adjacent to the Project area.	No
Flora	Myrtaceae	*Melaleuca biconvexa*	Biconvex Paperbark	V	V	Species or species habitat may occur within area	0	Distributed from coastal areas in NSW, from Jervis Bay to Port Macquarie (Harden, 1991). Associated with Eucalypt open forest with Sydney Blue Gum Eucalyptus saligna, Swamp Mahogany Eucalyptus robusta and Mountain Cedar Wattle Acacia elata. Grows in damp areas, often near watercourses, on alluvium soils over shale. Flowers in Summer.	Low or unlikely	The Project area does not occur over alluvial shale soils in swampy habitat, although suitable swamp forest is present within the wider area. Not likely to occur within the Project area.	No
Flora	Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E	V	Species or species habitat known to occur within area	17	Found only in NSW, from Lansdowne to Conjola State Forest. Found in littoral rainforest on sand or subtropical rainforest. Associated species include Small-leaved Fig Ficus obliqua, Plum Pine Podocarpus elatus and Lilly Pilly Syzygium smithii. Preferred soils are sandy and derived from sandstone.	Low or unlikely	No littoral or subtropical rainforest habitat within the Project area. The majority of the habitat within the Project area is substantially degraded.	No
Flora	Orchidaceae	*Caladenia tessellata*	Thick Lip Spider Orchid	E	V	Species or species habitat likely to occur within area	0	The Thick-lip Spider-orchid Caladenia tessellata is a perennial terrestrial orchid emerging annually from an underground tuber. About 19 populations are known, containing about 450 plants. The species has suffered a major decline in abundance throughout much of its range, largely due to loss of habitat. The Thick-lip Spider-orchid is endemic to mainland south-eastern Australia, where it is distributed from the central coast of New South Wales to the Westernport region of southern Victoria (Figure 1), in the South East Coastal Plain, South East Corner, and Sydney Basin bioregions (sensu DEH 2000). The species usually occurs on or near the coast, but in southern New South Wales, extends well inland to Braidwood. In New South Wales, the species is generally found in grassy dry sclerophyll woodland (for example *Kunzea* woodland) on clay loam or sandy soils, less commonly in heathland on sandy loam soils.	Low or unlikely	The Project area does not contain heathy woodland or dry sclerophyll forest habitat preferred by the species. Furthermore, habitat within the Project area is substantially degraded.	No
Flora	Orchidaceae	*Corunastylis insignis*	Wyong Midge Orchid	CE	CE	Species or species habitat known to occur within area	0	Distributed from Wyong, on the Central Coast of NSW. Found in patches of Kangaroo Grass Themeda australis in heathland and forest. Associated with dry sclerophyll woodland dominated by Scribbly Gum Eucalyptus haemostoma, Red Bloodwood Corymbia gummifera and Smooth-barked Apple Angophora costata. Flowers between August and November (TSSC, 2014).	Low or unlikely	The Project area does not contain suitable heathy forest habitat characterised by Smooth-barked Apple, Scribbly Gum or Red Bloodwood and there is no Kangaroo Grass in the understorey. The habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass.	No

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Flora	Orchidaceae	*Cryptostylis hunteriana*	Leafless Tongue-orchid	V	V	Species or species habitat known to occur within area	9	Distributed from East Gippsland in Victoria throughout coastal NSW, and up to the Tin Can Bay area in Southern QLD. Habitats include heathlands, heathy woodlands, sedgelands, dry sclerophyll forests, forested wetlands, freshwater wetlands, grassland and wet sclerophyll rainforests. Associated with Scribbly Gum *Eucalyptus haemastom* a, Silvertop Ash *Eucalyptus sieberi* , Red Bloodwood *Corymbia gummifera* and Black Sheoak *Allocasuarina littoralis.* Preferred soils are moist sands, moist to dry clay loam soils. Species flowers from November to February.	Low or unlikely	The Project area does not support heathy open forest, woodland or heathland habitat . The species was considered because records exist within the locality of the Project area but the species is considered unlikely to occur within the Project area.	No
Flora	Orchidaceae	*Diuris praecox*	Newcastle Doubletail	V	V	Species or species habitat likely to occur within area	1454	Distributed between Ourimbah and Nelson Bay, NSW. Grows on hills and slopes near the coast, in heathy open forest which have a dense grassy understorey. Distributed on well drained soil. Produces leaves and flowering stems in winter, with flowers previously recorded in July to early September.	Low or unlikely	The Project area does not contain suitable heathy forest habitat characterised by Smooth-barked Apple, Scribbly Gum or Red Bloodwood. The large number of previous records within the locality occur from a population over 5.5 km from the Project area.	No
Flora	Orchidaceae	*Pterostylis gibbosa*	Illawarra Greenhood	E	E	Species or species habitat may occur within area	0	Found in the Hunter Region, Illawarra Region and the Shoalhaven Region. Occurs in open forest or woodland, with a flat or gently sloping topography. Habitat associations include Forest red Gum Eucalyptus tereticornis, Woollybutt Eucalyptus longifolia and White Feather Honey Myrtle Melaleuca decora. Only visible above ground between late summer and spring.	Low or unlikely	No suitable woodland or open forest habitat dominated by eucalypts are recorded within the Project area and the habitats within the Project area are substantially degraded. Not likely to occur.	No
Flora	Polygonaceae	*Persicaria elatior*	Tall Knotweed	V	V	Species or species habitat likely to occur within area	0	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). The species also occurs in Queensland. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low or unlikely	Marginal wetland habitat within the Project area, however no swamp forest habitats occur. Not recorded during plot surveys.	No
Flora	Proteaceae	*Grevillea parviflora subsp. parviflora*	Small-flower Grevillea	V	V	Species or species habitat known to occur within area	60	Distributed between Moss Vale/Bargo and lower Hunter Valley. Broad habitat range including heath, shrubby woodland and open forest and often in distributed areas on the fringes of tracks or roads. Associated species include Earp's Gum Eucalyptus parramattensis subsp. decadens, Narrow-leaved Apple *Angophora bakeri* , Swamp Wattle *Acacia elongata* and Thyme Honey-myrtle *Melaleuca thymifolia* . Distributed on light clay or sandy soils.	Low or unlikely	Records in the locality are associated with heathy open forests on higher elevations to the north of the Project area and on the western side of Lake Macquarie.	No
Flora	Proteaceae	*Grevillea shiressii*	-	V	V	Species or species habitat likely to occur within area	0	Known from two populations near Gosford, on tributaries of the lower Hawkesbury River north of Sydney (Mooney Mooney Creek and Mullet Creek). Both populations occur within the Gosford Local Government Area. There is also a naturalised population at Newcastle. Grows along creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soils. Flowers mainly late winter to Spring (July-December), with seed released at maturity in October. Flowers are bird pollinated and seeds are dispersed by ants.	Low or unlikely	No wet sclerophyll forest habitat within the Projct area in loamy or alluvial sandy soils with a proportion of organic content. No suitable habitat present and the species is unlikely to occur.	No
Flora	Santalaceae	*Thesium australe*	Austral Toadflax	V	V	Species or species habitat may occur within area	0	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland. Found in association with Kangaroo Grass *Themeda australis* . Flowers in spring and summer.	Low or unlikely	This species is associated with native temperate grasslands or grassy woodland where the groundcover is dominated by Kangaroo Grass. No such habitat occurs within the Project area. Not likely to occur.	No
Insecta	Castniidae	*Synemon plana*	Golden Sun Moth	E	CE	Species or species habitat may occur within area	0	This species is associated with native natural or derived temperate graslands containing a high proportion of wallaby and spear grasses. Larvae feed almost exclusively on wallaby grasses (*Rytidosperma* species), spear grasses (*Austrostipa* species) and the exotic Chilean needle grass (*Nassella* species).	Low or unlikely	The Project area does not contain native temperate grasslands dominated by wallaby grasses or speargrasses. The distribution of the termperate grassland habitat in NSW is typically known to be further inland, such as on the slopes or inland of the Great Dividing Range, or up the Hunter Valley.	No

Group	Family	Scientific Name	Common Name	Status		Input Source		Habitat Association	Likelihood of ocurrence	Justification	Assessment with due reference to Significant Impact Guidelines 1.1 required
				BC Act	EPBC Act	EPBC Act Protected Matters Report	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)				
Mammalia	Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E	Species or species habitat known to occur within area	7	Inhabits a range of environments including rainforest, open forest, woodland, coastal health and inland riparian forest, from the sub-alpine zone to the coastline. Den subject sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, which are usually traversed along immensely vegetated creek lines. Use communal 'latrine sites', often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Such sites may be visited by multiple individuals and can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals. Generalist predator with a preference for medium-sized (500g-5kg) mammals. Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits, reptiles and insects. Also eats carrion and takes domestic fowl.	Low or unlikely	No den sites in the form of hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields or rocky cliff faces. Species has large foraging range and is known from locality as recently as August 2017 (recorded in Redhead). Could potentially move in the surrounding habitats to the Project area but the Project area itself does not provides suitable vegetated creek lines for movement.	No
Mammalia	Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E	V	Species or species habitat may occur within area	0	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Low or unlikely	The Project area is not located within the described landscapes for this species (i.e. sandstone cliffs, escarpments, outcrops etc). The species is unlikely to occur within the Project area	No
Mammalia	Muridae	*Pseudomys novaehollandiae*	New Holland mouse	-	V	Species or species habitat known to occur within area	8	The species has patchy distribution across Tasmania, New South Wales and Queensland. The species prefers soil types with deeper top soils and softer substrates for digging burrows. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. Distribution is patchy in time and space, with peaks in abundance during early to mid stages of vegetation succession typically induced by fire. Due to the largely granivorous diet of the species, sites where the New Holland Mouse is found are often high in floristic diversity, especially leguminous perennials.	Low or unlikely	Records within the locality are limited to bushland to the north of the Belmont Wetlands State Park in Jewells Swamp, around Whitebridge, to the west of Redhead, south-east of Bennetts Green. There are no records within 1km of the Project area. The suitable habitat in the Project area lacks floristic diversity, being substantially degraded by Bitou Bush invasion and the species is considered unlikely to occur.	No
Mammalia	Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	Species or species habitat known to occur within area	22	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares. Breeds from August to February.	Low or unlikely	No primary feed tree species or any Eucalypt species within the Project area; however, there are primary feed tree species within the surrounding native vegetion in swamp sclerophyll habitats dominated by *Eucalyptus robusta* (Swamp Mahogany). The species was not predicted by the BAM Calculator but has been included for consideration as there is one record within 1 km of the Project area (at Belmont Golf Course wetlands in swamp sclerophyll forest). However, the species is unlikely to utilise the habitats within the Project area.	No
Mammalia	Potoroidae	*Potorous tridactylus*	Long-Nosed Potoroo	V	V	Species or species habitat likely to occur within area	0	Restricted to east of the Great Dividing Range, with annual rainfall >760 mm. Inhabits coastal heath and dry and wet sclerophyll forests. Requires relatively thick ground cover and appears restricted to areas of light and sandy soil (Johnston 2008). Feeds on fungi, roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.	Low or unlikely	Although the species can occur in coastal heaths and scrub, the species relies on an abundant supply of fungi for food. The vegetated habitats within the Project area are degraded and are unlikely to provide sufficient foraging habitat. The species is considered unlikely to occur within the Project area. No previous records within the locality.	No
Mammalia	Pseudocheiridae	*Petauroides volans*	Greater Glider	-	V	Species or species habitat known to occur within area	0	The species is restricted to eastern Australia, from north QLD to central Victoria. This nocturnal marsupial lives in a variety of eucalypt-dominated habitats, ranging from low open forests on the coast to tall forests in the ranges and low woodland westwards of the Dividing Range. It feeds on eucalypt leaves and flowers. It uses large tree hollows in old, large trees.	Low or unlikely	There are no treed resources for foraging or nesting within the Project area. Eucalypt-dominated habitats occur in the locality but not within the Project area and the species is unlikely to utilise the Bitou Bush habitats present.	No

Group	Family	Scientific Name	Common Name	Status		Input Source		Habitat Association	Likelihood of ocurrence	Justification	Assessment with due reference to Significant Impact Guidelines 1.1 required
				BC Act	EPBC Act	EPBC Act Protected Matters Report	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)				
Mammalia	Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Roosting known to occur within area	202	Roosts in camps within 20km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby & Law, 2008). Will also forage in urban gardens and cultivated fruit crops.	Low or unlikely	The Project area is poor in foraging resources. It lacks mature trees, eucalypt species and mistletoes. Could visit habitat surrounding the Project area and be recorded flying over the Project area from time to time. Unlikely to occur within or utilise habitats within the Project area.	No
Mammalia	Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	Species or species habitat likely to occur within area	0	Sandstone cliffs and fertile woodland valley habitat within close proximity of each other is roosting habitat of importance to the Large-eared Pied Bat. Rainforest and moist eucalypt forest habitats on other geological substrates (rhyolite, trachyte and basalt) at high elevation are of similar importance to the species for roosting. In NSW this species has been recorded from a large range of vegetation types including: dry and wet sclerophyll forest; Cyprus Pine (*Callitris glauca*) dominated forest; tall open eucalypt forest with a rainforest sub-canopy; sub-alpine woodland; and sandstone outcrop country.	Low or unlikely	The Project area is not located within the described landscapes for this species (i.e. sandstone cliffs, fertile woodland valleys, sandstone outcrop country). The Project area does not support suitable roosting or breeding cave habitat, and is not located within 100m of suitalbe breeding or roosting habitat. There are no known records within the locality for this species.	No
Aves	Ardeidae	*Ardea ibis*	Cattle Egret	-	Mi	Breeding likely to occur within the area	12	Occurs across NSW. Principal breeding sites are the central east coast from Newcastle to Bundaberg. Also breeds in major inland wetlands in north NSW (notably the Macquarie Marshes). Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. Uses predominately shallow, open and fresh wetlands with low emergent vegetation and abundant aquatic flora. Sometimes observed in swamps with tall emergent vegetation and commonly use areas of tall pasture in moist, low-lying areas.	Low or unlikely	Wetland habitat within the Project area is not open, rather having dense Phragmites reedland growth. No emergent trees were present in the swamp habitat within the Project area.	No
Aves	Meropidae	*Merops ornatus*	Rainbow Bee-eater	-	Mi	Species or species habitat may occur within area	1	Distributed across much of mainland Australia, and several near-shore islands. Occurs in a range of habitats, including open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia. Nests are made in sandy banks.	Moderate	Rainbow Bee-eater observed during surveys within the locality of the Project area. No breeding habitat occurs within the Project area, however foraging may occur. Likely to utilise the Project area as a fly-over to suitable foraging habitat in the locality.	No

Appendix C – Flora and fauna species lists

Fauna species

The fauna species listed in Table C-1 below were recorded by GHD in the vicinity of the Project area during surveys undertaken in August-September 2019 and January-February 2020. Species that were recorded opportunistically within the Project area, in addition to those observed during targeted surveys, are also included within the table.

Flora species

The flora species listed in Table C-2 below were recorded during plot surveys of the Project area.

Table C-1 Fauna species recorded near and within the Project area

	Class	Family	Exotic	Species	Name	NSW Status	EPBC Status	Recorded in the vicinity of the Project area	Recorded in the Project area
1	Amphibia	Myobatrachidae		*Limnodynastes peronei*	Striped Marsh Frog				x
2	Amphibia	Myobatrachidae		*Platyplectrum ornatum*	Ornate Burrowing Frog				x
3	Amphibia	Myobatrachidae		*Uperoleia fusca*	Dusky Toadlet			x	
4	Aves	Acanthizidae		*Acanthiza nana*	Yellow Thornbill			x	
5	Aves	Acanthizidae		*Sericornis frontalis*	White-browed Scrubwren				x
6	Aves	Accipitridae		*Accipiter novaehollandiae*	Grey Goshawk				x
7	Aves	Accipitridae		*Circus approximans*	Swamp Harrier			x	
8	Aves	Accipitridae		*Elanus axillaris*	Black-shouldered Kite				x
9	Aves	Alcedinidae		*Dacelo novaeguineae*	Laughing Kookaburra			x	
10	Aves	Anatidae		*Anas superciliosa*	Pacific Black Duck			x	
11	Aves	Apodidae		*Hirundapus caudacutus*	White-throated Needletail		Vulnerable/ Migratory	x	
12	Aves	Artamidae		*Artamus leucorynchus*	White-breasted Woodswallow				x
13	Aves	Artamidae		*Cracticus nigrogularis*	Pied Butcherbird			x	
14	Aves	Artamidae		*Cracticus tibicen*	Australian Magpie				x
15	Aves	Artamidae		*Strepera graculina*	Pied Currawong			x	
16	Aves	Cacatuidae		*Cacatua galerita*	Sulphur-crested Cockatoo			x	
17	Aves	Cacatuidae		*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo			x	
18	Aves	Campephagidae		*Coracina novaehollandiae*	Black-faced Cuckoo-shrike			x	
19	Aves	Columbidae		*Geopelia humeralis*	Bar-shouldered Dove			x	
20	Aves	Columbidae		*Ocyphaps lophotes*	Crested Pigeon			x	

	Class	Family	Exotic	Species	Name	NSW Status	EPBC Status	Recorded in the vicinity of the Project area	Recorded in the Project area
21	Aves	Columbidae	*	*Streptopelia chinensis*	Spotted Turtle-Dove			x	
22	Aves	Corvidae		*Corvus coronoides*	Australian Raven			x	
23	Aves	Cuculidae		*Cacomantis flabelliformis*	Fan-tailed Cuckoo			x	
24	Aves	Cuculidae		*Eudynamys orientalis*	Eastern Koel			x	
25	Aves	Estrildidae		*Neochmia temporalis*	Red-browed Finch			x	
26	Aves	Hirundinidae		*Hirundo neoxena*	Welcome Swallow			x	x
27	Aves	Laridae		*Chroicocephalus novaehollandiae*	Silver Gull			x	x
28	Aves	Maluridae		*Malurus lamberti*	Variegated Fairy-wren			x	
29	Aves	Maluridae		*Stipiturus malachurus*	Southern Emu-wren				x
30	Aves	Meliphagidae		*Acanthorhynchus tenuirostris*	Eastern Spinebill			x	
31	Aves	Meliphagidae		*Anthochaera carunculata*	Red Wattlebird			x	
32	Aves	Meliphagidae		*Entomyzon cyanotis*	Blue-faced Honeyeater			x	
33	Aves	Meliphagidae		*Manorina melanocephala*	Noisy Miner			x	
34	Aves	Meliphagidae		*Meliphaga lewinii*	Lewin's Honeyeater			x	
35	Aves	Meliphagidae		*Philemon corniculatus*	Noisy Friarbird			x	
36	Aves	Meliphagidae		*Phylidonyris niger*	White-cheeked Honeyeater			x	
37	Aves	Pardalotidae		*Pardalotus punctatus*	Spotted Pardalote			x	
38	Aves	Phalacrocoracidae		*Phalacrocorax varius*	Pied Cormorant			x	
39	Aves	Psittacidae		*Platycercus eximius*	Eastern Rosella			x	
40	Aves	Psittacidae		*Trichoglossus haematodus*	Rainbow Lorikeet			x	
41	Aves	Psophodidae		*Psophodes olivaceus*	Eastern Whipbird			x	
42	Aves	Rhipiduridae		*Rhipidura albiscapa*	Grey Fantail			x	

	Class	Family	Exotic	Species	Name	NSW Status	EPBC Status	Recorded in the vicinity of the Project area	Recorded in the Project area
43	Aves	Rhipiduridae		*Rhipidura leucophrys*	Willie Wagtail				x
44	Mammalia	Canidae	*	*Canis lupis*	Domestic Dog			x	x
45	Mammalia	Canidae	*	*Vulpes vulpes*	Fox				x
46	Mammalia	Leporidae	*	*Lepus capensis*	Brown Hare				x
47	Mammalia	Molossidae		*Austronomus australis*	White-striped Freetail-bat			x	
48	Mammalia	Vespertilionidae		*Chalinolobus gouldii*	Gould's wattled bat			x	
49	Mammalia	Vespertilionidae		*Miniopterus australis*	Little Bentwing-bat	Vulnerable		x	
50	Mammalia	Vespertilionidae		*Nyctophilus geoffroyi*	Lesser Long-eared Bat			x	
51	Reptilia	Varanidae		*Varanus varius*	Lace Monitor			x	
52	Reptilia	Elapidae	-	*Cacophis squamulosus*	Golden-crowned Snake			x	
53	Reptilia	Scincidae	-	*Lampropholis delicata*	Dark-flecked Garden Sunskink				x
54	Reptilia	Pythonidae	-	*Morelia spilota spilota*	Diamond Python			x	

Table C-2 Flora species recorded within the Project area

Family	Scientific name	Common name	Growth form
Aizoaceae	*Carpobrotus glaucescens*	Pigface	FG
Aizoaceae	*Galenia pubescens*	Galenia	HT
Apiaceae	*Hydrocotyle bonariensis*	Largeleaf Pennywort	EX
Apocynaceae	*Parsonsia* spp.	-	OG
Apocynaceae	*Parsonsia straminea*	Common Silkpod	OG
Asteraceae	*Sonchus asper*	Prickly Sowthistle	EX
Asteraceae	*Chrysanthemoides monilifera* subsp. *Rotundata*	Bitou Bush	HT
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	EX
Asteraceae	*Senecio madagascariensis*	Fireweed	HT
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	#N/A
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	EX
Blechnaceae	*Blechnum indicum*	Swamp Water Fern	EG
Brassicaceae	*Cakile edentula*	American Sea Rocket	EX
Casuarinaceae	*Casuarina glauca*	Swamp Oak	TG
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	FG
Chenopodiaceae	*Rhagodia candolleana* Moq. subsp. *Candolleana*	Coastal Saltbush	SG
Commelinaceae	*Commelina cyanea*	Native Wandering Jew	FG
Convolvulaceae	*Ipomoea cairica*	Coastal Morning Glory	HT
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge	GG
Cyperaceae	*Lepironia articulata*	Grey Rush	GG
Cyperaceae	*Machaerina acuta*	Pale Twig-rush	GG
Cyperaceae	*Ficinia nodosa*	Knobby Club-rush	GG
Cyperaceae	*Cyperus* spp.	-	GG
Cyperaceae	*Bolboschoenus caldwellii*	-	GG
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	EG
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern	OG
Fabaceae	*Senna artemisioides*	Silver Cassia	SG
Fabaceae (Faboideae)	*Viminaria juncea*	Native Broom	SG
Fabaceae (Faboideae)	*Vicia sativa*	Common vetch	EX
Fabaceae (Mimosoideae)	*Acacia longifolia* subsp. *Sophorae*	Coastal Wattle	SG
Fabaceae (Mimosoideae)	*Acacia saligna*	Golden Wreath Wattle	EX
Goodeniaceae	*Scaevola calendulacea*	Dune Fan Flower	SG
Goodeniaceae	*Scaevola* spp.	-	FG
Goodeniaceae	*Goodenia ovata*	Hop Goodenia	SG
Haloragaceae	*Gonocarpus humilis*	-	FG
Lamiaceae	*Westringia* spp.	-	SG
Lauraceae	*Cassytha glabella*	-	OG

Family	Scientific name	Common name	Growth form
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	GG
Menispermaceae	*Stephania japonica*	Snake vine	OG
Menyanthaceae	*Liparophyllum exaltatum*	-	OG
Myrsinaceae	*Lysimachia arvensis*	Scarlet Pimpernel	EX
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark	TG
Myrtaceae	*Leptospermum juniperinum*	Prickly Tea-tree	SG
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush	SG
Myrtaceae	*Leptospermum laevigatum*	Coast Teatree	SG
Phormiaceae	*Dianella longifolia*	Blueberry Lily	FG
Poaceae	*Phragmites australis*	Common Reed	GG
Poaceae	*Triodia scariosa*	Porcupine Grass	GG
Poaceae	*Imperata cylindrica*	Blady Grass	GG
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	HT
Poaceae	*Paspalum urvillei*	Vasey Grass	HT
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HT
Poaceae	*Panicum* spp.	Panicum	GG
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HT
Restionaceae	*Baloskion tetraphyllum*	-	GG
Restionaceae	*Lepyrodia scariosa*	-	GG
Restionaceae	*Empodisma minus*	Spreading rope-rush	GG
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart	SG
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	EX
Verbenaceae	*Lantana camara*	Lantana	HT
Verbenaceae	*Verbena bonariensis*	Purpletop	EX
Violaceae	*Viola hederacea*	Ivy-leaved Violet	FG

TG – Tree
SG – Shrub
GG – Grass and grass-like
FG – Forb
EG – Fern
OG – Other
EX – Exotic
HT – High threat exotic

Appendix D – Vegetation integrity plot data

Family	Scientific name	Common name	Growth form	Q1		Q2		Q3		Q4		Q5		Q7		Q8		Q9		Q10		Q11	
				Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance
Fabaceae (Mimosoideae)	*Acacia longifolia subsp. sophorae*	Coastal Wattle	SG	0.1	12	20	10											0.1	3	90	100		
Fabaceae (Mimosoideae)	*Acacia saligna*	Golden Wreath Wattle	EX															0.1	50				
Restionaceae	*Baloskion tetraphyllum*	-	GG															0.1	50				
Blechnaceae	*Blechnum indicum*	Swamp Water Fern	EG															0.2	50				
Cyperaceae	*Bolboschoenus caldwellii*	-	GG															10	1000				
Brassicaceae	*Cakile edentula*	American Sea Rocket	EX																			5	150
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush	SG															5	50				
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern	OG													0.1	5						
Aizoaceae	*Carpobrotus glaucescens*	Pigface	FG			20	20													2	10	3	10
Lauraceae	*Cassytha glabella*	-	OG											0.1	10	3	2	0.5	2				
Casuarinaceae	*Casuarina glauca*	Swamp Oak	TG													20	40						
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	HT					100	1000	10	100	100	1000	0.2	25								
Asteraceae	*Chrysanthemoides monilifera subsp. rotundata*	Bitou Bush	HT	95	500	60	200			95	500			0.5	3	0.1	5	2	100	5	50	2	10
Commelinaceae	*Commelina cyanea*	Native Wandering Jew	FG											0.2	50	15	1000						
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	EX											0.1	10	0.1	5	0.1	5				
Cyperaceae	*Cyperus spp.*	-	GG															0.1	100				
Phormiaceae	*Dianella longifolia*	Blueberry Lily	FG											0.1	10			0.1	1				
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HT																	0.3	50		
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HT			0.1	10																
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	FG																	0.1	10		
Restionaceae	*Empodisma minus*	Spreading rope-rush	GG															5	1000				
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart	SG															0.1	1				
Cyperaceae	*Ficinia nodosa*	Knobby Club-rush	GG											5	750								
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge	GG											0.1	1	0.1	5	15	1000				
Aizoaceae	*Galenia pubescens*	Galenia	HT																	5	50		
Haloragaceae	*Gonocarpus humilis*	-	FG													0.1	20	0.2	300				
Goodeniaceae	*Goodenia ovata*	Hop Goodenia	SG															1	300				
Apiaceae	*Hydrocotyle bonariensis*	Largeleaf Pennywort	EX											80	500	75	5000	0.1	10				
Poaceae	*Imperata cylindrica*	Blady Grass	GG											0.1	50								
Convolvulaceae	*Ipomoea cairica*	Coastal Morning Glory	HT									0.5	10	0.3	20	0.1	2						
Verbenaceae	*Lantana camara*	Lantana	HT											0.2	2								
Cyperaceae	*Lepironia articulata*	Grey Rush	GG											0.2	100	0.2	20						
Myrtaceae	*Leptospermum juniperinum*	Prickly Tea-tree	SG															3	50				
Myrtaceae	*Leptospermum laevigatum*	Coast Teatree	SG	0.1	2																		
Restionaceae	*Lepyrodia scariosa*	-	GG															1	100				
Menyanthaceae	*Liparophyllum exaltatum*	-	OG															20	1200				
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	GG																	0.1	1		
Myrsinaceae	*Lysimachia arvensis*	Scarlet Pimpernel	EX											0.1	20								
Cyperaceae	*Machaerina acuta*	Pale Twig-rush	GG											0.1	50								
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark	TG													1	1	20	30				
Poaceae	*Panicum spp.*	Panicum	GG																	1	30		
Apocynaceae	*Parsonsia spp.*	-	OG													0.1	1						
Apocynaceae	*Parsonsia straminea*	Common Silkpod	OG															0.1	3				
Poaceae	*Paspalum urvillei*	Vasey Grass	HT											0.2	20								
Poaceae	*Phragmites australis*	Common Reed	GG											65	4000	10	500	5	300				
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	EG													0.1	10	5	100				
Goodeniaceae	*Scaevola calendulacea*	Dune Fan Flower	SG	0.1	5	0.1	10															0.1	3
Goodeniaceae	*Scaevola spp.*	-	FG															0.1	20				
Asteraceae	*Senecio madagascariensis*	Fireweed	HT			0.1	1							0.1	20	0.1	5						
Fabaceae	*Senna artemisioides*	Silver Cassia	SG													0.1	2						
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	EX											10	300	35	1000	0.2	50				
Asteraceae	*Sonchus asper*	Prickly Sowthistle	EX													0.1	2						
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	EX													0.1	5						
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	EX					0.1	1					0.1	5			0.1	2				
Menispermaceae	*Stephania japonica*	Snake vine	OG											0.2	20	0.1	5	0.1	10				
Poaceae	*Triodia scariosa*	Porcupine Grass	GG																			5	300
Verbenaceae	*Verbena bonariensis*	Purpletop	EX															0.1	2				
Fabaceae (Faboideae)	*Vicia sativa*	Common vetch	EX									0.1	7										
Fabaceae (Faboideae)	*Viminaria juncea*	Native Broom	SG															1	100				
Violaceae	*Viola hederacea*	Ivy-leaved Violet	FG															0.1	200				
Lamiaceae	*Westringia spp.*	-	SG															0.3	200				

Appendix E – BAM calculator import data

Plot	Pct	area	patchsize	conditionclass	Zone	easting	northing	bearing
1	N/A	4.66	0	low_bitou	56	6342410	375654.6	210
2	N/A	4.66	0	low_bitou	56	6342332	375686.7	240
3	N/A	4.73	0	low_grass	56	6342503	375769.5	322
4	N/A	4.66	0	low_bitou	56	6342398	375617.2	150
5	N/A	4.73	0	low_grass	56	6342472	375636.5	135
7	1071	0.12	101	moderate	56	6342647	375573.4	206
8	1724	0.08	101	moderate	56	6342582	375511.6	142
9	783	0.02	101	moderate	56	6342518	375476.9	88
10	772	0.08	101	moderate	56	6342603	375873.6	41
11	1204	0.29	101	moderate	56	6342592	375921.5	30

Plot	compTree	compShrub	compGrass	compForbs	compFerns	compOther
1	0	3	0	0	0	0
2	0	2	0	1	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
7	0	0	6	2	0	2
8	1	1	1	1	1	1
9	1	7	7	5	2	3
10	0	1	2	2	0	0
11	0	1	1	1	0	0

plot	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther
1	0.0	0.3	0.0	0.0	0.0	0.0
2	0.0	20.1	0.0	20.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	70.5	0.3	0.0	0.3
8	20	100.6	42.3	25.6	5.2	0.7
9	20.0	10.5	36.2	20.5	5.2	0.7
10	0.0	90.0	1.1	2.1	0.0	0.0
11	0.0	0.1	5.0	3.0	0.0	0.0

plot	funLarge Trees	funHollow trees	funLitter Cover	funLenFallen Logs	funTreeStem 5to9	funTreeStem 10to19	funTreeStem 20to29	funTreeStem 30to49	funTreeStem 50to79	funTree Regen	funHigh ThreatExotic
1	0	0	94.0	0.0	0	0	0	0	0	0	95.0
2	0	0	72.0	0.0	0	0	0	0	0	0	60.1
3	0	0	100.0	0.0	0	0	0	0	0	0	100.0
4	0	0	54.0	0.0	0	0	0	0	0	0	105.0
5	0	0	100.0	0.0	0	0	0	0	0	0	100.5
7	0	0	0.0	0.0	0	0	0	0	0	0	1.1
8	0	0	31.0	6.0	1	1	1	1	0	0	0.3
9	0	0	0.0	0.0	0	0	0	0	0	0	2.0
10	0	0	88.0	3.0	0	0	0	0	0	0	10.3
11	0	0	0.0	0.0	0	0	0	0	0	0	2.0

Appendix F – Biodiversity credit report

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00013228/BAAS17098/18/00013229	Drought Response Desalination Plant	18/06/2020
Assessor Name	Assessor Number	BAM Data version *
Arien Quin	BAAS17098	29
Proponent Names	Report Created	BAM Case Status
Hunter Water Corporation	25/06/2020	Finalised
Assessment Revision	Assessment Type	Date Finalised
7	Major Projects	25/06/2020

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

Potential Serious and Irreversible Impacts

Nil

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

BAM Biodiversity Credit Report (Like for like)

Predicted Threatened Species Not On Site

Name
Calyptorhynchus lathami / Glossy Black-Cockatoo
Calidris tenuirostris / Great Knot
Irediparra gallinacea / Comb-crested Jacana
Limicola falcinellus / Broad-billed Sandpiper
Limosa limosa / Black-tailed Godwit
Xenus cinereus / Terek Sandpiper
Calidris ferruginea / Curlew Sandpiper

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

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
772-Coastal foredune wattle scrub	Not a TEC	0.1	1.00
1204-Beach Spinifex grassland	Not a TEC	0.3	0.00
1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	0.1	4.00
783-Coastal freshwater swamps of the Sydney Basin Bioregion	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	0.0	1.00

772-Coastal foredune wattle scrub	**Like-for-like credit retirement options**			
	Class	Trading group	HBT	IBRA region

	Sydney Coastal Heaths This includes PCT's: 772, 1822	Sydney Coastal Heaths >=50% and <70%	No	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
783-Coastal freshwater swamps of the Sydney Basin Bioregion	**Like-for-like credit retirement options**			
	Name of offset trading group	Trading group	HBT	IBRA region
	Sydney Freshwater Wetlands in the Sydney Basin Bioregion This includes PCT's: 780, 781, 783, 1071, 1231, 1808, 1809, 1911	-	No	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	**Like-for-like credit retirement options**			
	Name of offset trading group	Trading group	HBT	IBRA region

	Sydney Freshwater Wetlands in the Sydney Basin Bioregion This includes PCT's: 780, 781, 783, 1071, 1231, 1808, 1809, 1911	-	No	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1204-Beach Spinifex grassland	**Like-for-like credit retirement options**			
	Class	Trading group	HBT	IBRA region
	Maritime Grasslands This includes PCT's: 779, 897, 898, 1204, 1272, 1697	Maritime Grasslands <50%	No	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

No Species Credit Data

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	A. Quin	C. Phu		N. Malcolm		29/06/2020
1	A. Quin	C. Phu		N. Malcolm		29/07/2020

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