Hunter Water Corporation

Belmont Drought Response Desalination Plant
Biodiversity Development Assessment Report

November 2019

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1. Introduction

1.1 Project background

The Lower Hunter has sufficient water to meet its needs in average climate conditions in the medium term. However, the region's reliance on rain-fed dams and groundwater supplies makes it vulnerable to severe drought.

The Lower Hunter Water Plan was developed in 2014 with the aim to ensure that the Lower Hunter is able to withstand a severe drought as well as meeting community needs in the medium term. Within the plan, desalination is proposed in conjunction with other staged drought response measures in the event of an extreme drought. A drought response desalination plant would help make the water supply system more resilient to climate variability, with the primary benefit being that it would provide a drought contingency measure that is not dependent on rainfall.

Following a number of options assessments, a drought response desalination plant (also referred to as the temporary desalination plant) to be located within the existing wastewater treatment works site at Belmont was selected as the preferred option. Hunter Water submitted a State Significant Infrastructure (SSI) application for the Project to the Department of Planning and Environment in November 2017 and received the Secretary's Environmental Assessment Requirements (SEARs) in December 2017 (SSI 8896). These SEARs outline the requirements for the preparation of an Environmental Impact Statement (EIS) to assess the future construction and operation of the Project, with particular requirements for the assessment of biodiversity impacts.

Hunter Water is seeking a 10 year validity for the approval, during which time further project stages (including detailed design and construction) would be instigated if and when dam storage volumes drop to specific trigger levels.

1.2 Purpose and scope of this report

This report has been prepared to support the Environmental Impact Statement (EIS) for the proposed Belmont Temporary 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 Biodiversity Development Assessment Report (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 is 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
- 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) to 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; the assessment of marine values is covered in a separate marine impact assessment report (Appendix E of the EIS main report).

1.3 Secretary's Environmental Assessment Requirements

Hunter Water submitted a State Significant Infrastructure (SSI) application for the proposal with the Department of Planning and Environment (DPE) in November 2017 and received Secretary's Environmental Assessment Requirements (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 to traffic and transport 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

Key issues	Requirements	Where addressed
		(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. 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).
- **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.
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
BTDP	Belmont Temporary Desalination Plant
CEEC	Critically endangered ecological community
CEMP	Construction Environmental Management Plan
DEE	Department of the Environment and Energy
DIWA	Directory of Important Wetlands in Australia
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment (previously Department of Planning and Environment)
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

Term	Definition
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 temporary 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
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.

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 site 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 report.

2.1 Project location

The temporary desalination plant is proposed to be located on the southern portion of the current wastewater treatment works (WWTW) site, off Ocean Park Road, to the east of the Pacific Highway. The proposed plant is located 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 Land use

The temporary desalination plant would be located entirely within the boundary of the Belmont WWTW (Lot 1 of DP 433549), 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).

Photograph 2-1 Former evaporation pond at temporary desalination plant site

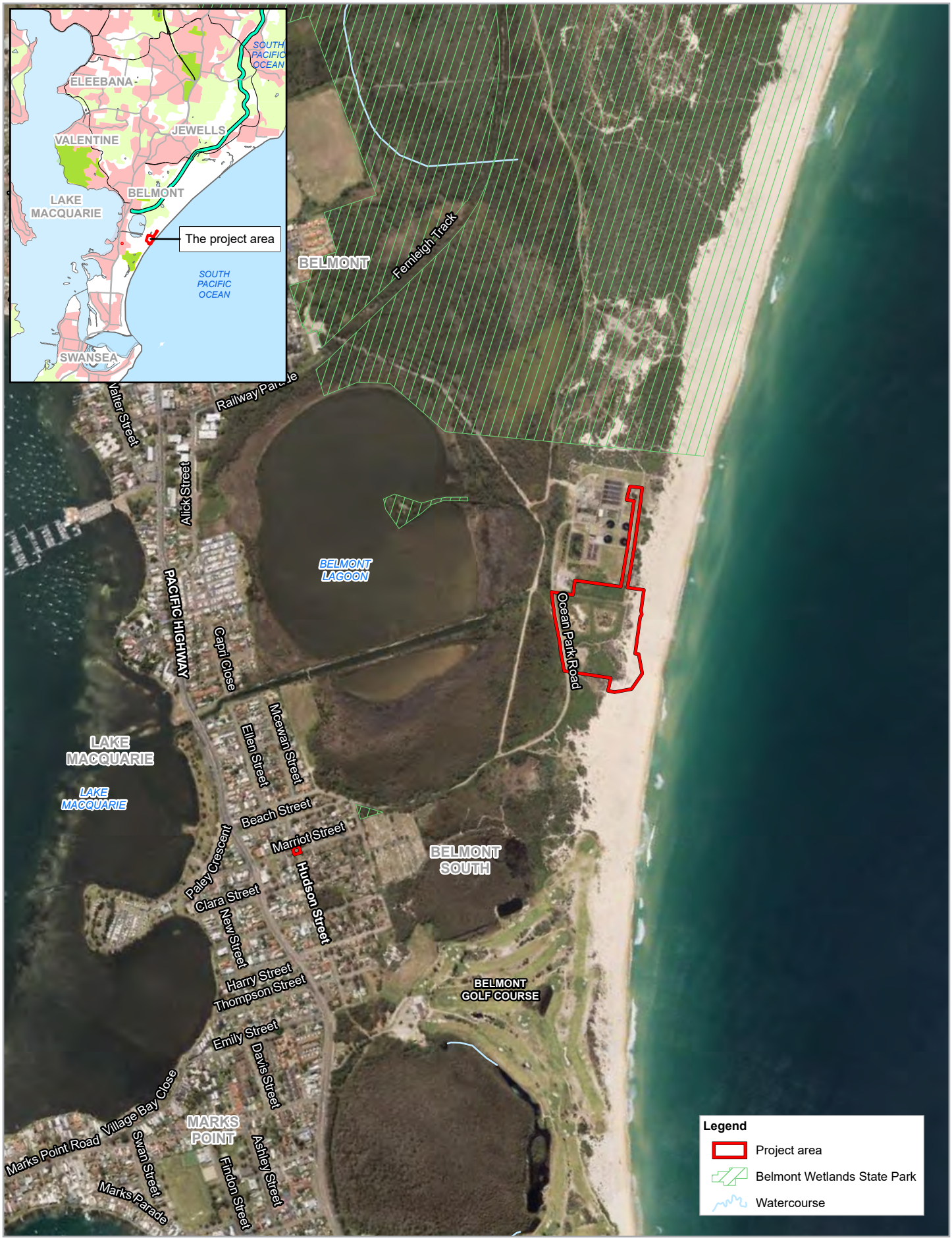
2.3 Surrounding environment

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 is located alongside mapped Coastal Wetlands 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 support a number of threatened ecological communities listed under the BC Act and EPBC Act.

The Project area itself does not contain waterways but within the wider locality, ephemeral unnamed drainage lines to the north of the Project area flow into Crokers Creek, passing through the Belmont Wetlands State Park.

The Project is located near the Fernleigh Track which is zoned RE1 – Public Recreation and is a walking and cycling track used for local commuting and recreation. 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.



Paper Size ISO A4

0 110 220 330 440

Metres

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

Hunter Water Corporation
Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

Project location

FIGURE 2-1

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Print date: 11 Oct 2019 - 14:05

Data source: LPI: DTDB / DCDB, 2017; public_NSW_Imagery: . Created by: TMorton

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 15 ML/day of potable water, with key components including:

- **Seawater intakes** – The central intake structures would be a concrete structure (referred to as a caisson) of approximately nine to 11 metres diameter, installed to a depth up to 20 m below existing surface levels. The intake structures will be finished above the existing surface (0.5 m to 1 m) to prevent being covered by dune sands over time. The raw feed water (seawater) input is proposed to be extracted from a sub-surface saline aquifer. This would be extracted by intake pipes located approximately eight to 15 m below ground level radiating out from the central structure. Pipelines and pumps are required to transfer the seawater to the desalination plant.
- **Water treatment process plant** – The water treatment process plant would comprise a range of equipment potentially in containerised form. 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 seawater.
  - *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 around 28 ML/day 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 the existing nearby Belmont WWTW for disposal via the existing ocean outfall pipe.
- **Power supply** – Power requirements of the plant would be met by a minor upgrade to the existing power supply network in the vicinity of Hudson and Marriot Streets. A power line extension from the existing line along Ocean Park Road into a new substation within the proposed drought response desalination plant would also be required.
- **Ancillary facilities** – including a tank farm, chemical storage and dosing, hardstand areas, stormwater and cross drainage, access roads, and fencing, signage and lighting.

A description of each of the key components of the Project is provided in Section 4 of the EIS.

The potable water pipelines connecting the Project to the potable water network do not form part of the Project and would be constructed separately. The construction and operation of the potable water pipeline 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** – trenchless or open trench crossing of footpath and road.

Paper Size ISO A4

0 50 100 150 200

Metres

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

Hunter Water Corporation
Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

Project area

FIGURE 2-2

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Data source: LPI: DTDB / DCDB, 2017; public_NSW_Imagery: . Created by: TMorton

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 will be prepared for the potable water pipes. 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 temporary 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, which is a separate project and scope to the temporary desalination plant development. However, 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 temporary desalination plant site as well as providing a valuable coastal ecosystem. The works proposed would involve:

- Providing a designated accessway to the beach for off road vehicles on Lake Macquarie City Council (LMCC) land
- Possible dune reshaping
- Installation of dune forming fences within the fenced area to provide for sand build up.
- Perimeter fencing to restrict access to a 12 ha area of dune to enable native vegetation regrowth
- Spinifex seeding
- Bitou Bush removal

Photograph 2-2 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 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

The Project is not located within land mapped as coastal wetlands or littoral rainforest, although it is adjacent to mapped coastal wetlands and within the proximity area for coastal wetlands. 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 adjacent coastal wetland values, including wetland and swamp forest habitats located to the west of 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 No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) 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.*

The definitions of potential and core koala habitat are defined under SEPP 44 as follows:

- **Potential Koala habitat** means areas of native vegetation where the trees of the types listed in Schedule 2 (of the instrument) constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.
- **Core Koala habitat** means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

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 44 does not apply. Nevertheless, the impacts on Koala habitat have been considered for consistency in the biodiversity assessment for the Project.

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 are described in Section 8.

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.

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 of the Environment and Energy (DEE) 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 DEE 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 surveys in the surrounding area in late 2018 to early 2019 for the 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 (2019c)

Data theme	Dataset or database	Application	Source
Threatened species and communities	The DEE Protected Matters Search Tool (PMST),	Search conducted for all MNES considered possible within a 10 km radius of the proposal.	DEE (2018a)
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 (2018d)
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 (2018b)
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 (2019d)
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.

The threatened biota and migratory species identified in the desktop assessment are presented in Appendix A. Following collation of database records and threatened species and community profiles, a 'likelihood of occurrence' assessment was prepared 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.

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 EIS main report).

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 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 on 8 and 22 August 2019 and on 6 September 2019 by two GHD ecologists. Site surveys included:

- Initial site stratification and vegetation mapping
- Sampling of five BAM plots
- Habitat assessment
- Opportunistic fauna and flora observations

Note that no targeted surveys for candidate threatened species were undertaken. 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 candidate threatened species were unlikely to utilise the Project area. The assessment of habitat constraints was undertaken in accordance with Step 2 of Section 6.4 of the BAM (OEH, 2017a).

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, 2018c). The closest equivalent PCT for each vegetation community was determined through a comparison of the floristic descriptions of PCTs in the database with the plot/transect data collected from the site. In addition to floristic and structural similarity, the landscape position, soil type and other diagnostic features of the vegetation communities on the 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 presented later in this BDAR in Section 6.1.3.

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.

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 to be present.

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

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 DEE 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 on the site.

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 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 on the site, or where the habitat is determined to be significantly degraded, or where the vegetation is determined to be missing key structural elements (see Part 3 of OEH, 2018a).

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 candidate threatened species were unlikely to utilise the Project area. For this reason, no targeted surveys for potential candidate threatened species were carried out.

4.3.6 Opportunistic observations

Opportunistic and incidental observations of fauna and flora species were recorded during field surveys. This included a conscious focus on suitable areas of habitat during surveys; although it is noted that habitat within the Project area was substantially degraded and lacked habitat features such as fallen timber, mature trees and stags. Species lists are provided in Appendix B.

4.3.7 Aquatic habitat survey

Although the Project area is surrounded by wetland and swamp vegetation, no 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) records for the survey date are outlined in Table 4-3. These records were taken at the Lake Macquarie weather station [061412].

Table 4-3 Daily weather observations during the fauna survey period (BoM 2019)

Date	Minimum temp (Deg Celsius)	Max temp (Deg Celsius)	Rainfall (mm)	Max wind gust (km/hr)
8/08/2019	4.2	23.3	0.4	50
22/08/2019	12.7	21.7	0	46
6/09/2019	7.0	32.1	0	76

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 Cecilia Phu (accredited assessor number BAAS17058) in accordance with the BAM, based on field surveys completed by Cecilia Phu and Bianca Seal. A technical review of the report was undertaken by Kirsten Crosby (accredited assessor number BAAS17011).

The BAM credit calculations were performed by Cecilia Phu using credit calculator version 1.2.4.00 (OEH, 2019b) with BAM data version 15 (updated 27/09/2019). Technical review was undertaken by Kirsten Crosby (accredited assessor number BAAS17011).

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

Table 4-4 GHD ecology staff and qualifications

Name	Position	Project Role	Qualifications	Relevant Experience
Cecilia Phu	Senior Ecologist	Field survey Reporting BAM assessment	BSc (Hons) BAM accredited	12+ years
Bianca Seal	Graduate Ecologist	Field assistant	BSc	2+ 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 TBCD for targeted species, this does not guarantee that the species will be detected even if suitable habitat is present.

Notwithstanding the above, only degraded habitat is present within the Project area and 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 40 80 120 160

Metres

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

Hunter Water Corporation
Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

Survey locations

FIGURE 4-1

G:\22\19573\Design\04 Deliverables\02 Other\2219573_BDAR_Sept2019_0.aprx
Print date: 11 Oct 2019 - 14:16

Data source: LPI: DTDB / DCDB, 2017; public_NSW_Imagery: . Created by: TMorton

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
Wetlands	The Project area does not contain any wetland areas. There are no Ramsar wetlands in the buffered assessment area. One wetland listed in the Directory of Important Wetlands in Australia (DIWA) is within the buffered assessment area (but not 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 Proximity Area for the Belmont Lagoon Coastal Wetland. The mapped Coastal Wetlands broadly corresponds to the DIWA Lake Macquarie Coastal Wetlands (NSW189).	Figure 5-4 Figure 5-5

Landscape feature	Project area	Figure Reference
Connectivity features	The Project area is located just to the east of 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 temporary 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 probability of occurrence of acid sulphate soils across the south-west portion of the Project area. The acid sulphate soil risk is high, and is associated with Aeolian processes on sandplains and swamps. 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 subject site.	n/a
Percentage native vegetation cover	20.7%	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, 2016b).

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, 2016a).

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 and is taken from DECC (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 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 of occurrence of acid sulphate soils 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 buffered assessment 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 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 gum*mifera). 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 austr*alis) in fresh water areas.

Table 5-3 Soil landscapes within the buffered assessment area

Landscape type	Location	Description	Limitations
Tuggerah landscape	Associated with dunefields along the coast, this landscape is mapped on the eastern half of the desalination plant site towards Ocean Park Road. It 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, localized flooding, high water table, strongly acid soil in places and the landscape coincides with a mine subsidence district.
Woy Woy landscape	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	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.

5.1.5 Wetlands

DIWA wetlands

The Project area is situated approximately 50 m to the east of 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 wetlands within the general vicinity of the Project area include:

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

The closest wetland waterbody is Belmont Lagoon. The eastern foreshore of Belmont Lagoon is located approximately 200 m to the west of the site of the temporary desalination plant, with surrounding coastal swamp vegetation occurring to the western edge of Ocean Park Road.

SEPP wetlands

The Project area is located directly to the east of Coastal Wetlands mapped under the Coastal Management SEPP and occurs within the Proximity Area for 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 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 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 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, passerines and honeyeaters and bats.

LMCC Native Vegetation Corridor mapping

The site of the temporary 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 southern portion of the site and along the eastern boundary of the site.

Key Habitats and Corridors Project

The buffered assessment area intersects 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. Whilst the power connection component of the Project area intersects the Nine Mile Beach regional corridor, it is located within residential development and does not provide connectivity value. The temporary desalination plant site does not occur within the mapped regional corridor but it is located directly to the east of the mapped corridor.

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)	1224.7 ha
Total native vegetation (ha)	253.8 ha
Per cent native vegetation cover	20.7%
Cover class	10-30%

5.2.2 Patch size

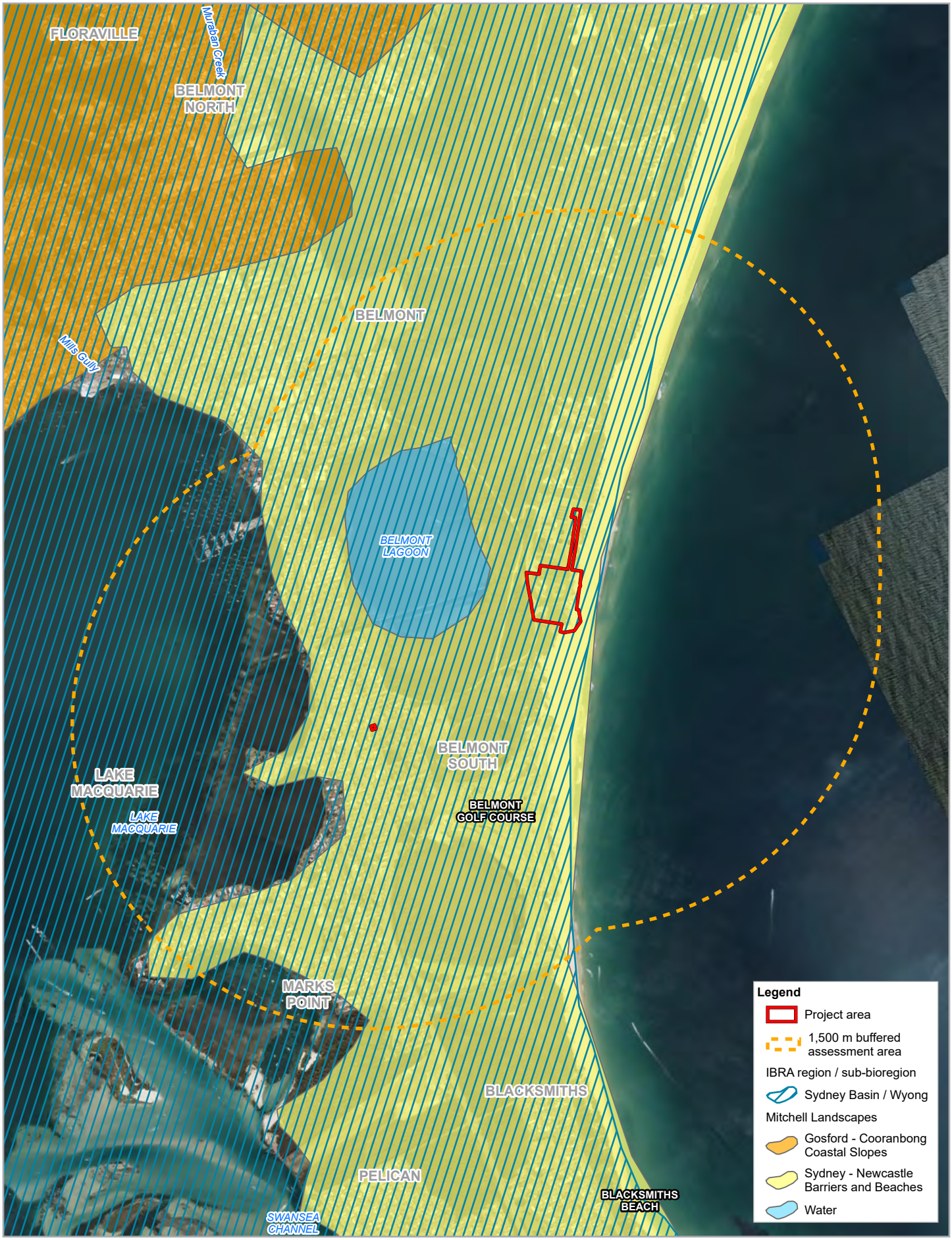
Patch size is defined under the BAM (OEH, 2017a) as an area of intact native vegetation that:

- 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.

The patch size class applied to all vegetation zones within the Project area is 0 ha as the vegetation on site is non-native and does not constitute intact native vegetation (i.e. does not contain all the structural layers characteristic of the original PCT that would have been present). Discussion of how the non-native vegetation has been treated and assessed for this BDAR is provided in Section 6.1.



Paper Size ISO A4

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Metres

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

Hunter Water Corporation
Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

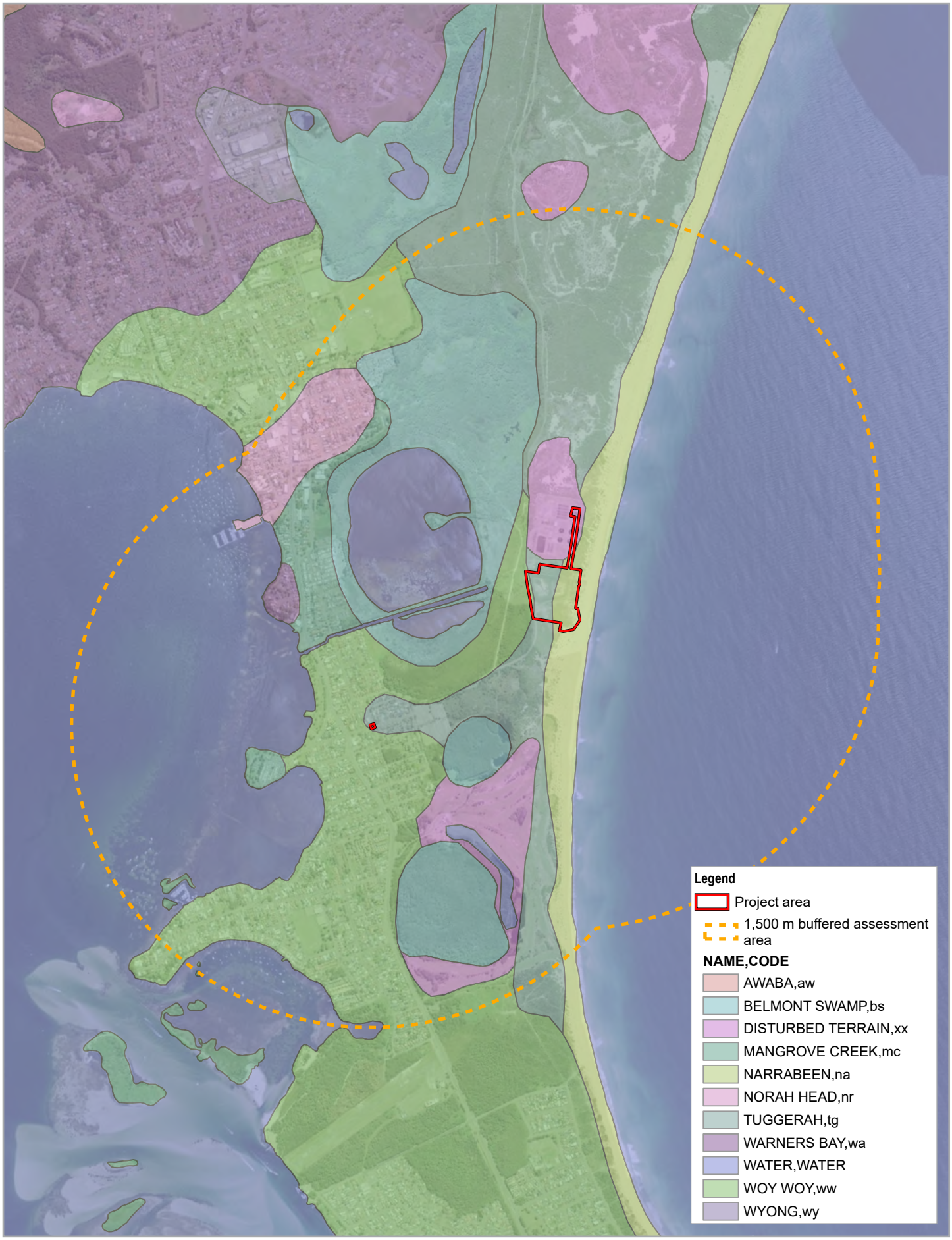
Landscape features
BioNet NSW landscapes and IBRA (sub)regions

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

FIGURE 5-1

G:\22\19573\Design\04 Deliverables\02 Other\2219573_BDAR_Sept2019_0.aprx
Print date: 11 Oct 2019 - 14:01

Data source: LPI: DTDB / DCDB, 2017; DPE: Wetlands, 2018, public_NSW_Imagery: . Created by: TMorton



Paper Size ISO A4

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Meters

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

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GHD

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Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

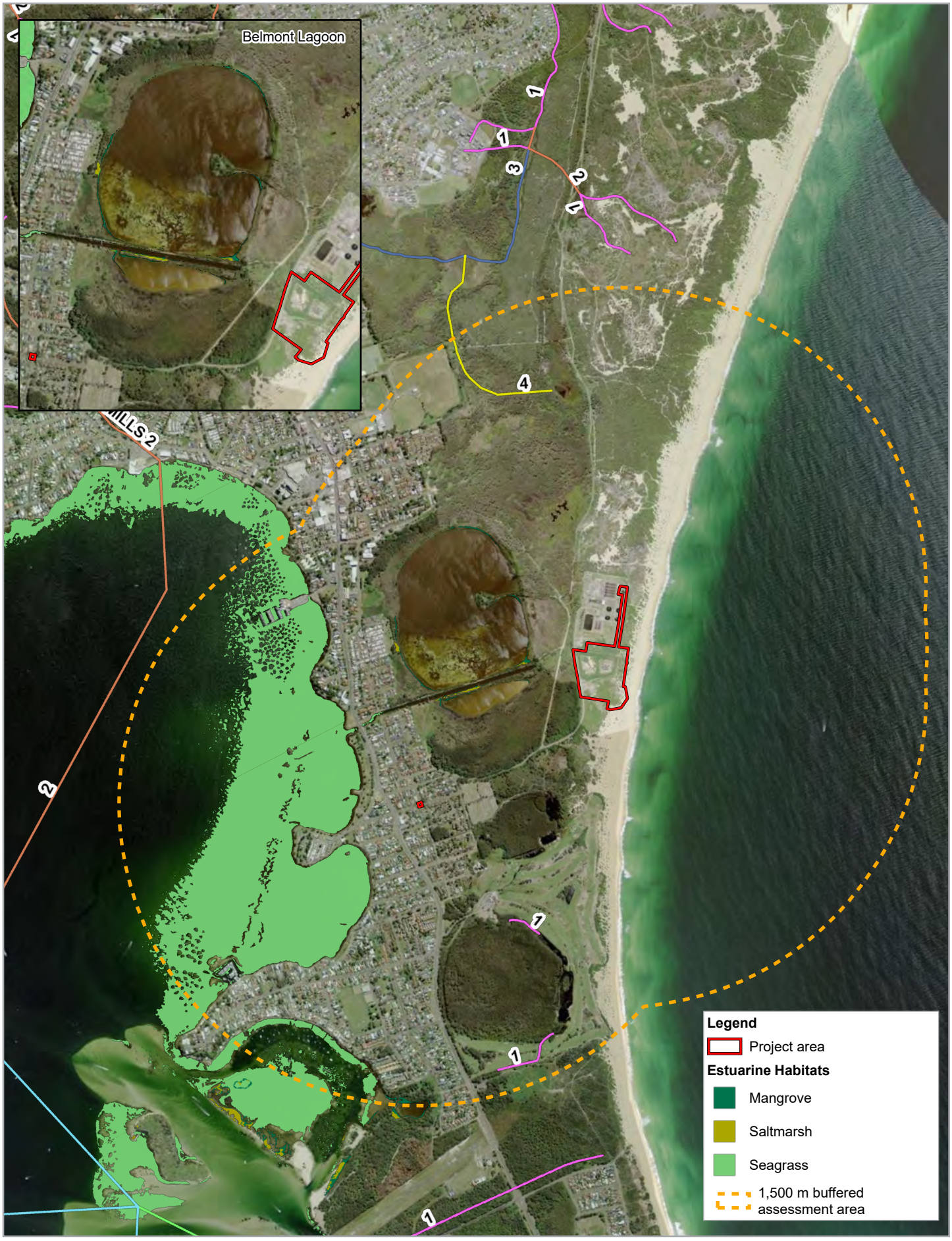
Landscape features
Soil landscapes

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

FIGURE 5-2

G:\22\19573\Design\04 Deliverables\02 Other\2219573_BDAR_Sept2019_0.aprx
Print date: 11 Oct 2019 - 14:04

Data source: OEH: Soil landscapes, 2016. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. Created by:



Paper Size ISO A4

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Meters

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

Hunter Water Corporation
Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Stream orders and estuarine habitats

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

FIGURE 5-3

G:\22\19573\Design\04 Deliverables\02 Other\2219573_BDAR_Sept2019_0.aprx
Print date: 11 Oct 2019 - 14:04

Data source: DPI: Stream order / Estuarine habitat, 2019. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017 Exploration_Portal/NSW_Estuarine_Habitats: PUBLIC/StreamOrder: WaterNSW. Created by:

Paper Size ISO A4

0 180 360 540 720

Metres

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

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Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Nationally important wetlands

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

FIGURE 5-4

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Paper Size ISO A4

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Meters

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

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

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

FIGURE 5-5

G:\22\19573\Design\04 Deliverables\02 Other\2219573_BDAR_Sept2019_0.aprx
Print date: 11 Oct 2019 - 14:02

Data source: DPI: Coastal management areas, 2019. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017
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Paper Size ISO A4

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Metres

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

Hunter Water Corporation
Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Key fauna corridors

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

FIGURE 5-6

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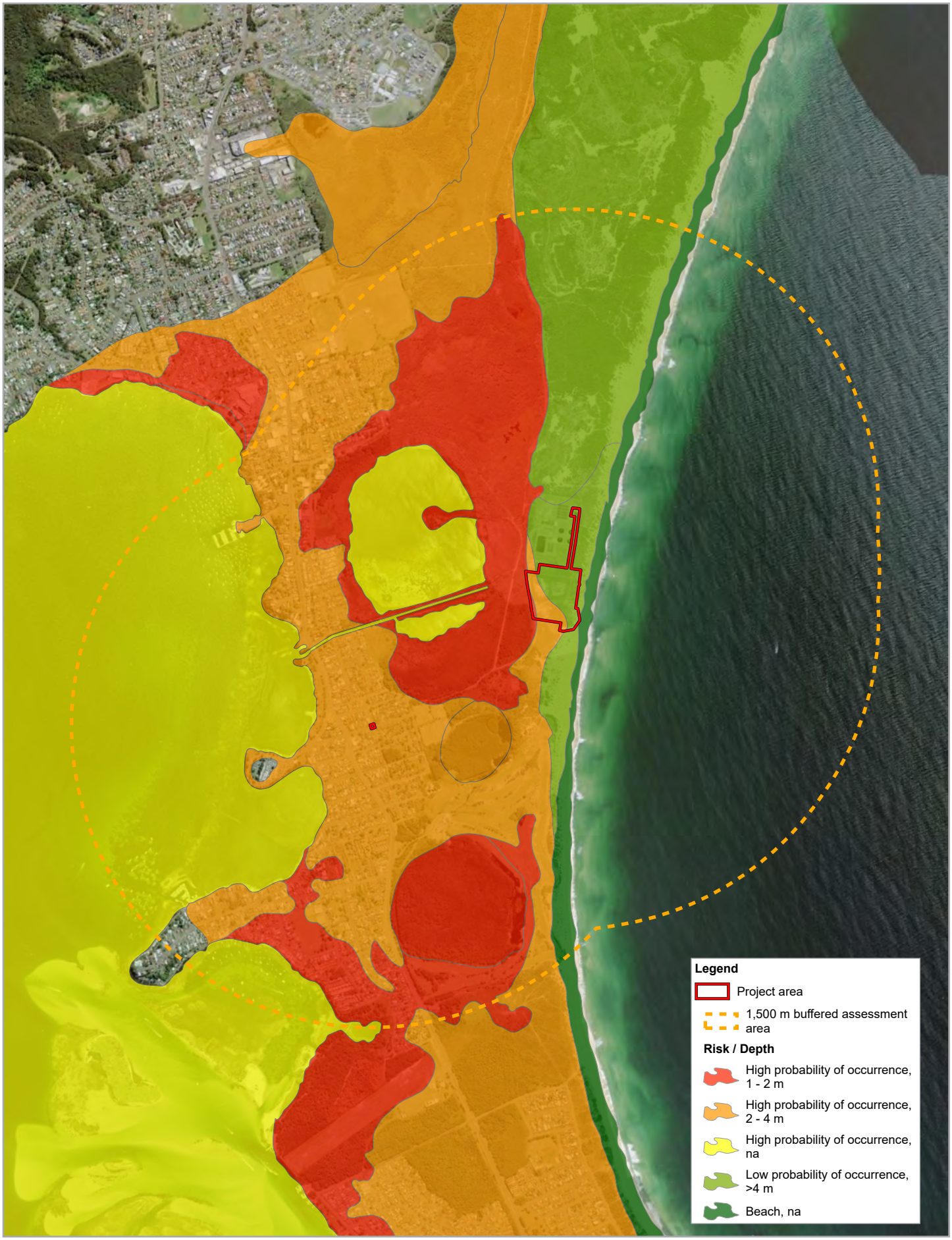

Paper Size ISO A4

0 180 360 540 720

Meters

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

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Hunter Water Corporation
Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

Landscape features
Acid sulfate soil risk mapping

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

FIGURE 5-7

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Paper Size ISO A4

0 250 500 750 1,000

Meters

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

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Landscape features
Percent native vegetation cover

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

FIGURE 5-8

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Print date: 11 Oct 2019 - 14:04

6. Vegetation and habitat

6.1 Vegetation of the study area

6.1.1 General description

Desalination plant

The desalination plant component of the Project area is located on the foredunes on the seaward side of the Belmont peninsula, behind Nine Mile Beach. The foredunes would have originally been vegetated by coastal scrub featuring salt pruned shrubs and stunted trees typical of the coastal foredune zone in the Lake Macquarie area, such as *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia), *Leptospermum laevigatum* (Coast Teatree) and *Acacia longifolia* subsp. *sophorae* (Coastal Wattle). On the landward side of the dunes to the west of the Project area, native vegetation represented by swamp forest, wet heath, rushland and estuarine vegetation associated with Belmont Lagoon and the greater Lake Macquarie Coastal Wetlands (NSW189) occurs.

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. 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, *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) scrub, 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.

Power connection

The power connection component of the Project area is located on the corner of Marriot Street and Hudson Street and has been completely urbanised. The vegetation at this intersection is comprised of a grassed roadside verge dominated by a mix of exotic grass and forb species including *Chloris gayana* (Rhodes Grass), *Briza maxima* (Quaking Grass), *Melinis repens* (Red Natal Grass), *Hyparrhenia hirta* (Coolatai Grass), *Vicia sativa* (Vetch), *Hydrocotyle bonariensis* (Largeleaf Pennywort), *Medicago polymorpha* (Burr Medic) and *Trifolium repens* (White Clover).

Trees and shrubs are restricted to plantings within garden beds in adjacent residential properties, street plantings or weedy occurrences and include *Grevillea robusta* (Silky Oak), *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia), *Nerium oleander* (Oleander), *Monstera deliciosa* (Fruit Salad Plant), *Syagrus romanzoffiana* (Cocos Palm), *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Callistemon viminalis* (Weeping Bottlebrush).

6.1.2 Native vegetation cover

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, cleared land or other site features that are assessed for habitat suitability in accordance with Section 6 of the BAM (OEH, 2017a)

The Project area contains little to negligible areas of native vegetation cover. 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).

Due to the proximity of the proposed desalination plant to swamp and wetland vegetation associated with the Belmont Wetlands State Park and the Belmont Lagoon, and also due to the observed presence of some native fauna species in the foredune area (see Section 6.4), the non-native vegetation at the site of the proposed desalination plant is conservatively assessed in this BDAR for threatened species habitat suitability. As such, the non-native vegetation within the desalination plant component of the Project area is identified as native vegetation cover, in accordance with the Stage 1 BAM Operational Manual (OEH, 2018a). Approximately 6 ha of non-native vegetation within the desalination plant component of the Project area is mapped as native vegetation cover.

There is approximately 0.01 ha of non-native vegetation (represented by grassland in roadside verges) within the power connection component of the Project area that is not assessed as native vegetation cover in this BDAR. Cleared areas of the Project area are not assessed as native vegetation cover.

6.1.3 Plant community types and vegetation zones

There are two vegetation units that have been mapped across the Project area (see Figure 6-1); both of these vegetation units are non-native vegetation types (see Table 6-1). The remainder of the Project area is cleared of vegetation.

Table 6-1 Vegetation types within the Project area

Vegetation type	Extent within Project area (ha)		Total area (ha)
	Desalination plant	Power connection	
Bitou Bush Scrub	3.24	0	3.2
Exotic grassland	3.02	0.01	3.0
Cleared	1.36	0.03	1.4
Total area (ha)	**7.62**	**0.04**	**7.7**

Assigning a PCT to non-native vegetation zones

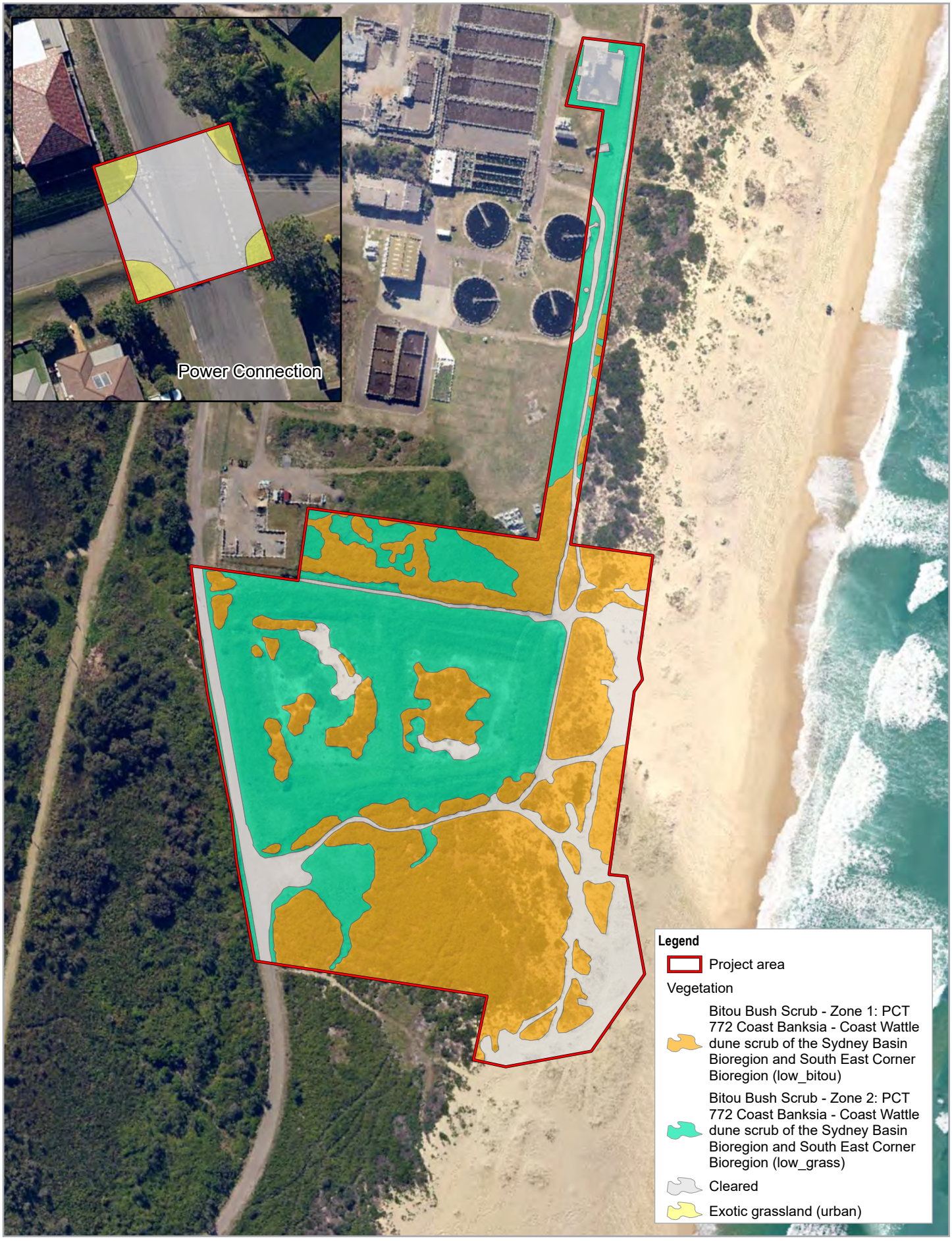
For the purposes of undertaking the threatened species assessment component of the BAM, the Bitou Bush Scrub and exotic grassland units (within the desalination plant component of the Project area) have been assigned to the original PCT that would have likely once occurred at that location.

For this reason, PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion (corresponding to Unit 50a described by Bell, 2016) was assigned to the vegetation within the Project area and stratified into two distinct low condition vegetation zones (to allow for input into the BAM calculator).

The vegetation zones identified within the Project area are detailed in Table 6-2 and shown on Figure 6-1. The vegetation integrity (VI) score of each vegetation zone is also shown in Table 6-2. The structure, species composition and condition of each the vegetation zones within the Project area is described in Table 6-3 to Table 6-5.

Table 6-2 Vegetation zones within the Project area

Vegetation type	Zone ID	PCT ID	PCT name	Condition/ ancillary code	Patch size (ha)	EPBC Act status	BC Act status	Extent within Project area	No. plots required	No. plots sampled	VI score
Bitou Bush Scrub	1	772	Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Low_bitou	0	Not listed	Not listed	3.2	2	3	2.8
Exotic grassland	2	772	Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Low_grass	0	Not listed	Not listed	3.0	2	2	2.5



Paper Size ISO A4

0 20 40 60 80

Meters

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

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Belmont Temporary Desalination Plant
Biodviersity Development Assessment Report

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

Vegetation zones in the Project area

FIGURE 6-1

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Print date: 11 Oct 2019 - 14:05

Table 6-3 Vegetation zone 1 – Bitou Bush Scrub as PCT 772 (low_bitou)

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
Occurrence within Project area	This vegetation zone occurs 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 towards the strand zone, where Beach Spinifex (sensu. Unit 53, Bell, 2016) would have once predominated.
Justification for PCT selection	PCT 772 was assigned to Bitou Bush Scrub as it is highly likely to be the original native plant community that would have occurred on the foredunes. This is evidenced by 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) in low numbers. These species are characteristic species for PCT 772. *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) is recognised as a high threat weed species that affects PCT 772.
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).
Conservation significance	Not listed under the EPBC Act or BC Act as a threatened ecological community.
Photo	See Photograph 6-1

Table 6-4 Vegetation zone 2 – Exotic grassland as PCT 772 (low_grass)

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	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). 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	PCT 772 was assigned to the occurrence of exotic grassland within the desalination plant component of the Project area. PCT 772 is likely to be the original plant community that would have occurred on the foredunes. This is evidenced by the presence of *Acacia longifolia* subsp. *sophorae* (Coastal Wattle) and *Carpobrotus glaucescens* (Pigface) in low numbers. These species are characteristic species for PCT 772. *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) is recognised as a high threat weed species that affects PCT 772 and was recorded within this vegetation zone.
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 6-2

Photograph 6-1 **Zone 1 - Bitou Bush Scrub in the desalination plant component of the Project area**

Photograph 6-2 **Zone 2 - Exotic grassland in the desalination plant component of the Project area (on the embankment)**

Table 6-5 Exotic grassland in the power connection component of the Project area

Attribute	Description
PCT name	n/a
PCT ID	n/a
Vegetation formation	n/a
Vegetation class	n/a
PCT % cleared	n/a
Plots sampled	n/a
Occurrence within Project area	Occurs in the roadside verges at the intersection of Marriot Street and Hudson Street
Floristic description	This is a roadside grassland verge on an urban residential street. The groundcover vegetation is dominated by a mix of exotic grass and forb species including *Chloris gayana* (Rhodes Grass), *Briza maxima* (Quaking Grass), *Melinis repens* (Red Natal Grass), *Lysimachia arvensis* (Scarlet Pimpernel), *Cerastium glomeratum* (Mouse-ear Chickweed), *Nothoscordum gracile* (Onion Weed), *Plantago lanceolata* (Lamb's Tongue), *Gazania* spp. (Treasure Flower), *Vulpia fasciculata* (Dune Fescue), *Silene gallica* var. *gallica* (French Catchfly), *Hyparrhenia hirta* (Coolatai Grass), *Vicia sativa* (Vetch), *Hydrocotyle bonariensis* (Largeleaf Pennywort), *Medicago polymorpha* (Burr Medic), *Stenotaphrum secundatum* (Buffalo Grass) and *Trifolium repens* (White Clover). Only two species recorded were native or naturalised species: *Cynodon dactylon* (Common Couch) and *Dichondra repens* (Kidney Weed). Trees and shrubs are restricted to plantings within garden beds in adjacent residential properties, street plantings or weedy occurrences and include *Grevillea robusta* (Silky Oak), *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia), *Nerium oleander* (Oleander), *Monstera deliciosa* (Fruit Salad Plant), *Agapanthus praecox* subsp. *orientalis* (African Lily), *Syagrus romanzoffiana* (Cocos Palm), *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Callistemon viminalis* (Weeping Bottlebrush).
Justification for PCT selection	n/a
Condition	Modified vegetation type, maintained by mowing as lawn on the roadside
Conservation significance	None
Photo	See Photograph 6-3 and Photograph 6-4

Photograph 6-3 **Corner of Marriot Street and Hudson Street (view from south-east corner of the north-west corner)**

Photograph 6-4 **Corner of Marriot Street and Hudson Street (view from north-east corner of the south-west corner)**

6.2 Flora species

6.2.1 Species recorded in the Project area

A total of 60 species were recorded within the Project area, comprising 18 native species and 42 exotic species. Of the native species, three were represented by grass species, three by Myrtaceous species and two by Proteaceous species, with the remaining representing a number of groundcover forbs and low shrubs typically found in foredune 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 Poaceae (grasses) and Asteraceae (daisies).

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

6.2.2 High threat weed species

The exotic species listed in Table 6-6 were recorded in 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 temporary desalination plant site) is dominated by high threat weed species, namely *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush), *Cenchrus clandestinus* (Kikuyu Grass) and *Hyparrhenia hirta* (Coolatai Grass).

Table 6-6 High threat weeds recorded in the Project area

Row Labels	Species	Name
Aizoaceae	*Galenia pubescens* var. *pubescens*	Galenia
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern
Asteraceae	*Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush
Asteraceae	*Gazania rigens*	Treasure Flower
Asteraceae	*Senecio madagascariensis*	Fireweed
Cactaceae	*Opuntia stricta*	Prickly Pear
Convolvulaceae	*Ipomoea cairica*	Coastal Morning Glory
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass
Poaceae	*Chloris gayana*	Rhodes Grass
Poaceae	*Ehrharta erecta*	Panic Veldtgrass
Poaceae	*Hyparrhenia hirta*	Coolatai Grass
Poaceae	*Paspalum dilatatum*	Paspalum
Poaceae	*Stenotaphrum secundatum*	Buffalo 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 (to which Lake Macquarie LGA belongs) were recorded within the Project area. The species, their relevant weed objectives (HLLS, 2017) and related regulatory measures are summarised in Table 6-7 below.

Table 6-7 Priority weeds recorded within the Project area

Species	Name	Weed objective	Measure
Asparagus aethiopicus	Asparagus Fern	Asset protection (State)	**Prohibition on dealings** must not be imported into the State or sold.
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.
Opuntia stricta	Prickly Pear	Additional species of concern (Regional)	**Prohibition on dealings** must not be imported into the State or sold.
Hyparrhenia hirta	Coolatai Grass	Asset protection (Regional)	**Regional recommended measure** The plant should not be bought, sold, grown, carried or released into the environment. Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread from their land. Land managers to reduce impacts from the plant on priority assets.
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, Lantana, Asparagus Fern and Prickly Pear 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), which is related to PCT 772 (OEH, 2019d). The Atlas mapped distribution of high potential terrestrial GDEs as it relates to the Project area is shown in Figure 6-2.

Native communities related to PCT 1644 Coast Tea Tree – Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast do not occur within the Project area, as PCT 772 has been replaced by Bitou Bush Scrub and exotic grasslands. As such, no GDEs are present in the Project area.

6.3.2 GDEs near the Project area

Potential terrestrial and aquatic GDEs are also mapped to the west of the temporary desalination plant and include Belmont Lagoon as well as 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.

Terrestrial vegetation located to the west of the Project area 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, 2019d).

The LMCC LGA mapping (Bell, 2016) indicates that the vegetation between the eastern edge of Belmont Lagoon and the Project area is characterised by a mix of coastal swamp forests, coastal heath forests and sand heath scrub. These communities contain sedge and fern understorey species that are influenced by varying degrees of waterlogging in the soils.

6.4 Terrestrial fauna and fauna habitat

6.4.1 Fauna species

Five fauna species were recorded within the Project area at the site of the proposed desalination plant during survey.

A small number of Welcome Swallows (*Hirundo neoxena*) 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. One 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 observed flying in the distance on the seaward side of the foredunes within proximity of the Project area. 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. The Project area is also frequently accessed by pedestrians walking their dogs. None these fauna species recorded are threatened species listed under the BC Act or EPBC Act.

No fauna species were recorded at the power connection site during survey; however, common urbanised species such as Noisy Miner (*Manorina melanocephala*) and Rainbow Lorikeet (*Trichoglossus haematodus*) are likely to fly over or to feed in the planted trees and shrubs in residential gardens from time to time.

Of the fauna identified within the broader area over the 2018-2019 period during surveys by GHD for the related pipeline project, a total of 46 species from 25 families were identified and include 45 native species and 1 introduced species (see Appendix B). This comprised two frog species, 39 bird species, four mammal species and one 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, the Little Bent-winged Bat (*Miniopterus australis*) is a Vulnerable species listed under the BC Act and is assessed further in Section 7.1.

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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High potential GDEs mapped by the Groundwater Dependent Ecosystems Atlas

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FIGURE 6-2

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Print date: 11 Oct 2019 - 14:03

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

6.4.2 Fauna habitats

The Project area provides very limited habitat for native fauna. It 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.

The Project area lacks aquatic, wetland and forested habitats. The foraging and sheltering resources provided by such habitat types are therefore limited or absent from the Project area, including hollow-bearing trees, blossom and nectar resources from myrtaceous trees and mistletoes, fallen timber and logs, mudflats, fringing vegetation around wetland ponds etc.

The Project area is situated directly adjacent 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.

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 6-8) provides a discussion of the fauna habitat values within the Project area.

Table 6-8 Description of relevant habitat types

Habitat type	Habitat description
Foredune scrub (i.e. Bitou Bush 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 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. However, the native species diversity of the Bitou Bush Scrub is very 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 only scattered 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 Bitou Bush Scrub, with a diversity of saltbush, grass and forb species generally missing from the understorey.

Habitat type	Habitat description
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 and snakes and common birds such as the 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.
Aquatic or wetland habitats	The Project area does not provide aquatic and wetland habitats for native fauna. The decommissioned evaporation ponds, being located on sandy substrate, 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. There are four identified wetlands and two ephemeral drainage lines within the buffered assessment area. These wetland areas containing wetland vegetation may provide suitable 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.

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 6-9.

6.4.3 Koala habitat (SEPP 44)

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 44 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, 2019c).

The vegetation within the Project area is generally treeless and dominated by non-native species. There are no Koala feed tree species or supplementary tree species present in the Project area (i.e. SEPP 44 Schedule 2 list, or tree species listed in the Koala Recovery Plan) and the vegetation does not constitute potential or core Koala habitat.

Table 6-9 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) Powerful Owl (*Ninox strenua*) (breeding) Masked Owl (*Tyto novahollandiae*) (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*)
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*)
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*)
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*)

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

6.5 Aquatic biodiversity

6.5.1 Aquatic habitat

No aquatic habitat occurs within the Project area. In the wider area, the Project area (at the temporary desalination plant site) is surrounded by swamp and wetland vegetation associated with Belmont Lagoon and the greater Lake Macquarie Coastal Wetlands (NSW189) and mapped as Coastal Management SEPP Coastal Wetlands. 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 Ocean Park Road and a vegetated corridor of approximately 200 m width.

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 areas of SEPP Coastal Wetlands or marine waterways are located within the Project area. There is no mapped key fish habitat within the Project area.

Paper Size ISO A4

0 50 100 150 200

Meters

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

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Key fish habitat and threatened fish distributions

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FIGURE 6-3

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Print date: 11 Oct 2019 - 14:03

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

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)

The predicted threatened species that have been assessed for ecosystem credits are listed in Table 7-1 below. It is acknowledged that the habitat value of the Project area for the species listed in Table 7-1 is considered to be low (as the vegetated habitats represent non-native vegetation types) and therefore, most species are unlikely to utilise the habitats in the Project area (see likelihood of occurrence assessment, Appendix A). However, the assignment of PCT 772 to the vegetation zones within the Project area automatically populates these species into the BAM assessment and they cannot be eliminated without determining that relevant habitat constraints are absent from the Project area.

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 must be retained to be assessed for ecosystem credits.

Only Glossy Black-cockatoo (*Calyptorhynchus lathami*) was removed from the predicted species list as no *Allocasuarina* or *Casuarina* species were recorded within the Project area. This species was not assessed for ecosystem credits.

Other 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) were not considered likely to occur within, or to utilise habitats within the Project area (see likelihood of occurrence assessment, Appendix A).

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. Two additional species not generated by the BAM calculator were also considered for further assessment of species credits and are also included in Table 7-2: Mahony's Toadlet (*Uperoleia mahonyi*) and Wallum Froglet (*Crinia tinnula*). Although these species are not associated with PCT 772 and hence were not generated by the BAM calculator, further assessment has been considered due to the presence of wetland and swamp habitats within proximity of the Project area.

All of the 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).

The degradation of habitat within the Project area is considered to be substantial, being dominated by high threat weeds *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush), *Hyparrhenia hirta* (Coolatai Grass) and *Cenchrus clandestinus* (Kikuyu Grass) to the extent that the vegetation largely comprises non-native vegetation.

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
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 cyanopterus*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	-	No	n/a
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.
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	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
Varied Sittella	*Daphoenositta chrysoptera*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	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	High	-	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	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
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
White-bellied Sea-Eagle (foraging)	*Haliaeetus leucogaster*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner 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	Moderate	-	No	n/a
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
Square-tailed Kite (foraging)	*Lophoictinia isura*	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	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	High	-	No	n/a Recorded in previous surveys in vicinity of Project area
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	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

Common Name	Scientific Name	Vegetation Types(s)	Sensitivity to potential gain class^	Habitat constraint^	Excluded from further assessment	Justification for exclusion
Eastern Osprey (foraging)	*Pandion cristatus*	772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	-	No	n/a
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis 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
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
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

^From the Threatened Biodiversity Data Collection

Table 7-2 Candidate threatened species assessed for species credits

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Habitat degraded	Excluded from further assessment	Justification for exclusion
Charmhaven Apple	*Angophora inopina*	n/a	-	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 few regenerating *Melaleuca quinquenervia* trees in one stand.
Regent Honeyeater (breeding)	*Anthochaera phrygia*	High	Mapped important areas	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	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.
Thick Lip Spider Orchid	*Caladenia tessellata*	Moderate	-	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.
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.	Yes	Yes	Project area lacks *Allocasuarina* and *Casuarina* species, and lacks living or dead trees with hollows.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Habitat degraded	Excluded from further assessment	Justification for exclusion
Eastern Pygmy Possum	*Cercartetus nanus*	High	-	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. The habitat within the Project area is substantially degraded by Bitou Bush invasion.
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.	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	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. 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. 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.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Habitat degraded	Excluded from further assessment	Justification for exclusion
Wallum Froglet	*Crinia tinnula*	Moderate	-	Yes	Yes	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 (last record in 1998). Multiple records to the north are from Redhead and Whitebridge areas and are located over 2 km away. Records were made generally within paperbark or *Banksia aemula* (i.e. Wallum) wet heath or sedgelands (OEH, 2019c). There is suitable habitat for the species within the adjacent wetland habitats associated with Belmont Lagoon. However, there is no suitable habitat within the Project area, nor does the Bitou Bush scrub habitat within the Project area provide an obvious movement corridor between areas of suitable sedgeland or wet heath habitats. Species was not detected in the broader area during targeted survey undertaken for the related pipeline project. Unlikely to occur within or utilise habitats within the Project area.
White-flowered Wax Plant	*Cynanchum elegans*	High	-	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.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Habitat degraded	Excluded from further assessment	Justification for exclusion
Pied Oystercatcher	*Haematopus longirostris*	High	Within 100 m of estuarine areas and the ocean	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.
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	Yes	Yes	The Project area lacks suitable breeding habitat in the form of living or dead mature trees.
Little Eagle (breeding)	*Hieraaetus morphnoides*	Moderate	Nest trees - live (occasionally dead) large old trees within vegetation	Yes	Yes	The Project area lacks suitable breeding habitat in the form of living or dead mature trees.
Pale-headed Snake	*Hoplocephalus bitorquatus*	High	-	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	Yes	Yes	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. The Project area is poor in wintering foraging resources. 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.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Habitat degraded	Excluded from further assessment	Justification for exclusion
Green and Golden Bell Frog	*Litoria aurea*	High	Within 1 km of semi-permanent/ephemeral wet areas, swamps and waterbodies	Yes	Yes	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 does not contain any waterbodies although it is located within 1 km of waterbodies. Grassland areas of the Project area do not connect waterbodies or provide an obvious movement corridor between waterbodies. The grassy habitat within the Project area is substantially degraded by high threat weeds, Coolatai Grass and Kikuyu Grass. While the species was known to occur at Belmont in the 1970s (DEC, 2005), there have been no recent records of the species (OEH, 2019c). 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	-	Yes	Yes	The Project area does not contain suitable rainforest, eucalypt forest or heathland habitat. The habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass.

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Habitat degraded	Excluded from further assessment	Justification for exclusion
Mahony's Toadlet	*Uperoleia mahonyi*	High	-	Yes	Yes	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, 2019c), 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, 2019c). There is suitable habitat for the species within the adjacent wetland habitats associated with Belmont Lagoon. The Project area lacks suitable breeding habitat for the species but also lacks suitable intact wet heath or wallum heath vegetation that would provide terrestrial habitat for the species during its non-breeding period. If the species were assumed to be present in adjacent potential habitats, it is unlikely that they would move into, or utilise the habitats within the Project area during non-breeding periods.
Square-tailed Kite (breeding)	*Lophoictinia isura*	Moderate	Nest trees	Yes	Yes	The Project area lacks suitable breeding habitat in the form of nest 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	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^	Habitat degraded	Excluded from further assessment	Justification for exclusion
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	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.	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 habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass.
Powerful Owl (breeding)	*Ninox strenua*	High	Living or dead trees with hollow greater than 20 cm diameter	Yes	Yes	The Project area does not contain living or dead trees for breeding.
Eastern Osprey (breeding)	*Pandion cristatus*	Moderate	Living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting.	Yes	Yes	The Project area does not contain living or dead trees, or artificial structures suitable for nesting.
Squirrel Glider	*Petaurus norfolcensis*	High	-	Yes	Yes	Records within the locality are associated with forested habitat and not associated with foredune habitat. The Project area does not contain suitable habitat for the species, and any habitat within the Project area is substantially degraded by Bitou Bush invasion.
Brush-tailed Phascogale	*Phascogale tapoatafa*	High	Hollow-bearing trees.	Yes	Yes	The Project area does not contain any hollow-bearing trees or forest or woodland habitat.
Common Planigale	*Planigale maculata*	High	-	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	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).

Common Name	Scientific Name	Sensitivity to potential gain class^	Habitat constraint^	Habitat degraded	Excluded from further assessment	Justification for exclusion
Coast Groundsel	*Senecio spathulatus*	Moderate	-	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.
Masked Owl (breeding)	*Tyto novahollandiae*	High	Living or dead trees with hollows greater than 20 cm diameter.	Yes	Yes	The Project area does not contain living or dead trees for breeding.

^From the Threatened Biodiversity Data Collection

7.2 Threatened ecological communities

No threatened ecological communities listed under the BC Act and EPBC Act have been identified within the Project area.

The vegetation present in the Project area comprises non-native vegetation represented by Bitou Bush Scrub and exotic grasslands. Furthermore, the original vegetation of the coastal foredunes (i.e. PCT 772) does not conform to any threatened ecological communities listed under the BC Act and EPBC Act.

In the wider area, 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 Sclerophyll Forest on Coastal Floodplains*, which is listed as Endangered under the BC Act
- *Swamp Oak Floodplain Forest*, which is listed as Endangered under both the BC Act and EPBC Act
- *Freshwater Wetlands on Coastal Floodplains*, which is listed as Endangered under the BC Act
- *Coastal Saltmarsh*, which is listed as Endangered under the BC Act and Vulnerable under the EPBC Act

7.3 Matters of national environmental significance

7.3.1 Threatened ecological communities

No threatened ecological communities listed under the EPBC Act have been identified 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

7.3.2 Threatened species

Database results indicate that there are approximately 46 threatened species 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.

None of these species were considered likely 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 and frog species are associated with estuarine habitats (i.e. intertidal mudflats, mangroves, samphire, saltmarsh), rocky beach platforms or reefs, gravelly or coralline shorelines, large waterbodies (such as coastal lagoons, inlets), or wetland/aquatic habitats (i.e. wet grassland meadows, reedlands or sedgelands, and inundated tussock grasslands), which are not present in the Project area.

A large proportion of the remaining species (mammals and plants) are associated with swamp forest, dry eucalypt forests, heathy woodlands or forests, grassy woodlands etc., or require diversity of flowering trees and shrubs, insect- or fungi-rich loamy soils. These habitats are generally absent from the Project area. A few species are almost exclusively aerial in habit, and are unlikely to utilise the habitats within the Project area.

The species assessed have potential to occur in the native vegetation and coastal habitats in the locality of the Project area. The estuarine and 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) are likely to provide suitable habitat for the assessed species.

The seaward side of the foredunes to the east of the Project area may also 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. 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 were assessed (see Appendix A) and are also considered unlikely to utilise the habitats within the Project area.

Migratory species that were assessed are all represented by either wetland birds, shorebirds, or terrestrial birds that are associated with forested habitats. These habitats are generally absent from the Project area. A few species 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.

As discussed above for threatened species, the migratory species assessed have potential to occur in the native vegetation and coastal habitats in the locality of the Project area, with Nine Mile Beach, Belmont Lagoon and Belmont Wetlands State Park being notable coastal features in the locality of the Project area and popular with birdwatchers. The estuarine and 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) are likely to provide suitable habitat for the migratory species assessed.

Many migratory species do not breed in the southern hemisphere but 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 also 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. 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.

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:
  - 1 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 and does not constitute important habitat for migratory species.

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 temporary 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 environmental benefit due to reduced overall construction and operational impacts that would otherwise result from the installation of new infrastructure

The Project (both the proposed desalination plant and the proposed power connection) is located in non-native vegetation comprising Bitou Bush Scrub and exotic grasslands. Construction of the Project would avoid 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.

The Project also avoids Coastal Wetland mapped under the Coastal Management SEPP, although it does fall within the proximity area for mapped Coastal Wetland. No aquatic or wetland 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 200 m from the Project area and are buffered by a corridor of swamp forest, wet heath and bushland vegetation.

8.2 Mitigation of impacts on biodiversity values

8.2.1 Key potential impacts

Although the Project is likely to avoid direct impacts on native vegetation, threatened species habitat and coastal wetland habitat, the Project is located on the foredunes behind Nine Mile Beach and is situated on soil landscapes that are susceptible to wind erosion. Bitou Bush, Kikuyu and Coolatai Grass are highly invasive weed species and have low biodiversity value but they also currently act as a dune stabiliser.

Considering the proximity of native swamp and wetland habitats to the Project area, the potential biodiversity impacts of the Project would likely arise during construction and would affect native swamp forests and wetland vegetation adjacent to the proposed temporary desalination plant site. 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.

Other potential biodiversity impacts of the Project include:

- 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

To mitigate the potential impacts of increased surface runoff due to the construction and operation of the temporary desalination plant, the Project would include the following design measures:

- Installation of impermeable concrete bunding around chemical storage areas to minimise the risk of contamination
- Use of crushed gravel for hardstand areas to minimise the generation of runoff
- Roof water catchment areas generally limited to containers and tanks (i.e. no large buildings and roof surfaces that would generate runoff)

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
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
	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
Acid sulfate soils	Prepare an acid sulphate soil management plan 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 during construction and prior to excavation in an area • 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 temporary 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

Hazard	Mitigation	Timing	Responsibility
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
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

Hazard	Mitigation	Timing	Responsibility
	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
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 6 ha of vegetation comprising Bitou Bush Scrub and exotic grassland (see Table 8-2) for the proposed temporary desalination plant at the Belmont WWTW site, and for the construction of the power connection at the Marriott Street and Hudson Street intersection.

This vegetation is non-native and does not conform to any native vegetation communities listed as threatened under the BC Act or EPBC Act.

Table 8-2 Direct clearing impacts within the Project area

Vegetation type	Extent within Project area (ha)		Total area (ha)
	Desalination plant	Power connection	
Bitou Bush Scrub	3.24	0	3.2
Exotic grassland	3.02	0.01	3.0
Cleared	1.36	0.03	1.4
Total area (ha)	**7.62**	**0.04**	**7.7**

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 temporary desalination plant at the Belmont WWTW site. The adjacent vegetation includes community types that are threatened under the BC Act or EPBC Act.

The potential indirect impacts are largely associated with wind erosion hazards and disturbance 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.

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 temporary 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 6-6 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 adjacent wetland habitats and swamp vegetation during construction. 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 to the west of 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). 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). This topography, as well as the lack of drainage lines flowing into the wetlands to the west, limits the sedimentation risks on sensitive receivers to the west.

Regardless, 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 non-vegetation and indirect impacts on adjacent native vegetation. There is no evidence that the non-native 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 does not contain or support habitat for any 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 Australian Height Datum (AHD). Groundwater modelling undertaken for this Project predicts that water levels will drop by a further 0.5 metres at a maximum distance of 30 metres west of Ocean Park Road as a result of groundwater drawdown for the Project (see Appendix C of the EIS main report). Drawdown will therefore occur below vegetation mapped as terrestrial GDE, corresponding to PCT 1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast. This drawdown is estimated to occur for up to 2 years (assuming up to 2 years extraction during extreme drought) followed by rapid recovery over the next 1-2 years.

The drawdown 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 predicted drop in water table levels by up to 0.5 metres 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 temporary 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 BC Act offset requirements

9.1.1 Impacts requiring offset

This BDAR assumed on a conservative basis that the non-native vegetation within the Project area is associated with threatened species habitat and assessed the Project area for ecosystem and species credits.

There are no impacts associated with the Project that require offsetting (see Section 9.1.2 below). No ecosystem credits were generated as the current vegetation integrity score is below those set out in Section 10.3.1 of the BAM (OEH, 2017a).

Further assessment of the vegetation within the Project area found that the habitat is substantially degraded and therefore, no candidate threatened species required further assessment for species credits.

9.1.2 Impacts not requiring offset

The impacts associated with the Project that require assessment but do not require offsetting include the removal of approximately 6 ha of non-native vegetation within the proposed desalination plant site representing Bitou Bush Scrub and exotic grassland. This is shown on Figure 9-1.

The vegetation zones established for the above non-native vegetation (assuming it is a PCT associated with threatened species habitat) have vegetation integrity scores of less than 17 and therefore do not require offsetting with ecosystem credits Table 9-1.

Table 9-1 Impacts not requiring offset

Vegetation type	PCT name	Area	Current vegetation integrity score	Future vegetation integrity score	Status	Ecosystem credits required
Bitou Bush Scrub	772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion (low_bitou)	3.2	2.8	0	Not listed	0
Exotic grassland	772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion (low_grass)	3.0	2.5	0	Not listed	0

9.1.3 Impacts not requiring further assessment

Approximately 0.01 ha of exotic grassland representing roadside verges and all cleared areas without vegetation was not assessed for ecosystem credits.

9.2 EPBC Act offset requirements

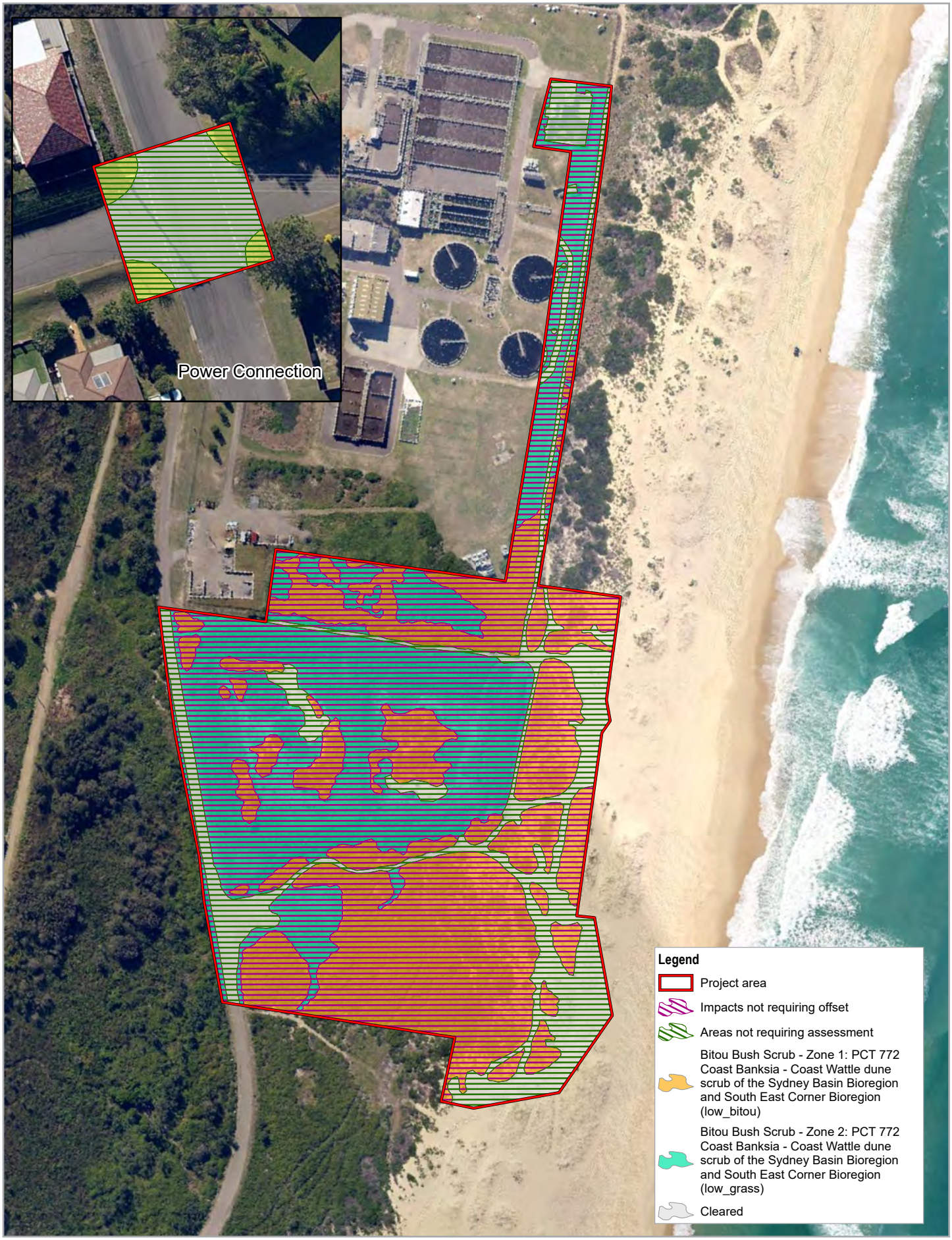
DEE administers an environmental offset policy under the EPBC Act (DSEWPaC, 2012). Environmental offsets are only required for controlled actions where residual impacts are considered to be significant.

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.

9.3 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). There are limited indirect impacts on key fish habitat to the east and west of the temporary 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 20 40 60 80

Meters

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

Hunter Water Corporation
Belmont Temporary Desalination Plant
Biodiversity Development Assessment Report

Project No. **22-19573**
Revision No. **0**
Date **11/10/2019**

Impact summary

FIGURE 9-1

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10. Conclusion

Hunter Water is proposing to construct a temporary 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) 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 1.2.4.00 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 of Nine Mile Beach and is surrounded by native swamp and wetland habitats associated with Belmont Lagoon, Lake Macquarie and the Belmont Wetlands State Park. 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 the land surrounding the Project area also include threatened ecological communities listed under the EPBC Act and BC Act and provides habitat for threatened species.

The Project area was 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 four-wheel 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. The direct impacts of the Project would comprise the clearing of approximately 6 ha of non-native vegetation. The potential biodiversity impacts of the Project is likely to be 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 series 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 Project does not require biodiversity credits to be retired to offset the impacts of the Project under the BC Act.

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 – Threatened species assessment tables

Table A.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	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)	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 previosuly 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	38	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	18	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	-	-	4	No	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.	No
Aves	Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V	-	-	15	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 - 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	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)	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	-	-	2	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, even though there is no suitable saltmarsh or swamp vegetation within the Project area. One record exists near mangrove vegetation at the eastern edge of Belmont Lagoon.	Yes
Aves	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V	-	-	7	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*).	Yes
Aves	Psittacidae	*Lathamus discolor*	Swift Parrot	E	CE	Species or species habitat known to occur within area	34	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 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.	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	-	-	20	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, bouider 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 or riparian habitat 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

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	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)	Generated by BAM Calculator	Ecosystem	Species		Foraging	Breeding				
Mammalia	Molossidae	*Micronomus norfolkensis* (syn. *Mormopterus norfolkensis*)	Eastern Coastal Free-tailed Bat	V	-	-	17	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	15	No	Foraging	Breeding		-	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 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 - although there is a record within 1 km of the Project area and the species has potential to occur in adjacent native vegetation, the species is considered highly unlikely to occur within the Project area
Mammalia	Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Roosting known to occur within area	208	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, 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
Mammalia	Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V	-	-	6	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. 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 1 km of the Project area. However, the species is unlikely to utilise the habitats within the Project area.	No - although there is a record within 1 km of the Project area and the species has potential to occur in adjacent native vegetation, the species is considered unlikely to utilise the habitats within the Project area
Mammalia	Vespertilionidae	*Miniopterus australis*	Little Bent-winged Bat	V	-	-	77	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	-	-	52	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	-	-	9	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 1 km of the Project area. However, the species is unlikely to utilise the habitats within the Project area.	No - although there is a record within 1 km of the Project area and the species has potential to occur in adjacent native vegetation, the species is considered unlikely to utilise the habitats within the Project area

Table A.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		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	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)	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	-	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 (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 does not contain any waterbodies although it is located within 1 km of waterbodies. Grassland areas of the Project area do not connect waterbodies or provide an obvious movement corridor between waterbodies. The grassy habitat within the Project area is substantially degraded by high threat weeds, Coolatai Grass and Kikuyu Grass.	No
Amphibia	Hylidae	*Litoria brevipalmata*	Green-thighed Frog	V	-	-	0	Yes	-	Species	-	-	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. The habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass.	No
Amphibia	Myobatrachidae	*Crinia tinnula*	Wallum Froglet	V	-	-	11	No	-	Species	-	-	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.	Low or unlikely	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 (last record in 1998). Multiple records to the north are from Redhead and Whitebridge areas and are located over 2 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 adjacent wetland habitats associated with Belmont Lagoon. However, there is no suitable habitat within the Project area, nor does the Bitou Bush scrub habitat within the Project area provide an obvious movement corridor between areas of suitable sedgeland or wet heath habitats.	No
Amphibia	Myobatrachidae	*Uperoleia mahonyi*	Mahony's Toadlet	E	-	-	0	No	-	Species	-	-	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.	Low or unlikely	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 the adjacent wetland habitats associated with Belmont Lagoon. The Project area lacks suitable breeding habitat for the species but also lacks suitable intact wet heath or wallum heath vegetation that would provide terrestrial habitat for the species during its non-breeding period. If the species were assumed to be present in adjacent habitats, it is unlikely that they would move into, and utilise the habitats within the Project area during non-breeding periods.	No
Aves	Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V	Ma	Species or species habitat known to occur within area	38	Yes	Foraging	Breeding	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	The Project area lacks suitable breeding habitat in the form of living or dead mature trees.	No
Aves	Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V	-	-	0	Yes	Foraging	Breeding	-	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	-	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

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Aves	Accipitridae	*Pandion cristatus*	Eastern Osprey	V	M, Ma	Species or species habitat known to occur within area	18	Yes	Foraging	Breeding	-	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	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.	No
Aves	Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V	-	-	15	Yes	Foraging	Breeding	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, and lacks living or dead trees with hollows.	No
Aves	Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	E	-	-	20	Yes	-	Species	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 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	-	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 for the species and habitat within the Project area is substantially degraded by Bitou Bush invasion.	No
Aves	Psittacidae	*Lathamus discolor*	Swift Parrot	E	CE	Species or species habitat known to occur within area	34	Yes	Foraging	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 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 habitat within the Project area is substantially degraded by BItou Bush invasion.	No
Aves	Strigidae	*Ninox strenua*	Powerful Owl	V	-	-	135	Yes	Foraging	Breeding	-	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	-	-	20	Yes	Foraging	Breeding	-	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	-	-	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	*Senecio spathulatus*	Coast Groundsel	E	-	-	0	Yes	-	Species	-	-	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.	Low or unlikely	The foredune habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass. Not recorded within 1 km of the Project area. Bitou Bush is a key threat for this species, as it typically invades habitat and smothers the species.	No

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Flora	Elaeocarpaceae	*Tetratheca glandulosa*	-	V	-	-	1	No	-	Species	-	-	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 habiat 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	2451	No	-	Species	-	-	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 Project area also contains habitat that is substantially degraded by Bitou Bush invasion.	No
Flora	Ericaceae	*Epacris purpurascens var. purpurascens*	-	V	-	-	1	No	-	Species	-	-	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	-	-	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*)	Low or unlikely	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.	No
Flora	Fabaceae (Faboideae)	*Pultenaea maritima*	Coast Headland Pea	V	-	-	6	No	-	Species	-	-	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	12	No	-	Species	-	-	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
Flora	Myrtaceae	*Angophora inopina*	Charmhaven Apple	V	V	Species or species habitat likely to occur within area	39	Yes	-	Species	-	-	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 within the Project area is substantially degraded by Bitou Bush invasion.	No
Flora	Myrtaceae	*Callistemon linearifolius*	Netted Bottle Brush	V	-	-	12	No	-	Species	-	-	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	Not recorded during survey of the Project area. The habitat within the Project area is substantially degraded by Bitou Bush invasion.	No
Flora	Myrtaceae	*Eucalyptus camfieldii*	Camfield's Stringybark	V	V	Species or species habitat likely to occur within area	2	No	-	Species	-	-	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	Not recorded during survey of the Project area. The habitat within the Project area is not associated with heathy woodland or forest vegetation and is otherwise substantially degraded by Bitou Bush invasion.	No
Flora	Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	CE	-	-	7	No	-	Species	-	-	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
Flora	Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E	V	Species or species habitat known to occur within area	16	No	-	Species	-	-	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 habitat within the Project area is substantially degraded by Bitou Bush invasion.	No
Flora	Orchidaceae	*Caladenia tessellata*	Thick Lip Spider Orchid	E	V	Species or species habitat likely to occur within area	0	Yes	-	Species	-	-	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 by Bitou Bush invasion.	No

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Flora	Orchidaceae	*Corybas dowlingii*	Red Helmet Orchid	E	-	-	3	No	-	Species	-	-	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	4	No	-	Species	-	-	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	9	No	-	Species	-	-	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 habitat within the Project area is substantially degraded by high threat weeds, Bitou Bush, Coolatai Grass and Kikuyu Grass.	No
Flora	Proteaceae	*Grevillea parviflora subsp. parviflora*	Small-flower Grevillea	V	V	Species or species habitat known to occur within area	95	No	-	Species	-	-	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	Zannichelliaceae	*Zannichellia palustris*	-	V	-	-	1	No	-	Species	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 wetland areas of slightly brackish to estauarine, slow-moving waters, which is absent from the Project area.	No
Mammalia	Burramyidae	*Cercartetus nanus*	Eastern Pygmy Possum	V	-	-	2	Yes	-	Species	-	-	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 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. The habitat within the Project area is substantially degraded by Bitou Bush invasion.	No
Mammalia	Dasyuridae	*Phascogale tapoatafa*	Brush-tailed Phascogale	V	-	-	0	Yes	-	Species	-	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 any hollow-bearing trees.	No
Mammalia	Dasyuridae	*Planigale maculata*	Common Planigale	V	-	-	0	Yes	-	Species	-	-	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	-	-	82	Yes	-	Species	-	-	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 assocated with foredunes, The Project area does not contain suitable habitat for the species, and this habitat is substantially degraded by Bitou Bush invasion.	No
Mammalia	Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Roosting known to occur within area	208	Yes	Foraging	Breeding	-	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 camps.	No

Group	Family	Scientific Name	Common Name	Status		Input Source			Credit Type		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	Records in locality (10km radius), BioNet Atlas of NSW Wildlife (OEH, 2019)	Generated by BAM Calculator	Ecosystem	Species	Foraging or roosting	Breeding				
Mammalia	Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	Species or species habitat likely to occur within area	0	Yes	-	Species	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 suitalbe 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	-	-	77	Yes	Foraging	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 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	-	-	52	Yes	Foraging	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 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	-	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 substantially degraded by Bitou Bush invasion.	No
Mammalia	Vespertilionidae	*Vespadelus troughtoni*	Eastern Cave Bat	V	-	-	6	No	-	Species	'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	-	-	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

Appendix B – Flora and fauna species lists

Fauna species

The fauna species listed in Table B-1 below were recorded by GHD in the vicinity of the Project area during surveys undertaken in late 2018 and early 2019. Species that were recorded opportunistically within the Project area in August 2019 are indicated in the final column of the table.

Flora species

The flora species listed in Table B-2 below were recorded during meandering walking survey of the Project area.

Table B-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 peronii*	Brown-striped Frog			x	
2	Amphibia	Myobatrachidae		*Platyplectrum ornatum*	Ornate Burrowing Frog			x	
3	Aves	Acanthizidae		*Acanthiza nana*	Yellow Thornbill			x	
4	Aves	Acanthizidae		*Sericornis frontalis*	White-browed Scrubwren			x	
5	Aves	Accipitridae		*Accipiter novaehollandiae*	Grey Goshawk			x	
6	Aves	Accipitridae		*Circus approximans*	Swamp Harrier			x	
7	Aves	Accipitridae		*Elanus axillaris*	Black-shouldered Kite				x
8	Aves	Alcedinidae		*Dacelo novaeguineae*	Laughing Kookaburra			x	
9	Aves	Anatidae		*Anas superciliosa*	Pacific Black Duck			x	
10	Aves	Apodidae		*Hirundapus caudacutus*	White-throated Needletail		Vulnerable/ Migratory	x	
11	Aves	Artamidae		*Artamus leucorynchus*	White-breasted Woodswallow			x	
12	Aves	Artamidae		*Cracticus nigrogularis*	Pied Butcherbird			x	
13	Aves	Artamidae		*Cracticus tibicen*	Australian Magpie			x	x
14	Aves	Artamidae		*Strepera graculina*	Pied Currawong			x	
15	Aves	Cacatuidae		*Cacatua galerita*	Sulphur-crested Cockatoo			x	
16	Aves	Cacatuidae		*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo			x	
17	Aves	Campephagidae		*Coracina novaehollandiae*	Black-faced Cuckoo-shrike			x	
18	Aves	Columbidae		*Geopelia humeralis*	Bar-shouldered Dove			x	
19	Aves	Columbidae		*Ocyphaps lophotes*	Crested Pigeon			x	
20	Aves	Columbidae	*	*Streptopelia chinensis*	Spotted Turtle-Dove			x	
21	Aves	Corvidae		*Corvus coronoides*	Australian Raven			x	
22	Aves	Cuculidae		*Cacomantis flabelliformis*	Fan-tailed Cuckoo			x	
23	Aves	Cuculidae		*Eudynamys orientalis*	Eastern Koel			x	
24	Aves	Estrildidae		*Neochmia temporalis*	Red-browed Finch			x	
25	Aves	Hirundinidae		*Hirundo neoxena*	Welcome Swallow			x	x
26	Aves	Laridae		*Chroicocephalus novaehollandiae*	Silver Gull			x	x

	Class	Family	Exotic	Species	Name	NSW Status	EPBC Status	Recorded in the vicinity of the Project area	Recorded in the Project area
27	Aves	Maluridae		*Malurus lamberti*	Variegated Fairy-wren			x	
28	Aves	Meliphagidae		*Acanthorhynchus tenuirostris*	Eastern Spinebill			x	
29	Aves	Meliphagidae		*Anthochaera carunculata*	Red Wattlebird			x	
30	Aves	Meliphagidae		*Entomyzon cyanotis*	Blue-faced Honeyeater			x	
31	Aves	Meliphagidae		*Manorina melanocephala*	Noisy Miner			x	
32	Aves	Meliphagidae		*Meliphaga lewinii*	Lewin's Honeyeater			x	
33	Aves	Meliphagidae		*Philemon corniculatus*	Noisy Friarbird			x	
34	Aves	Meliphagidae		*Phylidonyris niger*	White-cheeked Honeyeater			x	
35	Aves	Pardalotidae		*Pardalotus punctatus*	Spotted Pardalote			x	
36	Aves	Phalacrocoracidae		*Phalacrocorax varius*	Pied Cormorant			x	
37	Aves	Psittacidae		*Platycercus eximius*	Eastern Rosella			x	
38	Aves	Psittacidae		*Trichoglossus haematodus*	Rainbow Lorikeet			x	
39	Aves	Psophodidae		*Psophodes olivaceus*	Eastern Whipbird			x	
40	Aves	Rhipiduridae		*Rhipidura albiscapa*	Grey Fantail			x	
41	Aves	Rhipiduridae		*Rhipidura leucophrys*	Willie Wagtail			x	
42	Mammalia	Canidae	*	*Canis lupis*	Domestic Dog			x	x
43	Mammalia	Molossidae		*Austronomus australis*	White-striped Freetail-bat			x	
44	Mammalia	Vespertilionidae		*Chalinolobus gouldii*	Gould's wattled bat			x	
45	Mammalia	Vespertilionidae		*Miniopterus australis*	Little Bent-winged Bat	Vulnerable		x	
46	Mammalia	Vespertilionidae		*Nyctophilus geoffroyi*	Lesser Long-eared Bat			x	
47	Reptilia	Varanidae		*Varanus varius*	Lace Monitor			x	

Table B-2 Flora species recorded within the Project area

	Family	Species	Name	Growth
1	Aizoaceae	*Carpobrotus glaucescens*	Pigface	FG
2	Aizoaceae	*Galenia pubescens* var. *pubescens*	Galenia	HT
3	Alliaceae	*Agapanthus praecox* subsp. *orientalis*	African Lily	EX
4	Alliaceae	*Nothoscordum gracile*	Onion Weed	EX
5	Apocynaceae	*Nerium oleander*	Oleander	EX
6	Araceae	*Monstera deliciosa*	Fruit Salad Plant	EX
7	Araliaceae	*Hydrocotyle bonariensis*	Largeleaf Pennywort	EX
8	Arecaceae	*Syagrus romanzoffiana*	Cocos Palm	EX
9	Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	HT
10	Asteraceae	*Arctotheca calendula*	Capeweed	EX
11	Asteraceae	*Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush	HT
12	Asteraceae	*Gamochaeta* sp.	Cudweed	EX
13	Asteraceae	*Gazania linearis*	Treasure Flower	EX
14	Asteraceae	*Gazania rigens*	Treasure Flower	HT
15	Asteraceae	*Hypochaeris radicata*	Catsear	EX
16	Asteraceae	*Senecio madagascariensis*	Fireweed	HT
17	Asteraceae	*Soliva sessilis*	Bindyi	EX
18	Asteraceae	*Sonchus oleraceus*	Common Sowthistle	EX
19	Brassicaceae	*Cakile maritima* subsp. *maritima*	Sea Rocket	EX
20	Cactaceae	*Opuntia stricta*	Prickly Pear	HT
21	Caryophyllaceae	*Cerastium glomeratum*	Mouse-ear Chickweed	EX
22	Caryophyllaceae	*Polycarpon tetraphylla*	Four-leaved Allseed	EX
23	Caryophyllaceae	*Silene gallica* var. *gallica*	French Catchfly	EX
24	Chenopodiaceae	*Rhagodia candolleana* subsp. *candolleana*	Coastal Saltbush	SG
25	Convolvulaceae	*Dichondra repens*	Kidney Weed	FG
26	Convolvulaceae	*Ipomoea cairica*	Coastal Morning Glory	HT
27	Crassulaceae	*Crassula sieberiana* subsp. *sieberiana*	Australian Stonecrop	FG
28	Fabaceae (Faboideae)	*Medicago polymorpha*	Burr Medic	EX
29	Fabaceae (Faboideae)	*Trifolium arvense*	Haresfoot Clover	EX
30	Fabaceae (Faboideae)	*Vicia sativa*	Vetch	EX
31	Fabaceae (Mimosoideae)	*Acacia longifolia* subsp. *sophorae*	Coastal Wattle	SG
32	Fabaceae (Mimosoideae)	*Acacia saligna*	Golden Wreath Wattle	EX
33	Juncaeae	*Juncus kraussii*	Sea Rush	GG
34	Lauraceae	*Cassytha glabella* f. *glabella*	-	OG
35	Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	GG
36	Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	EX
37	Myrtaceae	*Callistemon viminalis*	Weeping Bottlebrush	TG
38	Myrtaceae	*Leptospermum laevigatum*	Coast Teatree	SG
39	Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark	TG
40	Phormiaceae	*Dianella caerulea*	Blue Flax-lily	FG
41	Plantaginaceae	*Plantago lanceolata*	Lamb's Tongue	EX
42	Poaceae	*Briza maxima*	Quaking Grass	EX
43	Poaceae	*Bromus catharticus*	Prairie Grass	EX

	Family	Species	Name	Growth
44	Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	HT
45	Poaceae	*Chloris gayana*	Rhodes Grass	HT
46	Poaceae	*Cynodon dactylon*	Common Couch	GG
47	Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HT
48	Poaceae	*Hyparrhenia hirta*	Coolatai Grass	HT
49	Poaceae	*Melinis repens*	Red Natal Grass	EX
50	Poaceae	*Paspalum dilatatum*	Paspalum	HT
51	Poaceae	*Phragmites australis*	Common Reed	GG
52	Poaceae	*Setaria parviflora*	Pigeon Grass	EX
53	Poaceae	*Spinifex sericeus*	Hairy Spinifex	GG
54	Poaceae	*Stenotaphrum secundatum*	Buffalo Grass	HT
55	Poaceae	*Vulpia fasciculata*	Dune Fescue	EX
56	Primulaceae	*Lysimachia arvensis*	Scarlet Pimpernel	EX
57	Proteaceae	*Banksia integrifolia* subsp. *integrifolia*	Coast Banksia	TG
58	Proteaceae	*Grevillea robusta*	Silky Oak	TG
59	Thymelaeaceae	*Pimelea linifolia* subsp. *linifolia*	Queen of the Bush	SG
60	Verbenaceae	*Lantana camara*	Lantana	HT

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

Appendix C – Vegetation integrity plot data

Family	Species	Name	Growth	Q1		Q2		Q3		Q4		Q5	
				C	A	C	A	C	A	C	A	C	A
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	EX					0.1	1				
Fabaceae (Faboideae)	*Vicia sativa*	Vetch	EX									0.1	7
Aizoaceae	*Carpobrotus glaucescens*	Pigface	FG			20	20						
Asteraceae	*Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush	HT	95	500	60	200			95	500		
Asteraceae	*Senecio madagascariensis*	Fireweed	HT			0.1	1						
Convolvulaceae	*Ipomoea cairica*	Coastal Morning Glory	HT									0.5	10
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	HT					100	1000	10	100	100	1000
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HT			0.1	10						
Chenopodiaceae	*Rhagodia candolleana* subsp. *candolleana*	Coastal Saltbush	SG	0.1	5	0.1	10						
Fabaceae (Mimosoideae)	*Acacia longifolia* subsp. *sophorae*	Coastal Wattle	SG	0.1	12	20	10						
Myrtaceae	*Leptospermum laevigatum*	Coast Teatree	SG	0.1	2								

Appendix D – BAM calculator import data

plot	pct	area	patchsize	Condition class	zone	easting	northing	bearing
Text [Maximum 10 characters]	Number	Number with 2 decimal point	Number	Text[Letters, numbers, underscores and hyphens] Please fill condition-class name in all plots [Maximum 20 characters]	[54 or 55 or 56]			Range in [0-359]
Q1	772	3.24	0	low_bitou	56	6342410	375654.6	210
Q2	772	3.24	0	low_bitou	56	6342332	375686.7	240
Q3	772	3.02	0	low_grass	56	6342503	375769.5	322
Q4	772	3.24	0	low_bitou	56	6342398	375617.2	150
Q5	772	3.02	0	low_grass	56	6342472	375636.5	135

plot	compTree	compShrub	compGrass	compForbs	compFerns	compOther
Text[Maximum 10 characters]	Number	Number	Number	Number	Number	Number
Q1	0	3	0	0	0	0
Q2	0	2	0	1	0	0
Q3	0	0	0	0	0	0
Q4	0	0	0	0	0	0
Q5	0	0	0	0	0	0

plot	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther
Text[Maximum 10 characters]	Number with 1 decimal point	Number with 1 decimal point	Number with 1 decimal point	Number with 1 decimal point	Number with 1 decimal point	Number with 1 decimal point
Q1	0.0	0.3	0.0	0.0	0.0	0.0
Q2	0.0	20.1	0.0	20.0	0.0	0.0
Q3	0.0	0.0	0.0	0.0	0.0	0.0
Q4	0.0	0.0	0.0	0.0	0.0	0.0
Q5	0.0	0.0	0.0	0.0	0.0	0.0

plot	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
Text [Maximum 10 characters]	Number	Number	Number with 1 decimal point	Number with 1 decimal point	[0,1]	[0,1]	[0,1]	[0,1]	[0,1]	[0,1]	Number with 1 decimal point
Q1	0	0	94.0	0.0	0	0	0	0	0	0	95.0
Q2	0	0	72.0	0.0	0	0	0	0	0	0	60.1
Q3	0	0	100.0	0.0	0	0	0	0	0	0	100.0
Q4	0	0	54.0	0.0	0	0	0	0	0	0	105.0
Q5	0	0	100.0	0.0	0	0	0	0	0	0	100.5

Appendix E – Biodiversity credit report

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00013228/BAAS17058/19/00013229	Temporary Desalination Plant - Desalination plant only_no pipelines	27/09/2019
Assessor Name	Assessor Number	BAM Data version *
Cecilia Phu	BAAS17058	15
Proponent Names	Report Created	BAM Case Status
	30/09/2019	Open
Assessment Revision	Assessment Type	Date Finalised
4	Major Projects	To be finalised

* 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

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-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Not a TEC	6.3	0.00

772-Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion

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% - < 70% cleared group (including Tier 6 or higher).	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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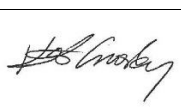
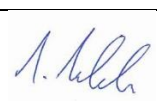
2219573-32137/https://projects.ghd.com/oc/newcastle1/cs0865hwctemporaryde/Delivery/Documents/2219573-REP_BTDP BDAR.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	C. Phu	K. Crosby		N. Malcolm		14/10/2019
1	C. Phu	K. Crosby		N. Malcolm		4/11/2019

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