Jackson Place EIS

Biodiversity Development Assessment Report

Transport for NSW | April 2020

NSW GOVERNMENT

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Biodiversity Development Assessment Report

Transport for NSW | April 2020

Prepared by GHD Pty Ltd

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Executive summary

Transport for NSW (TfNSW) proposes to remediate contaminated land located at 3 Highcliff Road, Earlwood (the site). This site forms part of a vegetated corridor within the Wolli Creek valley. The site is understood to have been used as an illegal landfill by a previous landowner. Remediation would be undertaken using a capping method, which includes placing clean crushed sandstone on top of the existing ground surface. Once capping is complete, the site would be revegetated to make it suitable for public use as a green corridor.

The proposal meets the provisions of Schedule 3 Clause 15(c) of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) and Clause 10 of State of Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) and is classified as designated development. As the proposal is designated development, an environmental impact statement (EIS) is required to be prepared in accordance with the Planning Secretary's Environmental Assessment Requirements (SEARs) and submitted to Council with the Development Application.

This Biodiversity Development Assessment Report (BDAR) has been prepared to satisfy the SEARS for the EIS. The BDAR assesses the impacts of the proposal on biodiversity values, including native vegetation and habitat features, threatened entities and coastal wetlands identified in the Biodiversity Values Map (BVM) (DPIE 2020), and identifies the required biodiversity offset in accordance with the Biodiversity Assessment Method (BAM).

The proposal will not have a significant impact on biodiversity values but there will be some residual impacts that cannot be avoided and that will need to be offset if the site is to be made safe for future use.

Specific measures are proposed to avoid impacts on biodiversity values. These include exclusion of most of the floodplain and the sandstone outcrop from the works area, and retention of mature native trees. A number of other mitigation measures to minimise impacts would be implemented as part of the proposal in line with the Roads and Maritime Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority 2011).

Vegetation in the upper fill platform is highly disturbed as a result of previous clearing and dumping of rubbish. Remnant trees are present, with much of the groundcover comprising mown lawn. Many weed species occur in the midstorey. The lower portion of the site borders Wolli Creek and a large area of saltmarsh, and smaller areas of mangroves and Swamp Oak forest. This area is mapped as a Coastal Wetland on the BVM (DPIE, 2020). Small areas of the following plant community types (PCTs) would be impacted by the remediation works:

- PCT 1776 Smooth-barked Apple - Coast Banksia / Cheese Tree open forest
- PCT 1126 Saltmarsh in estuaries.

PCT 1126 Saltmarsh in estuaries is commensurate with Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, listed as an endangered ecological community under the *Biodiversity Conservation Act 2016* (BC Act). This PCT is also commensurate with Subtropical and Temperate Coastal Saltmarsh, listed as a vulnerable ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Two candidate threatened fauna species have the potential to occur at the site. The Southern Myotis (*Myotis macropus*) (listed as a vulnerable species under the BC Act) may forage along Wolli Creek and could roost in vegetation within the construction boundary. The Southern Myotis was not recorded during surveys and there are few records in the locality, however suitable habitat is present. The Southern Myotis has been retained as a candidate threatened species given the community concern regarding impacts on biodiversity at the site and presence of other threatened and non-threatened microbats at the site. Potential habitat for the Green and Golden Bell Frog (*Litoria aurea*) (listed as an endangered species under the BC Act and a vulnerable species under the EPBC Act) is present in saltmarsh areas of the site. There are no recent records of the Green and Golden Bell Frog in the Wolli Creek area, and it is likely that it is extinct at

this location given the substantial retraction in distribution of the Cooks River key population in the last twenty years. Targeted surveys in appropriate conditions were conducted for this species and it was not recorded at the site. As such, this species has been marked ‘surveyed – not present’ in the BAM calculator.

There would be no direct impact on the roost colony of the Grey-headed Flying-fox (*Pteropus poliocephalus*) (listed as a vulnerable species under the BC Act and EPBC Act), which is located about 700 metres upstream of the site. No hollow-bearing trees suitable for nesting by species such as the Powerful Owl (*Ninox strenua*) (listed as a vulnerable species under the BC Act), would be impacted. Habitat at the site is considered ‘degraded’ for other threatened fauna that could potentially be candidate threatened species.

Candidate threatened flora species were surveyed for and none recorded at the site. All candidate threatened flora species have been marked ‘surveyed – not present’ in the BAM calculator.

This BDAR assessed the type and number of credits as a result of the proposal using the Biodiversity Assessment Methodology. These calculations identified the following offset requirements for the proposal:

- Three credits for impacts on 0.08 ha of PCT 1126 Saltmarsh in estuaries
- One credit for impacts on potential habitat for the Southern Myotis.

It is anticipated that offsets would be delivered via payment into the Biodiversity Conservation Fund.

Offsets are also required under the *Fisheries Management Act 1994* (FM Act) for impacts on Coastal Wetlands. It is recommended that the area of saltmarsh to be impacted is reduced to minimise offsets required for these impacts.

Given the small area of remediation works and limited habitat values present at the site, there are unlikely to be any significant impacts on matters of national environmental significance listed under the EPBC Act.

As noted above, the remediation works area would be revegetated following capping and would continue to provide habitat and wildlife connectivity along the Wolli Creek corridor. Additional mitigation measures to improve habitat values are recommended, including planting of Grey-headed Flying-fox feed trees.

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Glossary of terms

Definitions	
BAM assessment area	The area of land in the 1500m buffer zone around a development site, or land to be biodiversity certified or a biodiversity stewardship site, that is determined in accordance with Subsection 4.3.2 of the BAM (OEH 2017).
Biodiversity credits	Ecosystem credits or species credits
Biodiversity credit report	The report produced by the Biodiversity Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site (OEH 2017).
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity values from the impacts of development (OEH 2017).
Biodiversity Credit Calculator (BCC)	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site (OEH 2017).
Construction boundary	The area to be directly impacted by the proposal during construction activities. Includes the remediation area and a 10 m buffer for construction and ancillary activities. Analogous with subject land (see definition for subject land).
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to the proposal SEARs for cumulative impact assessment requirements.
Development footprint	Analogous with subject land (see definition for subject land).
Direct impact	An impact on biodiversity values that is a direct result of vegetation clearance for a development. It is predictable, usually occurs at or near to the development site and can be readily identified during the planning, design, construction, and operational phases of a development (OEH 2017).
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	A measurement of the value of threatened species habitat for species that can be reliably predicted to occur with a PCT (OEH 2014).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.

Definitions	
Indirect impact	An impact on biodiversity values that occurs when development related activities affect threatened species, threatened species habitat, or ecological communities in a manner other than direct impact. Compared to direct impacts, indirect impacts often: • occur over a wider area than just the site of the development • have a lower intensity of impact in the extent to which they occur compared to direct impacts • occur off site • have a lower predictability of when the impact occurs have unclear boundaries of responsibility (OEH 2017).
Local population	The population that occurs in the site. In cases where multiple populations occur in the site or a population occupies part of the site, impacts on each subpopulation must be assessed separately (OEH 2017).
MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the EPBC Act
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH 2014).
Mitigation	Action to reduce the severity of an impact (OEH 2014).
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Operational footprint	The area that will be subject to ongoing operational impacts from the proposal. This includes the road, surrounding safety verges and infrastructure, fauna connectivity structures and maintenance access tracks and compounds.
Population	A group of organisms, all of the same species, occupying a particular area.
Proposal	Remediation of Jackson Place including re-profiling the existing batter and capping using a low permeability geosynthetic clay liner and clean crushed sandstone on top of the contaminated fill. Once capping is complete, the site would be revegetated to make it suitable for public use as a green corridor and would be managed through implementation of a long term environmental management plan.
RAP	Remedial action plan
Remediation area	The area where remediation works would be undertaken (refer to Figure 1.1)
Site	The entire site at 3 Highcliff Road, Earlwood, which includes the remediation area, construction boundary and areas not being remediated.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Species credit species	Threatened species that are assessed according to Section 6.4.of the BAM

Definitions	
Subject land	Land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land. It includes land that may be a development site (the area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials), clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement (OEH 2017). For the purpose of this assessment, the subject land is all land within the construction boundary.
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.
Threatened Biodiversity Data Collection	Part of the BioNet database, published by the NSW Department of Planning, Industry and Environment (DPIE) and accessible from the BioNet website at *www.bionet.nsw.gov.au*.

Abbreviations	
BAM	Biodiversity Assessment Method
BCC	Biodiversity Credit Calculator
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BDAR	Biodiversity Development Assessment Report
CEEC	Critically endangered ecological community
CEMP	Construction Environmental Management Plan
DP&E	Department of Planning and Environment
DoEE	Department of Environment and Energy
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment (formerly OEH)
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Federal)
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage (now DPIE)
PCT	Plant Community Type
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSI	State Significant Infrastructure

Abbreviations	
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened Ecological Communities
VIS	Vegetation information system (BioNet Vegetation Classification)

1. Introduction

1.1 The proposal

1.1.1 Proposal background

Transport for NSW (TfNSW) proposes to remediate contaminated land located at 3 Highcliff Road, Earlwood (the site). The site has an area of 1.8 hectares, of which about 6500 square metres is proposed to be remediated.

The site is understood to have been used as an illegal landfill by a previous landowner. Between 1912 and 1969, around 0.6 hectares of the site was covered with approximately 31,300 m^3 of fill. It is understood the fill comprises soil, building rubble and other wastes from city demolition sites and potentially other domestic waste, and was dumped in an uncontrolled manner.

The site was compulsorily acquired by the then Roads and Traffic Authority (RTA), now TfNSW, in 1993 as part of the then proposed M5 South Western Freeway development.

Land contamination investigations have indicated that the upper fill platform contains elevated levels of heavy metals, including zinc, copper, cadmium, arsenic, asbestos in fibrous and bonded forms and organochlorine pesticides.

Elevated concentrations of copper, lead and zinc were also recorded in groundwater in a single sample collected from the base of the fill below the upper fill platform.

The site is now redundant to TfNSW operational requirements and TfNSW proposes to remediate the existing soil contamination to make the site suitable for use as a green corridor.

Based on an evaluation of remedial options, discussion with TfNSW, the appointed NSW EPA accredited site auditor and local stakeholders, the preferred remedial option is capping of contaminated fill in-situ. This would apply to the upper area and slopes only, excluding the sandstone outcrop area and lower floodplain area, and would exclude structural root zones of a number of trees. The scope of the proposed remediation work is documented in the GHD (2019) 'Remedial Action Plan' (RAP).

The proposal is mapped on Figure 1-1.

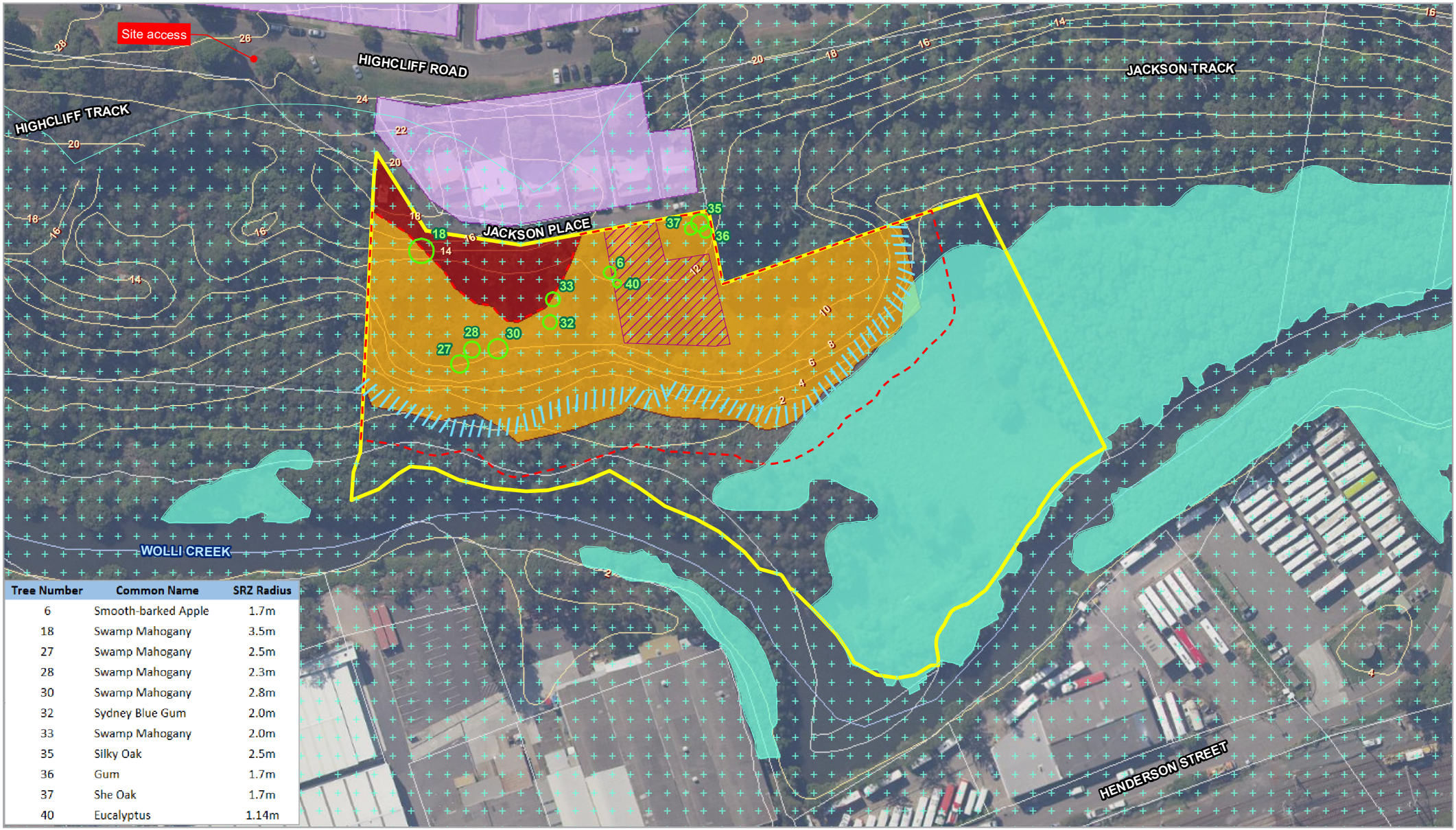
1.1.2 Key features of the proposal

Remediation would be undertaken using a capping method, which includes placing clean crushed sandstone on top of the existing ground surface. Once capping is complete, the site would be revegetated to potentially be incorporated into a proposed river-valley park as part of a green corridor.

Key features of the proposal include:

- installing temporary fencing, signage and erosion and sediment controls
- clearing the majority of vegetation on the upper fill platform (excluding eleven mature trees and their structural root zones) and installing a site shed and ancillary site on the upper fill platform
- re-profiling the existing batter to a flatter 2.3:1 (horizontal to vertical) batter, which would result in some surplus fill material being placed at the top of the fill platform, and possible removal off-site

- placement of a low permeability GCL over 31,300 cubic metres of contaminated fill material, which will act as a barrier to leaching and a marker layer. The design of the capping would consider the necessary site features including but not limited to utilities, irrigation and drainage features
- importing and placing clean capping material over the GCL (nominally crushed sandstone)
- re-turfing and re-introduction of native vegetation where appropriate
- removing equipment, site facilities, temporary fencing and erosion and sediment controls
- implementing a long term environmental management plan.



Tree Number	Common Name	SRZ Radius
6	Smooth-barked Apple	1.7m
18	Swamp Mahogany	3.5m
27	Swamp Mahogany	2.5m
28	Swamp Mahogany	2.3m
30	Swamp Mahogany	2.8m
32	Sydney Blue Gum	2.0m
33	Swamp Mahogany	2.0m
35	Silky Oak	2.5m
36	Gum	1.7m
37	She Oak	1.7m
40	Eucalyptus	1.14m

LEGEND

- Site boundary
- Construction boundary
- Remediation works
- Ancillary site
- Trees to be retained*
- Coastal wetlands
- Proximity area for coastal wetlands
- Sandstone outcrop (inferred)
- Residential area
- Cadastre
- Steep embarkment
- Waterway
- Contours (2m)

* Labels identify tree number

Paper Size ISO A4

0 20 40

Metres

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

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TfNSW
Jackson Place Remediation
Biodiversity Assessment

Project No. **21-28196**
Revision No. **-**
Date **29 Apr 2020**

Proposal site layout

FIGURE 1.1

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Data source: Aerial imagery - Sixmaps 2019 (); General topo- NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2017; Coastal wetlands - SEPP, NSW DPE 2019. Created by: eibbertson

© 2020. Whilst every care has been taken to prepare this map, GHD (and Sixmaps 2019, NSW Department of Lands, NSW Department of Planning and Environment) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

1.2 SEARs

The proposal is Category 1 remediation work and in accordance with State Environmental Planning Policy 55 – Remediation of Land, the proposal is permissible with development consent and is subject to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The proposal is local development, and Canterbury-Bankstown Council (Council) is the consent authority. A development application (DA) is required to be submitted in accordance with the requirements of the EP&A Act and the provisions of the Canterbury Local Environmental Plan 2012 (CLEP).

The proposal meets the provisions of Schedule 3 Clause 15(c) of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) and Clause 10 of State of Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) and is classified as designated development.

Hence, the proposal is considered to be designated development and TfNSW is required to prepare and submit an environmental impact statement (EIS) to Council with the DA.

Environmental Impacts Statements (EISs) are prepared to assess the impacts of designated development, and must be prepared in accordance with the Planning Secretary's requirements. This BDAR forms part of the EIS being prepared for the Jackson Place Remediation and assesses the biodiversity impacts of the proposal.

EIS's are subject to a range of legislative and policy requirements as set out in the Secretary's Environment Assessment Requirements (SEARs). Table 1.1 sets how the biodiversity requirements in SEARs 1354 have been addressed in this BDAR.

Biodiversity assessment requirements established by the *Biodiversity Conservation Act 2016* (BC Act), require a BDAR to be prepared for projects assessed under Division 5.2 of the EP&A Act, using a person accredited under the BC Act. These requirements are reflected in the SEARs.

Table 1-1: Secretary's Environmental Assessment Requirements for biodiversity

Key issue and desired performance outcome	Requirement (specific assessment requirements in addition to the general requirements)	Section addressed
Biodiversity	Accurate predictions of any vegetation clearing on site or for any road upgrades	Section 7.1.1 Direct impacts on native vegetation and habitat
	An assessment of the proposal in accordance with the Biodiversity Assessment Method (BAM) including the potential impacts on any threatened species, populations, endangered ecological communities or their habitats and groundwater dependent ecosystems.	This report

Key issue and desired performance outcome	Requirement (specific assessment requirements in addition to the general requirements)	Section addressed
	Details of weed management during construction and operation in accordance with existing State, regional or local weed management plans or strategies.	Section 8 Mitigation
	A detailed description of the measures to avoid, minimise, mitigate and offset biodiversity impacts.	Section 6 (avoid and minimise impacts) Section 8 Mitigation Section 9 Offsetting

1.3 Assessment guidelines used in this report

The assessment presented in this BDAR was undertaken in accordance with the Biodiversity Assessment Method (OEH 2017) and with reference to the following guidelines:

- Policy and Guidelines for fish habitat conservation and management (DPI 2013)
- Risk Assessment Guidelines for Groundwater Dependant Ecosystems (DPI 2012)
- Matter of National Environmental Significance Significant Impact Guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999* (DotE 2013).

1.4 Personnel

This BDAR was carried out by appropriate qualified and experienced environmental professionals, ecologists and accredited people as identified in Table 1-2.

Table 1-2: Personnel

Name	Role	Qualifications
Kirsten Crosby	Principal Ecologist / reporting, credit calculations	BSc (Hons) PhD (Zoology) BAM accredited (BAAS17011)
Kath Chesnut	Senior Ecologist / field surveys, reporting	B. Env. Sc (Hons) BAM accredited (BAAS17031)
Malith Weerakoon	Ecologist / desktop assessment, field surveys, reporting	BSc, MPhil by research
Isabel Lyons	Graduate Ecologist / field surveys, reporting	BSc
Cecilia Phu	Principal Ecologist / review of credit calculations	BSc (Hons) BAM accredited (BAAS17058)
Jayne Tipping	Technical Director Biodiversity / technical review	BSc MEnv Law

1.5 Assumptions

This BDAR has been prepared based on the proposal description and engineering drawings provided by the proponent and design team. It is assumed that the description and spatial data accurately represent the extent of direct impacts arising from the proposal and so these data have been used to calculate the extent of removal of vegetation and habitat arising from the proposal using GIS. These calculations have in turn been relied upon in the BAM calculations and the determination of key thresholds such as whether a particular impact is likely to be significant. The assessment conclusions may change as a result of the provision of an updated proposal design and/or spatial data.

1.6 Structure of this report

This report includes the following sections:

Chapter 1 – introduction and description of the proposal

Chapter 2 – description of landscape features

Chapter 3 – description of flora methods, native vegetation and groundwater dependent ecosystems

Chapter 4 – description of survey methods for threatened species, threatened species survey results, fauna habitats, and aquatic habitat assessment

Chapter 5 – description Matters of National Environmental Significance

Chapter 6 – measures to avoid and minimise impacts

Chapter 7 – impact assessment

Chapter 8 – proposed mitigation measures

Chapter 9 – offsetting requirements.

2. Landscape features

2.1 Identified features

Landscape features are described in detail below and mapped on Figure 2-1. A summary of landscape features is provided in Table 2-2. For the purposes of this assessment, the 'subject land' for which data has been entered into the credit calculator is land within the construction boundary (refer to Figure 1-1).

2.1.1 Location and land uses

The site is known as Lot 1 on deposited plan (DP) 5527246 and is located at 3 Highcliff Road, Earlwood (refer to Figure 1-1) in the Canterbury-Bankstown local government area (LGA), and is also known as Jackson Place. The site is situated on vacant land adjacent to Jackson Place, Earlwood. There are six residential properties located along Jackson Place directly north of the site.

Surrounding land uses include:

- Low density residential housing off Jackson Place to the north
- Open space/parkland to the east
- Wolli Creek and commercial/industrial premises (including the Turrella industrial area) to the south
- Open space/parkland (Turrella Reserve) to the west.

The site consists of two distinct topographic areas, namely the upper area and lower floodplain.

The upper area is about 200 metres long by 40 metres wide (0.75 hectares). About 0.65 hectares of this upper area is a platform of fill and 0.1 hectares is a sandstone outcrop with a thin layer of surface fill. This area of the site includes open grassed areas and is accessible to the public. However, the area is not an official park or recreational area and there are no public amenities such as playgrounds or sporting facilities. The majority of recreational site users are likely to comprise walkers and nature enthusiasts (such as bird watchers).

The lower floodplain is densely vegetated and comprises habitat for birds and other wildlife species. This area is generally inaccessible.

2.1.2 Bioregion and IBRA subregion

The subject land occurs within the Pittwater IBRA (Interim Biogeographic Regionalisation for Australia) subregion of the Sydney Basin IBRA bioregion (refer to Figure 2-1). 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.

2.1.3 NSW landscape region (Mitchell Landscapes)

The majority of site is mapped within the 'Woronora Plateau' Mitchell Landscape within the Sydney Basin Cataract geological group (refer to Figure 2-1) (DECC, 2008a). The southern portion of the site is mapped as 'Port Jackson Basin' within the Sydney Basin Pittwater geological group.

The Woronora Plateau Mitchell Landscape is described as occurring on benched low angle slopes and steep sided valleys. It comprises nodular ironstone on ridge crests, deep uniform sands on slopes and valley floors. Elevations within the landscape range generally from 400 to 500m with rocky outcrops common on ridgelines and in creeks (DECC, 2008b).

The landscape comprises a shrubby woodland dominated by Silvertop Ash (*Eucalyptus sieberi*), Sydney Peppermint (*Eucalyptus piperita*), Old Man Banksia (*Banksia serrata*) and Smooth-barked Apple (*Angophora costata*). The midstorey includes a heathy shrubland of *Banksia* spp., *Hakea* spp., *Persoonia* spp. and *Gahnia* spp (DECC, 2008a).

The Mitchell landscapes layer is coarse (1:250,000 scale) and in this instance does not appear to be accurate at the site. Based on field observations and analysis of contours using GIS, the site does not contain the characteristic topography of the Woronora Plateau landscape, and occurs from about elevations of 0 - 10 m, while the Woronora Plateau is generally found between elevations of 400 - 500 m (DECC, 2008a).

The geomorphology, soils and vegetation observed by GHD ecologists suggests that the site is more consistent with the description provided for the Port Jackson Basin Mitchell landscape: "Deep elongated harbour with steep cliffed margins on horizontal Triassic quartz sandstone. Small pocket beaches and more extensive Quaternary estuary fill of muddy sand at the head of most tributary streams. General elevation 0 to 80m, local relief 10 to 50m. Sandstone slopes and cliffs have patches of uniform or gradational sandy soil on narrow benches and within joint crevices that support forest and woodland of Sydney Peppermint (*Eucalyptus piperita*), Smooth-barked Apple (*Angophora costata*), Red Bloodwood (*Corymbia gummifera*) and Blackbutt (*Eucalyptus pilularis*). Sheltered gullies contain some Turpentine (*Syncarpia glomulifera*), Coachwood (*Ceratopetalum apetalum*) and Water Gum (*Tristaniopsis laurina*). Estuarine sands were originally dominated by saltmarsh but have been taken over by Grey Mangrove (*Avicennia marina*) in the past century" (DECC, 2008a).

The BAM requires that the Mitchell Landscape which most accurately reflects the landscape in which the proposal occurs should be entered into the calculator (OEH, 2017a). The description of the Port Jackson Basin landscape is more consistent with the majority of the soil and vegetation within the site, as well as the more intact vegetation in surrounding areas, and so it was selected as the most accurate Mitchell Landscape for the proposal.

2.1.4 Soils and geology

Soil landscapes

The site is mapped as occurring on the Hawkesbury Soil landscape. This soil landscape comprises rolling to steep hills on Hawkesbury Sandstone with a local relief form 40-200m. It includes a soil profile of shallow (>50cm) soils with discontinuous Lithosols/Siliceous Sands associate with rock outcrops, and yellow Podzolic Soils on the inside of benches. The Hawkesbury soil landscape is known to occur adjacent to Port Jackson.

Soils representative of this landscape were identified on the upper platform where fill material was absent. Patches of sandstone outcrop and fragments were also recorded on this upper platform.

Soil hazards

The north of the site gently slopes southward at the fill areas and sandstone outcrop. This changes to a steep drop (about 45 degrees) at the edge of the upper fill platform and embankment which generally falls south towards Wolli Creek.

The *NSW Department of Land and Water Conservation, Acid Sulfate Soil Risk Maps* predict a high probability of occurrence of acid sulfate soils in the in-situ soils at the edge of the proposed capping area. A portion of the site is also mapped as Class 2 acid sulfate soils under the Canterbury LEP. Based on the nature of the fill material consisting predominantly of construction and demolition waste, it is unlikely to consist of acid sulfate soils. In addition, given the historical movement (excavation, transport and subsequent emplacement) of the waste, it is likely that any oxidation of sulfidic ores (if present) would have already occurred.

Areas of geological significance

The geology map for the area (1: 250 000, Sheet S1 56-5 Sydney Edition) indicates that the site is underlain by Hawkesbury Sandstone of the Narrabeen Group, including sandstone, quartz with some shale.

The fill material in the upper fill platform overlies Hawkesbury Sandstone bedrock, which has been encountered at variable depths within the fill to a maximum recorded depth of 9.5 metres below existing ground level.

The lower floodplain comprises Quaternary Alluvium (sandy silt and silty clay) which is also underlain by Hawkesbury Sandstone at depths recorded from 0.6 to 1.5 metres below ground level.

No particular areas of geological significance are present.

2.1.5 Rivers and wetlands

Wolli Creek forms the southern boundary of the site. It runs in a west to east direction and drains to the Cooks River about 1 kilometre to the east of the site. Wolli Creek is an estuarine, tidal creek. It is mapped as being of poor quality for freshwater fish (DPI 2019). Wolli Creek is a second order stream as it occurs alongside the site.

Coastal Saltmarsh adjacent to the remediation area is mapped as a Coastal Wetland under the State Environment Planning Policy (Coastal Management) 2018. The proximity area for this Coastal Wetland covers the entirety of the remediation area (see Figure 1-1). The BVM (DPIE, 2020) also confirms the presence of a small area of Coastal Wetland (as per the Coastal Management SEPP) within the site.

2.2 Site context

2.2.1 Native vegetation and patch size

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 (see Figure 2-1).

Native vegetation within the construction boundary is part of a larger patch that extends to the east and west of the site. Vegetation in the buffer area is associated with the riparian corridor of Wolli Creek.

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 OEH (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
- Mangroves
- Non-woody vegetation corresponding to native wetland vegetation (including reedlands and saltmarsh).

Areas excluded from the estimated native vegetation extent include:

- Cleared areas
- 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 2-1.

Table 2-1: Percent native vegetation cover

Attribute	Value
1,500 metre buffered area (ha)	774.65 ha
Total native vegetation (ha)	94.39 ha
Per cent native vegetation cover	12%
Cover class	10-30%

2.2.2 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 for the poor to medium condition forest vegetation zones that occur within the construction boundary is 25-100 ha, with 62.5 ha occurring within the buffer area. The overall patch size polygon includes additional areas of connected intact native vegetation, however for the purposes of this assessment, the total patch size has not been calculated outside of the buffer area, given the highest class was already reached within the buffer area. Therefore 100 ha was entered as the patch size for each of the medium condition vegetation zones in the BAM calculator. Vegetation zone 3 (PCT 1778_Low) has a patch size of zero, because it does not contain any native over storey vegetation cover and itself comprises a gap in intact native vegetation cover. Less than 1 ha of saltmarsh occurs in the site and is separated by more than 30m from other areas of saltmarsh. The patch size class for the saltmarsh is < 5 ha.

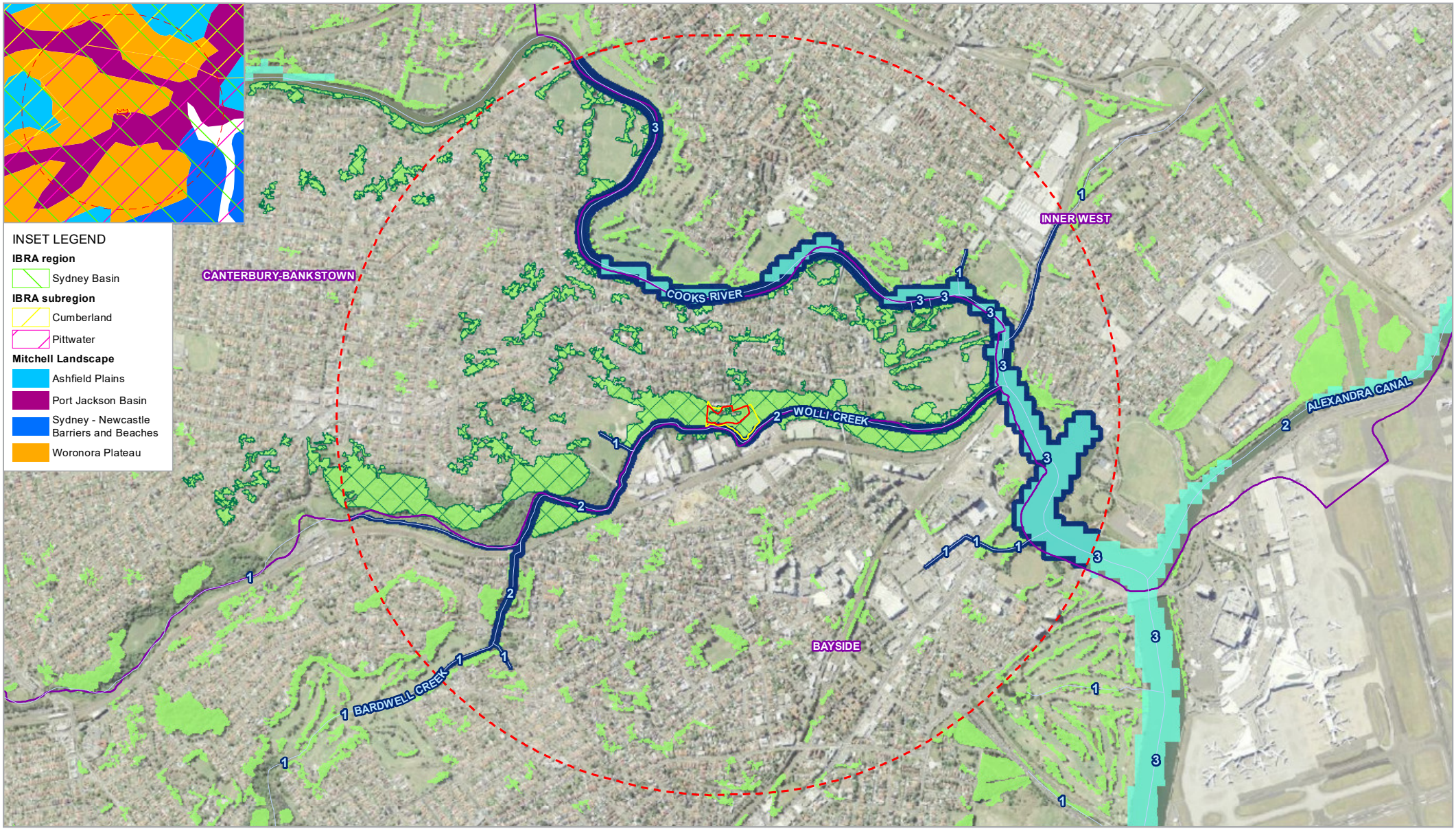
Within the 1,500 m buffer area surrounding the construction boundary, native vegetation comprises approximately 12 percent of the area.

2.3 Summary

A summary of landscape features is provided in Table 2-2 and mapped on Figure 2-1.

Table 2-2: Landscape features

Landscape feature	Subject land
IBRA bioregions and subregions	Sydney Basin, Pittwater
NSW landscape regions (Mitchell landscapes)	Port Jackson Basin
Native vegetation extent in the buffer area	93.23 ha within a 774.65 buffer area (12% native vegetation)
Rivers and streams	Wolli Creek occurs along the southern boundary of the site
Wetlands	Coastal Wetlands associated with Wolli Creek
Connectivity features	Wolli Creek riparian corridor
Areas of Geological Significance and Soil Hazard Features	None present
Areas of outstanding biodiversity value	None present



LEGEND

- Site boundary
- Construction boundary
- 1500m buffer area (774.6 ha)
- Local government area boundary
- Native vegetation extent
- Patch size (62.5 ha)
- Riparian buffer
- Wetlands NSW
- Waterway

Paper Size ISO A4

0 400 800

Metres

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

N

GHD

TfNSW
Jackson Place Remediation
Biodiversity Assessment

Landscape features

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Date **29 Apr 2020**

FIGURE 2.1

G:\21\28196\GIS\Maps\Deliverables\Biodiversity\21_28196_Z002_Biodiversity_LandscapeFeatures.mxd

Data source: Aerial imagery - Sixmaps 2019 (); General topo- NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2017' Native vegetation, Mitchell Landscapes, IBRA regions and subregions, Wetlands - OEH; LGAs - NSW DPE 2016. Created by: eibbertson

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3. Native vegetation

This chapter sets out the vegetation assessment undertaken for the proposal. The assessment conducted was consistent with the SEARS, BAM, survey guidelines and relevant impact assessment guidelines. The methods used and rationale behind their selection are described in Section 4.1.

3.1 Methods

3.1.1 Background research

The previous arborist and biodiversity assessment conducted for the site (GHD 2011 in GHD 2012) was reviewed as part of a wider desktop assessment for the proposal. This report included vegetation mapping of the site, and provided recommendations for retention of trees. The findings of the 2011 report (GHD 2011 in GHD 2012) was considered, along with the following information sources, to assist with an update of the vegetation mapping and identification of Plant Community Types and coastal wetlands:

- NSW *BioNet Vegetation Classification* (DPIE 2019a) to identify matching plant community types (PCTs) in the site.
- Aerial photographs and satellite imagery of the site.
- Available regional-scale vegetation mapping of the site (OEH 2016).
- Diagnostic species lists for native vegetation map units (e.g. OEH 2016) that are equivalent to PCTs in the site.
- Biodiversity Values Map and Threshold (BMAT) tool (DPIE, 2020).
- Directory of Important Wetlands of Australia (DIWA) (DEE 2019b).
- Atlas of Groundwater Dependent Ecosystems (BOM 2019b).

3.1.2 Identification of trees to be retained

An arborist and biodiversity assessment report was prepared by GHD (2011, in GHD 2012) which identified all trees on site and those that could be retained, as well as vegetation types within the site. Trees were nominated for retention because they were in very good structural and physical condition and were considered to provide a significant contribution to the landscape now and into the foreseeable future. These include mature Swamp Mahogany (*Eucalyptus robusta*), Smooth-barked Apple (*Angophora costata*), Sydney Blue Gum (*E. saligna*), Silky Oak (*Grevillea robusta*), and She Oak (*Casuaina glauca*). Trees to be removed predominantly comprise planted exotic species or juvenile native species (GHD 2011, in GHD 2012).

The recommendations for tree retention that were included in the report completed by GHD in 2011 (GHD 2011, in GHD 2012) are considered to be relevant to the current proposal. Based on a comparison of the findings of the GHD (2011) report with the current proposal, eleven trees and their structural root zones are proposed to be retained (refer to Figure 3-1).

3.1.3 Vegetation mapping

Existing vegetation mapping of the site (GHD 2011 in GHD 2012, OEH 2016) was reviewed prior to the current field survey, and was used as the basis for vegetation mapping for the current assessment. Existing mapping (GHD 2011 in GHD 2012, OEH 2016) was ground-truthed and updated (where necessary) in the field via systematic walked transects across the site and by walking the boundary of vegetation units. Necessary adjustments were made

by hand on aerial photographs of the site with reference to a handheld Global Positioning System (GPS) unit. Native vegetation was divided into vegetation zones which represented a distinct PCT and broad condition state. PCTs were identified based on vegetation structure, species composition, soil type and landscape position and with reference to the BioNet Vegetation Classification (DPIE 2019a) and diagnostic species lists for equivalent OEH (2016) vegetation map units. Better condition vegetation in adjacent areas that were publically accessible were also inspected.

The native vegetation in the site 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 site are described in Section 3.2.

3.1.4 Vegetation integrity survey plots (assessing site condition)

Following the stratification of the site 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 as per Table 4 of the BAM (OEH 2017a). The location of survey plots is shown on Figure 3-1 and the minimum plot survey requirements are summarised in Table 3-1. Two additional plots were also completed outside of the construction boundary, within the site, in order to be able to accurately describe the surrounding biodiversity values.

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).

All flora species within a 20 metre x 20 metre quadrat nestled within the 50 metre x 20 metre plot were identified according to the nomenclature of the Royal Botanic Gardens and Domain Trust (RGBT 2019). 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 3-1: Comparison of number of plots required and completed per zone area

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

Vegetation zone	Vegetation zone in site (ha)	Vegetation zone within construction boundary (ha)	BAM plot requirements	Number of plots completed
1. Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (moderate/good - medium)	0.28	0.20	1	1
2. Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (moderate/good - poor)	0.54	0.47	1	1
3. Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (low)	0.16	0.14	1	1
4. Saltmarsh in estuaries (moderate/good - medium)	0.54	0.09	1	1
Mangrove Forests in estuaries (moderate/good - medium)	0.16	0	1	1
Swamp Oak swamp forest (moderate/good - medium)	0.09	0	1	1

3.1.5 Plant community types

PCTs within the proposed site were identified according to section 5.2 of the BAM as described below. Existing regional vegetation mapping of the site area was considered in accordance with section 5.2.1.5 of the BAM. The highest resolution vegetation mapping that was available was the Vegetation mapping of the Sydney Metropolitan Area (OEH 2016). The OEH dataset was mapped across the site and adjacent areas and matched to candidate PCTs, which revealed:

- Coastal Sandstone Foreshores Forest mapped above the upper platform and on the slopes in the western edge of the site, which is equivalent to the candidate PCT Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney
- Estuarine Saltmarsh mapped as occurring on the lower platform on the south-eastern edges of the site which is equivalent to the candidate PCT Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion
- Estuarine Mangrove Forest mapped as occurring along the eastern edge and patches of the southern boundary of the site which is equivalent to the candidate PCT Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion
- Coastal Sandstone Galley Rainforest mapped as occurring on upper side slopes of the north eastern corner of the site which is equivalent to the candidate PCT Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of the Sydney basin
- A non-native vegetation type ‘Weeds and exotics’ mapped as occurring in on the slopes and lower platform of the site

- A small linear fragment on the upper platform of the site which was not assigned a vegetation type

  This preliminary vegetation map was ground-truthed during the current field surveys, based on observations of vegetation structure, dominant plant species, soil type, geomorphology and landscape position with reference to the BioNet Vegetation Classification (VIS) (DPIE 2019a) with the following results:

- PCT 1778 Smooth-barked Apple - Coast Banksia / Cheese Tree open forest was confirmed as the dominant vegetation type within the western half of the site.
- PCT 1126 Saltmarsh in estuaries was confirmed in the lower portion of the site.
- PCT 920 Mangrove Forests in estuaries was confirmed along waterways in the southern and eastern portions of the site.
- A new PCT; PCT 1234 Swamp Oak Swamp Forest was identified behind the Mangrove Forest vegetation.
- PCT 1828 Coachwood - Lilly Pilly - Water Gum gallery rainforest was discounted as occurring based on the absence of characteristic canopy and midstorey species listed in the PCT description. In general, this candidate PCT occurs closer to the coast and on more steeply incised slopes with more sheltered aspects than those at the site. Areas that were mapped as PCT 1828 by the OEH (2016) were found to support vegetation comparable to that mapped as PCT 1778.

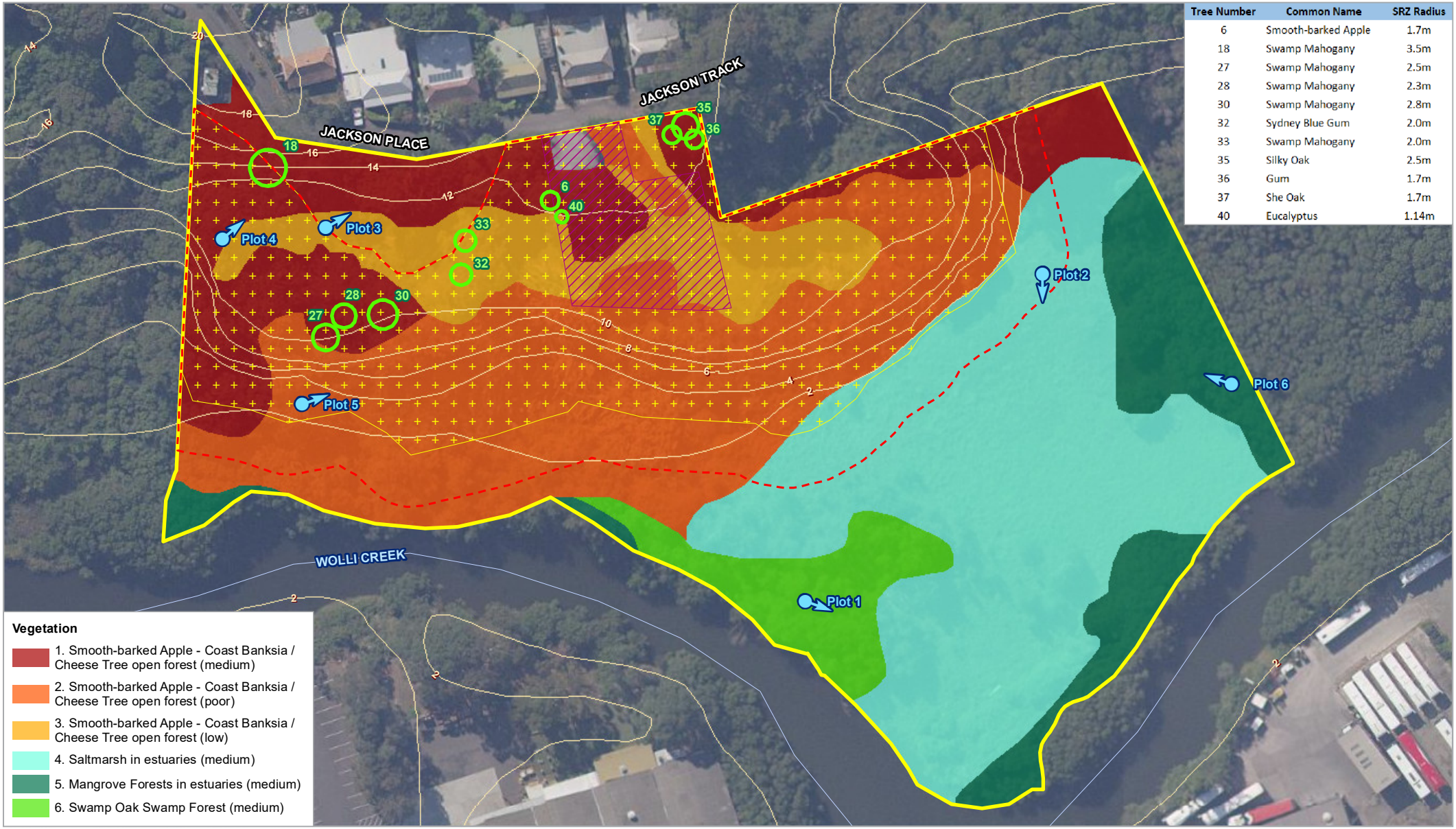
Plot/transects were sampled across PCTs as shown on Figure 3-1. Plot data was compared with diagnostic species lists for native vegetation map units (OEH 2016) that are equivalent to PCTs in the site in order to provide analysis of site survey data to help define PCTs in accordance with section 5.2.1.12 of the BAM.

The vegetation structure and quantitative analysis of site survey data from plots sampled within better condition patches of these PCTs was extrapolated to areas of sub mature or highly modified vegetation based on landscape position.

3.1.6 Survey limitations

It is likely that some species that occur in the site either permanently, seasonally or transiently were not detected during the survey. These species may include annual, ephemeral or cryptic flora species. The habitat assessment conducted allows for identification of habitat resources for such species, in order to make an assessment of their likelihood of occurring within the site. As such, the survey was not designed to detect all species, rather to provide an overall assessment of the ecological values and constraints within the site. This information was used to predict potential impacts of the proposal on threatened species habitat as far as possible.

Surveys were undertaken during a period of below average rainfall, and the site is a highly modified environment that has been subject to ongoing disturbances such as weed infestation, changes to landform and soil profile, rubbish dumping etc. There has been a history of planting vegetation within the site, some of which is broadly characteristic of vegetation in surrounding areas, as well as many species that are not native or indigenous to the site.



Tree Number	Common Name	SRZ Radius
6	Smooth-barked Apple	1.7m
18	Swamp Mahogany	3.5m
27	Swamp Mahogany	2.5m
28	Swamp Mahogany	2.3m
30	Swamp Mahogany	2.8m
32	Sydney Blue Gum	2.0m
33	Swamp Mahogany	2.0m
35	Silky Oak	2.5m
36	Gum	1.7m
37	She Oak	1.7m
40	Eucalyptus	1.14m

LEGEND

- Site boundary
- Construction boundary
- Remediation works
- Ancillary site
- Trees to be retained*
- Waterway
- Contours (2m)
- Plot/transect

* Labels identify tree number

Paper Size ISO A4

0 10 20

Metres

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

N

TfNSW
Jackson Place Remediation
Biodiversity Assessment

Native vegetation and location of plots

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FIGURE 3.1

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Data source: Aerial imagery - Sixmaps 2019 (); General topo- NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2017. Created by: eibbertson

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3.2 PCT descriptions

Vegetation in the upper fill platform is highly disturbed as a result of previous clearing and dumping of rubbish. Remnant trees are present, with much of the groundcover comprising mown lawn. Many weed species occur in the midstorey. For the purposes of the BAM calculations, this vegetation has been assigned to various condition zones of PCT 1778 Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney. This vegetation occurs in much better condition forest either side of the site.

The lower portion of the site contains PCT 1126 Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion. This PCT extends outside the construction boundary into the wider site. Also present outside the construction boundary along Wollli Creek are patches of PCT 920 Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion and PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion.

PCTs and vegetation zones within the construction boundary are shown on Figure 3-1 and summarised in Table 3-2. The vegetation zone description tables include vegetation types within the wider site, and include two vegetation zones that are not present within the construction boundary. Detailed descriptions of the PCTs within the site are provided in the tables on the following pages.

Table 3-2: Plant community types

Plant community type (PCT)	Condition	Vegetation integrity score	Patch size (ha)	Threatened ecological community?	Area (ha) within construction boundary
Smooth-barked Apple - Coast Banksia / Cheese Tree open forest	Medium	8.7	100	NO	0.20
	Poor	0.6	100	NO	0.47
	Low	0.8	0	NO	0.14
Saltmarsh in estuaries	Medium	72	1	YES	0.09
Mangrove Forests in estuaries	Medium	n/a	n/a	NO	n/a
Swamp Oak swamp forest fringing estuaries	Medium	n/a	n/a	YES	n/a
Total					**0.90**

Table 3-3: Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (medium)

Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (medium)		
PCT (DPIE 2019a)	Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	 Plate 1 Medium condition Smooth-barked Apple - Coast Banksia / Cheese Tree open forest at Plot 4. Note the trunks of canopy species (left of photo) were often hidden by exotic midstorey vegetation Plate 2 Medium condition Smooth-barked Apple - Coast Banksia / Cheese Tree open forest looking towards Jackson Place
PCT ID	1778	
Equivalent Map Units	S_DSF06 Coastal Sandstone Foreshores Forest (OEH 2016)	
Vegetation formation	KF_CH5B-Dry Sclerophyll Forests (Shrubby sub-formation)	
Vegetation class	Sydney Coastal Dry Sclerophyll Forests	
Survey effort	Plot 4	
Conservation significance	Native vegetation. Not listed as a TEC.	

Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (medium)	
Condition	Medium. BAM vegetation integrity plot data confirms that this vegetation is modified, likely through past clearing and activity associated with illegal dumping. Native species richness was low, and structurally this vegetation zone is modified, although canopy vegetation is present. Community structure is variable, and is mostly composed of mature trees and regrowth mid-storey vegetation. Fallen logs, large trees and litter cover were low. One hollow-bearing tree was recorded in this vegetation zone.
Evidence used to define vegetation unit	Presence close to a relatively major waterway (Wolli Creek), on sandstone geology. Open forest structure with moist midstorey and understorey species in a sheltered location (OEH 2016). Dominant plant species listed below are largely consistent with the VIS description for this PCT (DPIE 2019a).
Landscape position	On sheltered slopes near waterways, on sandstone geology.
Structure	Open forest with a dense mesic mid storey and relatively low native species diversity in the understorey
Overstorey	Features a sparse canopy of Sydney Red Gum (*Eucalyptus costata*), Bangalay (*Eucalyptus botryoides*) and White Cedar (*Melia azedarach*), along with scattered non-indigenous and exotic species that have been planted at the site.
Mid storey	Patchy and structurally variable, with some very dense patches of Sweet Pittosporum (*Pittosporum undulatum*) and Cheese Tree (*Glochidion ferdinandi*). Other mid storey species occur on occasion and include Coast Banksia (*Banksia integrifolia*), Coffee Bush (*Breynia oblongifolia*) and Flax-leaved Paperbark (*Melaleuca linariifolia*).
Groundcover	Poor in species diversity and structure. Groundcover species include a low cover of grass and grass-like growth forms, including Basket Grass (*Oplismenus aemulus*). Some herbs such as Blue Flax-lily (*Dianella caerulea*) were also present.
Exotic species	Exotic plant cover was high, and dominated the mid storey. This vegetation zone contains a high cover of Lantana *(Lantana camara*), Cape Ivy (*Delairea odorata*) and Crofton Weed (*Ageratina adenophora*). Other exotics occurring at lower densities include Pellitory (*Parietaria judaica*) and White Mulberry (*Morus alba*). High threat exotic plant cover within the vegetation zone was 118.3 percent.

Table 3-4: Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (poor)

Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (poor)		
PCT (DPIE 2019a)	Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	 Plate 3 Poor condition Smooth-barked Apple - Coast Banksia / Cheese Tree open forest at Plot 5. Plate 4 Poor condition Smooth-barked Apple - Coast Banksia / Cheese Tree open forest in the lower platform in the south of the site
PCT ID	1778	
Equivalent Map Units	S_DSF06 Coastal Sandstone Foreshores Forest (OEH 2016)	
Vegetation formation	KF_CH5B-Dry Sclerophyll Forests (Shrubby sub-formation)	
Vegetation class	Sydney Coastal Dry Sclerophyll Forests	
Survey effort	Plot 5	
Conservation significance	Native vegetation. Not listed as a TEC.	

Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (poor)	
Condition	Poor. BAM vegetation integrity plot data confirms that this vegetation is heavily modified, likely through past clearing and activity associated with illegal dumping. Low native species richness and structure, although a sparse canopy vegetation is present. Community structure is variable, and is mostly composed of mature trees and regrowth mid-storey vegetation. Fallen logs, large trees and litter cover was low.
Evidence used to define vegetation unit	Presence close to a relatively major waterway (Wolli Creek), on sandstone geology. Open forest structure with moist midstorey and understorey species in a sheltered location (OEH 2016). Dominant plant species listed below are largely consistent with the VIS description for this PCT (DPIE 2019a).
Landscape position	On sheltered slopes near waterways, on sandstone geology.
Structure	Open forest with a dense mid storey and low diversity in the understorey
Overstorey	Features a sparse canopy of Sydney Red Gum
Mid storey	None recorded.
Groundcover	None recorded
Exotic species	Exotic plant cover was very high and diverse. Exotic plant cover was highest in the midstorey where Lantana, Balloon Vine (*Cardiospermum grandiflorum*) and Cape Ivy were present in high densities. Other exotics occurring at lower densities include White Mulberry, Small-leaved Privet (*Ligustrum sinense*), Green Cestrum (*Cestrum parqui*), Bridal Creeper (*Asparagus asparagoides*), Wandering Jew (*Tradescantia fluminensis*), Giant Reed (*Arundo donax*), Crofton Weed (*Ageratina adenophora*), Panic Veldtgrass (*Ehrharta erecta*), Madeira Vine (*Anredera cordifolia*), White Mulberry (*Morus alba*) and Climbing Asparagus Fern (*Asparagus plumosus*). High threat exotic plant cover within the vegetation zone was 150.6 percent.

Table 3-5: Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (low)

Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (low)		
PCT (DPIE 2019a)	Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	 Plate 5 Low condition Smooth-barked Apple - Coast Banksia / Cheese Tree open forest at Plot 3. Plate 6 Low condition Smooth-barked Apple - Coast Banksia / Cheese Tree open forest in the upper fill platform within the remediation area
PCT ID	1778	
Equivalent Map Units	S_DSF06 Coastal Sandstone Foreshores Forest (OEH 2016)	
Vegetation formation	KF_CH5B-Dry Sclerophyll Forests (Shrubby sub-formation)	
Vegetation class	Sydney Coastal Dry Sclerophyll Forests	
Survey effort	Plot 3	
Conservation significance	Native vegetation. Not listed as a TEC.	

Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (low)	
Condition	Low. BAM vegetation integrity plot data confirms that this vegetation is heavily modified, likely through past clearing and activity associated with illegal dumping. Low native species richness and structure scores. Zone is characterised by an exotic grassland with fringing canopy and exotic midstorey vegetation. Fallen logs, large trees and litter cover was low. One hollow-bearing tree was recorded in this vegetation zone, which has been created through placement of a salvaged hollow into a mature tree.
Evidence used to define vegetation unit	Presence close to a relatively major waterway (Wolli Creek), on sandstone geology. Open forest structure with moist midstorey and understorey species in a sheltered location (OEH 2016). Dominant plant species listed below are largely consistent with the VIS description for this PCT (DPIE 2019a).
Landscape position	On sheltered slopes near waterways, on sandstone geology.
Structure	Cleared land comprising a predominately exotic grassland, with occasional native species in the midstorey. This vegetation zone appears to have undergone some management (mowing or slashing, in parts), in the past, resulting in a lack of canopy and midstorey species.
Overstorey	Occasional Sydney Blue Gum and Bangalay on the edges of this vegetation zone
Mid storey	None recorded.
Groundcover	Low diversity with patches of Weeping Grass (*Microlaena stipoides*), Native Wandering Jew (*Commelina cyanea*), Common Couch (*Cynodon dactylon*) and Spiny-headed Mat Rush (*Lomandra longifolia*).
Exotic species	Exotic plant cover was very high and diverse. Exotic plant cover was highest in the groundcover where Prairie Grass (***Bromus catharticus***) was the dominant exotic species present. Other exotics occurring at lower densities included Pellitory, Cape Ivy, *Morus* spp., Lantana, and Hop Clover (*Trifolium campestre*), Common Vetch (*Vicia sativa*), White Clover (*Trifolium repens*), Small-flowered Mallow (*Malva parviflora*), Common Sowthistle (*Sonchus oleraceus*), Rambling Dock (*Acetosa sagittata*), Great Brome (*Bromus diandrus*), A Medic (*Medicago* spp), Wandering Jew (*Tradescantia fluminensis*), Lamb's Tongues (*Plantago lanceolata*), Green Cestrum (*Cestrum parqui*), Shivery Grass (*Briza minor*), Flaxleaf Fleabane (*Conyza bonariensis*), Paddy's Lucerne (*Sida rhombifolia*), Perennial Ryegrass (*Lolium perenne*), Crofton Weed (*Ageratina adenophora*) and Mouse-ear Chickweed (*Cerastium glomeratum*) High threat exotic plant cover within the vegetation zone was 9 percent.

Table 3-6: Saltmarsh in estuaries (medium)

Saltmarsh in estuaries (medium)		
PCT (DPIE 2019a)	Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	 Plate 7 Medium condition Saltmarsh in estuaries at Plot 2. Plate 8 Medium condition Saltmarsh in estuaries in mid ground
PCT ID	1126	
Equivalent Map Units	S_SW02 Estuarine Saltmarsh (OEH 2016)	
Vegetation formation	Saline Wetlands	
Vegetation class	Saltmarshes	
Survey effort	Plot 2	

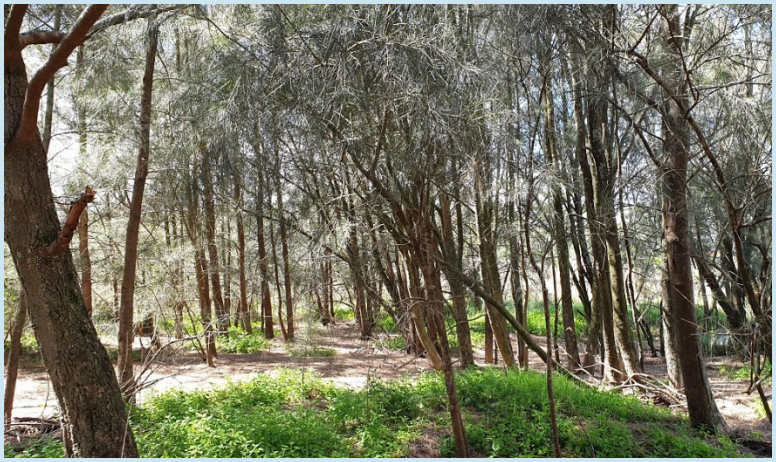
Saltmarsh in estuaries (medium)	
Conservation significance	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, listed as an endangered ecological community under the BC Act Subtropical and Temperate Coastal Saltmarsh, listed as a vulnerable ecological community under the EPBC Act
Condition	Medium. BAM vegetation integrity plot data confirms that this vegetation has been modified, and has integrity data outside of the average benchmark values for this PCT. Within the site, this PCT has low native species richness and is characterised by low saltmarsh and associated vegetation.
Evidence used to define vegetation unit	As per the description provided in OEH (2016), this PCT comprises low succulent herbs and rushes on tidally inundated land. Matches the vegetation type mapped by OEH (2016) within low lying portions of the site.
Landscape position	On occasionally inundated land influenced by tidal flows from Wolli Creek, behind the mangrove vegetation type that lines the creekline itself.
Structure	Open vegetation, dominated by salt tolerant groundcovers.
Overstorey	Absent
Mid storey	Grey Mangrove (*Avicennia marina* subsp. *australasica*) is present along the edges of this vegetation type.
Groundcover	Low diversity but high abundance of Seablite (*Suaeda australis*), Common Reed (*Phragmites australis*), Saltbush (*Atriplex* sp.) and *Sarcocornia quinqueflora* subsp. *quinqueflora*.
Exotic species	Exotic plant cover was low in diversity and low to moderate in cover. The only exotic species recorded was Sharp Rush (*Juncus acutus* subsp. *acutus*). High threat exotic plant cover within the vegetation zone was 0.5 percent.

Table 3-7: Mangrove Forests in estuaries (medium)

Mangrove Forests in estuaries (medium)		
PCT (DPIE 2019a)	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	 Plate 1. Mangroves along Wolli Creek
PCT ID	920	
Equivalent Map Units	S_SW01 Estuarine Mangrove Forest (OEH 2016)	
Vegetation formation	KF_CH10 Saline Wetlands	
Vegetation class	Mangrove Swamps	
Survey effort	Plot 6	
Conservation significance	Native vegetation. Not listed as a TEC. Protected marine vegetation under the FM Act.	
Condition	Medium. BAM vegetation integrity plot data confirms that this vegetation is in relatively good condition, with data close to benchmark values for most measured fields. This vegetation zone does not occur within the construction boundary, but is present in the site.	
Evidence used to define vegetation unit	Dominance of Grey Mangrove on mudflats along an estuary (OEH 2016).	
Landscape position	On mudflats along the Wolli Creek estuary.	
Structure	Low closed forest, with Grey Mangrove dominating the community. Few other species present.	
Overstorey	Grey Mangrove (*Avicennia marina* subsp. *australasica*)	

Mangrove Forests in estuaries (medium)	
Mid storey	Juvenile Grey Mangroves are scattered throughout this vegetation type. No native shrub species are present.
Groundcover	As is typical for this PCT, there was low diversity and low abundance of Seablite (*Suaeda australis*), Common Reed (*Phragmites australis*), New Zealand Spinach (*Tetragonia tetragonoides*) and *Sarcocornia quinqueflora* subsp. *quinqueflora*.
Exotic species	Exotic plant cover was low in diversity and low to moderate in cover. The main exotic species recorded was Asparagus Fern (*Asparagus aethiopicus*). Other exotic species present included Sharp Rush (*Juncus acutus* subsp. *acutus*), Bridal Creeper (*Asparagus asparagoides*), Madeira Vine (*Anredera cordifolia*), Panic Veldtgrass (*Ehrharta erecta*) and *Senna pendula* var. *glabrata*. High threat exotic plant cover within the vegetation zone was 6.1 percent.

Table 3-8: Swamp Oak Swamp Forest (medium)

Swamp Oak Swamp Forest (medium)		
PCT (DPIE 2019a)	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	 Plate 1. Swamp Oak swamp forest
PCT ID	1234	
Equivalent Map Units	S_FOW08 Estuarine Swamp Oak Forest (OEH 2016)	
Vegetation formation	KF_CH9 Forested Wetlands	
Vegetation class	Coastal Floodplain Wetlands	
Survey effort	Plot 1	
Conservation significance	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, listed as an endangered ecological community under the BC Act	
Condition	Medium. BAM vegetation integrity plot data confirms that this vegetation has been modified, likely through past clearing and impacts associated with changes to hydrology and adjacent land uses along Wolli Creek. Low native species richness characterised by a fairly closed canopy, largely absent native midstorey and ground layer dominated by fallen plant material with few native plants present in the understorey. Note that this vegetation type is not present within the construction boundary, but is present in the site.	
Evidence used to define vegetation unit	Forest comprised entirely of Swamp Oak, growing along the edges of a waterway with a relatively intact soil profile. Few native midstorey or groundcover species present. Dominant plant species listed below are consistent with the VIS description for this PCT (DPIE 2019a).	
Landscape position	Along the banks of Wolli Creek, interspersed with patches of Mangrove Forest.	

Swamp Oak Swamp Forest (medium)	
Structure	Closed forest vegetation, dominated by Swamp Oak, with few other species present.
Overstorey	Swamp Oak (*Casuarina glauca*)
Mid storey	Grey Mangrove (*Avicennia marina* subsp. *australasica*), *Acacia longifolia* and juvenile Swamp Oak (*Casuarina glauca*)
Groundcover	Low diversity and abundance of New Zealand Spinach (*Tetragonia tetragonioides*), Common Reed (*Phragmites australis*) and Weeping Grass (*Microlaena stipoides*).
Exotic species	Exotic plant cover was low in diversity and low to moderate in cover. The main exotic species recorded were Asparagus Fern (*Asparagus aethiopicus*) and Panic Veldtgrass (*Ehrharta erecta*). Other exotics occurring at lower densities include the woody weeds ***Senna pendula*** var. ***glabrata***, Lantana (***Lantana camara***) and Mickey Mouse Plant (***Ochna serrulata***); herbaceous species such as Flaxleaf Fleabane (***Conyza bonariensis***), Black-berry Nightshade (***Solanum nigrum***), Fireweed (***Senecio madagascariensis***) and Common Sowthistle (***Sonchus oleraceus***); ***Asparagus*** spp.; the grasses Praire Grass (***Bromus catharticus***) and Panic Veldtgrass (***Ehrharta erecta***); and the climber Madeira Vine (***Anredera cordifolia***). High threat exotic plant cover within the vegetation zone was 12.1 percent.

3.3 Threatened ecological communities

PCT 1126 Saltmarsh in estuaries is commensurate with Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, listed as an endangered ecological community under the BC Act. This PCT is also commensurate with Subtropical and Temperate Coastal Saltmarsh, listed as a vulnerable ecological community under the EPBC Act (see section 5.1). This PCT occurs on the lower portions of the site, within and adjacent to the construction footprint.

PCT 1234 Swamp Oak Swamp Forest is commensurate with Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, listed as an endangered ecological community under the BC Act. This PCT occurs downslope of the construction boundary and would not be directly impacted by the proposal. PCT 1234 within the site does not meet the condition thresholds for the EEC as listed under the EPBC Act (see section 5.1).

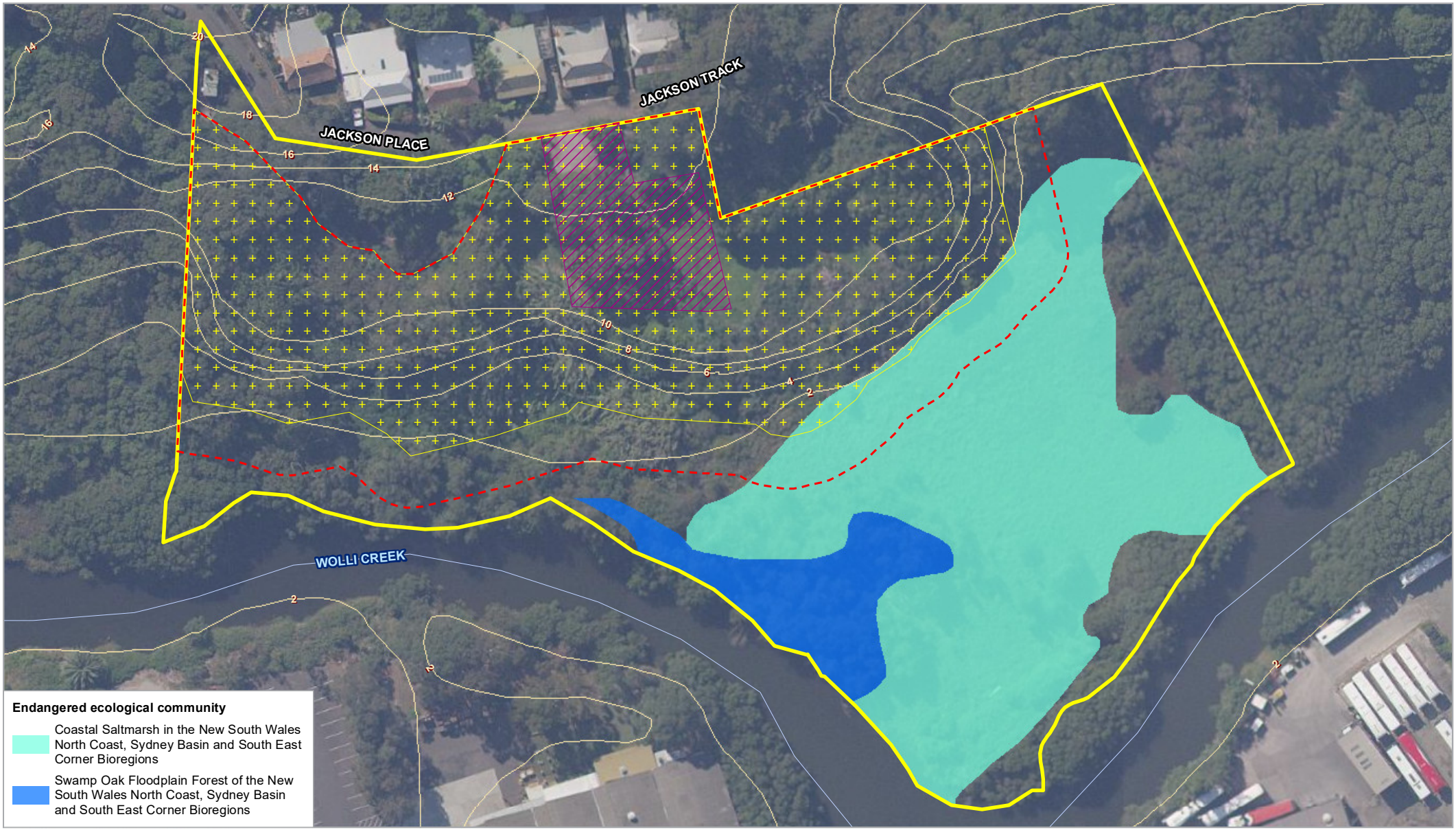
A comparison of these PCTs with the final determination for the threatened ecological communities as listed under the BC Act is provided in Table 3.9 and Table 3.10.

Table 3.9: Comparison of BC Act-listed Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions final determination criteria and PCT 1126

TEC & PCT	Bioregion	Landform and altitudinal range	Soil / geology	Structure	Species assemblage	Condition threshold
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	NSW North Coast, Sydney Basin and South East Corner Bioregions	Occurs in the intertidal zone on the shores of estuaries and lagoons including when they are intermittently closed	Occurs close to or on the fringe of a saline or semi-saline coastal estuary or lagoon	Mostly treeless plant community recognised by a low mosaic of succulent herbs, salt tolerant grasses and sedge	Characteristic plants include *Baumea juncea, Juncus krausii subsp. australiensis, Sarcocornia quinqueflora* subsp. *quinqueflora, Sporobolus virginicus, Triglochin striata, Ficinia nodosa, Samolus repens, Selliera radicans, Suaeda australis* and *Zoysia macrantha.* Dense stands of tall reeds (*Phragmites australis, Bulboschoenus* spp., *Schoenoplectus* spp., *Typha* spp.) may occur	A large number of weed species occur in NSW saltmarshes. Saltmarshes have frequently been used for casual rubbish dumping and are at risk from waterborne pollution
PCT 1126 Saltmarsh in estuaries	Sydney Basin	This vegetation type occurs on low lying areas associated with Wolli Creek.	This vegetation type occurs on low lying areas associated with Wolli Creek.	Saltmarsh with fringing mangroves present	Saltmarsh species including *Suaeda australis*, *Phragmites australis*, and *Sarcocornia quinqueflora* subsp. *quinqueflora* are present	Saltmarsh in the area is subject to weed invasion, rubbish and water pollution
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion

Table 3.10: Comparison of BC Act-listed Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions final determination criteria and PCT 1234

TEC & PCT	Bioregion	Landform and altitudinal range	Soil / geology	Structure	Species assemblage	Condition threshold
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions Threatened Ecological Community	North Coast, Sydney Basin and South East Corner bioregions	It generally occupies low-lying parts of floodplains, alluvial flats, drainage lines, lake margins and fringes of estuaries; habitats where flooding is periodic and soils show some influence of saline ground water.	Alluvium; silts, clay-loams and sandy loams.	The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees.	Dominated by a tree canopy of either *Casuarina glauca* or, more rarely, *Melaleuca ericifolia* with or without subordinate tree species; the relatively low abundance of Eucalyptus species; and the prominent groundcover of forbs and graminoids.	There is no condition threshold described for this community in the determination.
PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Sydney Basin	This vegetation type occurs on low lying areas associated with Wolli Creek.	Associated with alluvial flats of Wolli Creek	This PCT occurs as open forest in the site.	Tree canopy dominated by *Casuarina glauca.*	All condition class vegetation was considered to meet this threatened ecological community listing.
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion



LEGEND

- Site boundary
- Construction boundary
- Remediation works
- Ancillary site
- Waterway
- Contours (2m)

Paper Size ISO A4

0 10 20

Metres

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

N

TfNSW
Jackson Place Remediation
Biodiversity Assessment

Threatened ecological communities (BC Act)

Project No. **21-28196**
Revision No. **-**
Date **29 Apr 2020**

FIGURE 3.2

G:\21\28196\GIS\Maps\Deliverables\Biodiversity\21_28196_Z004_Biodiversity_TEC.mxd

Data source: Aerial imagery - Sixmaps 2019 (); General topo- NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2017. Created by: eibbertson

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3.4 Weeds

Weeds are common throughout the site (82 species of 116 recorded), and include environmental weeds and weeds with formal control measures identified. The *Biosecurity Act 2015* identifies priority weeds in NSW that have been assigned a biosecurity duty (such as prohibitions on sale and control measures). Twenty priority weed species are present at the site. All of these species have a general biosecurity duty which requires any person who deals with the plant to ensure the biosecurity risk of the weed is prevented, eliminated or minimised, so far as is reasonably practicable.

Under the Australian Weeds Strategy 2017 to 2027 (Invasive Plants and Animals Committee, 2016), 32 introduced plants have been identified as Weeds of National Significance (WONS). These weeds are regarded as the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts. WONS recorded at the site include Madeira Vine (*Anredera cordifolia*), Moth Vine (*Araujia sericifera*), Ground Asparagus (*Asparagus aethiopicus*), Bridal Creeper (*Asparagus asparagoides*), Climbing Asparagus Fern (*Asparagus plumosus*), Lantana (*Lantana camara*), and Fireweed (*Senecio madagascariensis*).

A number of weeds are also identified as high threat weeds. These are plants not native to Australia that if not controlled will invade and outcompete native plant species. The cover of high threat weeds in a plot is entered into the BAM calculator and affects the vegetation integrity score of a vegetation zone.

The Greater Sydney Local Land Services has developed the *Greater Sydney Regional Strategic Weed Management Plan 2017-2022* (GSLLS 2019), which identifies (amongst other things) strategies to minimise and manage weeds. The plan provides guidance on species that should be focused on to demonstrate compliance with the general biosecurity duty as per the Biosecurity Act 2015, and provides recommended strategic responses to specific weeds. The plan identifies weeds that are a priority for control at a state and regional level.

No weeds identified within the construction footprint are subject to mandatory control or notification provisions, nor are any listed as requiring eradication, according to the *Biosecirity Act 2015*.

Three species found within the site have recommendations listed in the Greater Sydney Regional Strategic Weed Management Plan 2017-2022 (GSLLS 2019), which guide land managers in fulfilling their general biosecurity duty:

- Giant Reed (*Arundo donax*)
    - Stretegic response in the region:
        - The plant should be fully and continuously suppressed and destroyed
        - Implement quarantine and/or hygiene protocols.
- Green Cestrum (*Cestrum parqui*)
    - Regional priority objective – asset protection.
        - Land managers prevent spread from their land where feasible.
    - Stretegic response in the region:
        - The plant should be fully and continuously suppressed and destroyed
        - Implement quarantine and/or hygiene protocols.
- African Olive (*Olea europa* subsp. *cuspidata*)
    - Regional priority objective – containment.
        - Outcome to demonstrate compliance with the general biosecurity duty:
        - • Land managers prevent spread from their land where feasible.
        - • Land managers reduce the impact on priority assets.
    - Strategic response in region:

- • Implement quarantine and/or hygiene protocols.
- • Surveillance and mapping to locate all infested properties and maintain currency of exclusion zone and objectives.
- • Monitor change in current distribution to ensure containment of spread.

The list of priority weeds, class and recommendation under the GSLLS (2019) plan, WONS and high threat weeds present at the site are detailed in Table 3-11.

Table 3-11: Priority weeds, WONS and high threat weeds present at the site

Scientific name	Duty (*Biosecurity Act*)	WONS	High Threat weed
Acetosa sagittata Turkey Rhubarb	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No
Ageratina adenophora Crofton Weed	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No
Anredera cordifolia Madeira Vine	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. **Prohibition on dealings** Must not be imported into the State or sold	Yes	Yes
Araujia sericifera Moth Vine	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	Yes

Scientific name	Duty (*Biosecurity Act*)	WONS	High Threat weed
Arundo donax Giant Reed	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. **Regional Recommended Measure*** Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.	Yes	No
Asparagus aethiopicus Ground Asparagus	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. **Prohibition on dealings** Must not be imported into the State or sold	Yes	Yes
Asparagus asparagoides Bridal Creeper	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. **Prohibition on dealings** Must not be imported into the State or sold *this requirement also applies to the Western Cape form of bridal creeper	Yes	Yes
Asparagus plumosus Climbing Asparagus Fern	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. **Prohibition on dealings** Must not be imported into the State or sold.	Yes	Yes

Scientific name	Duty (*Biosecurity Act*)	WONS	High Threat weed
Cardiospermum grandiflorum Balloon Vine	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No
Cestrum parqui Green Cestrum	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. **Regional Recommended Measure*** Land managers should mitigate the risk of new weeds being introduced to land used for grazing livestock. Land managers should mitigate spread from their land. Plant should not be bought, sold, grown, carried or released into the environment.	Yes	No
Delairea odorata Cape Ivy	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No
Erythrina crista-galli Cockspur Coral Tree	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No
Lantana camara Lantana	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. **Prohibition on dealings** Must not be imported into the State or sold	Yes	Yes

Scientific name	Duty (*Biosecurity Act*)	WONS	High Threat weed
Ligustrum lucidum Broad-leaved Privet	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No
Ligustrum sinense Small-leaved Privet-	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No
Ochna serrulata Ochna	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No
Olea europa subsp. *cuspidata* African Olive	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. **Regional Recommended Measure** Whole region: The plant or parts of the plant are not traded, carried, grown or released into the environment.	Yes	No
Senecio madagascariensis Fireweed	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. **Prohibition on dealings** Must not be imported into the State or sold	Yes	Yes

Scientific name	Duty (*Biosecurity Act)*	WONS	High Threat weed
Senna pendula var. *glabrata* Cassia	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No
Tradescantia fluminensis Trad	**General Biosecurity Duty** 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, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	Yes	No

3.5 Groundwater dependent ecosystems

3.5.1 Background

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 site 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:

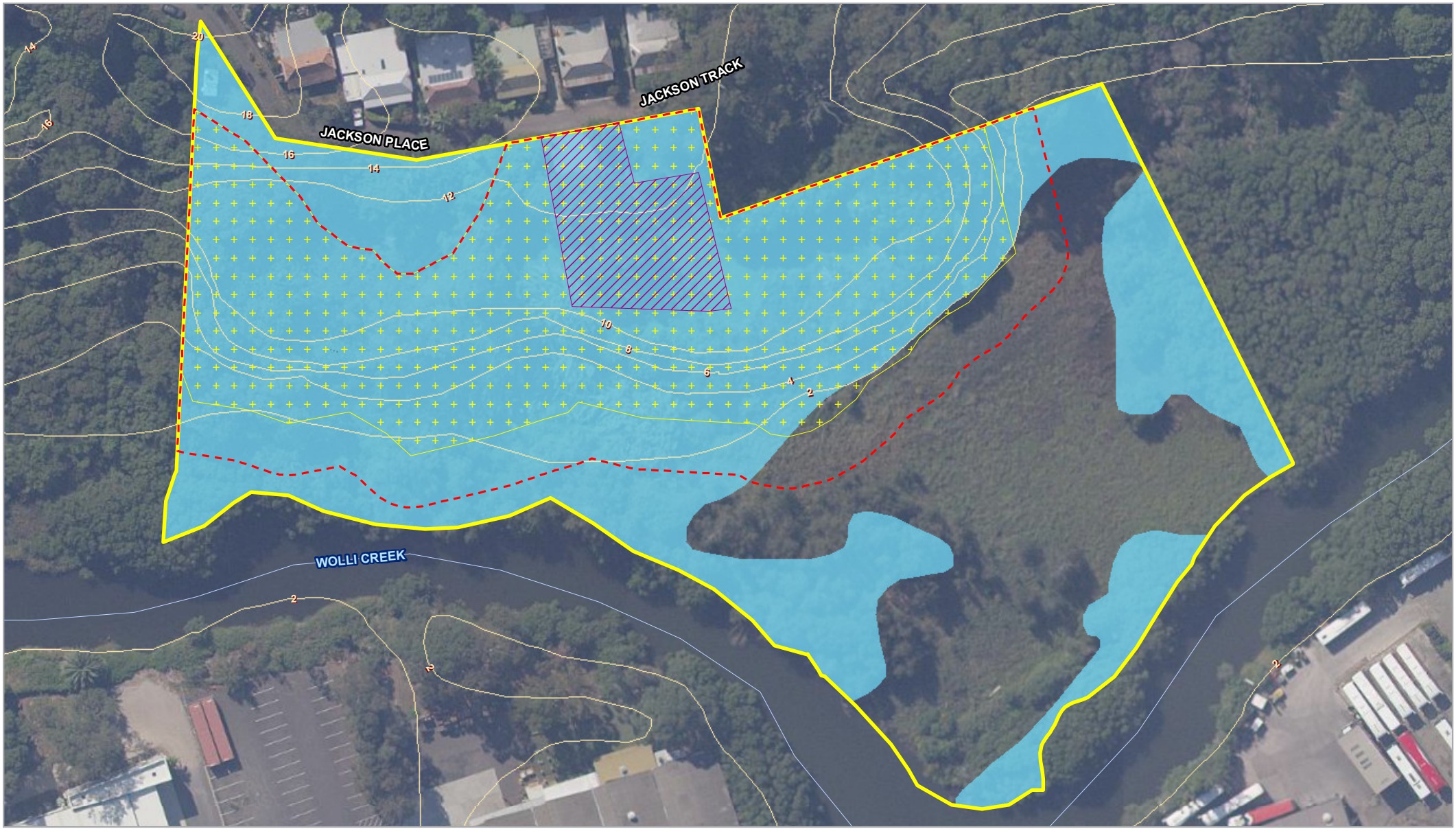
- Aquatic - ecosystems that rely on the surface expression of groundwater (e.g. springs, wetlands and rivers)
- Terrestrial - ecosystems that interact with the subsurface presence of groundwater (e.g. vegetation)
- Subterranean ecosystems - caves and aquifer ecosystems

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.

3.5.2 Groundwater

No groundwater was detected in the fill material during the investigation by HLA in 2007 or in the monitoring well previously installed by WWC in 2013. Given the poorly consolidated nature of the fill materials and resulting high porosity, any groundwater potentially present within the fill is expected to be transient in nature (i.e. perched) and highly dependent on rainfall events. Regional groundwater is likely to be present within the underlying Hawkesbury Sandstone bedrock at depth. In addition, a shallow alluvial aquifer in the lower floodplain was identified by HLA (2007) with depths to groundwater recorded between 0.8 and 0.9 metres below ground level. HLA (2007) also noted that the groundwater in the lower floodplain could be tidally influenced by Wolli Creek. Given the site's proximity to Wolli Creek and the likelihood of tidal influence on groundwater, the groundwater system and adjacent waterway are anticipated to be closely linked.

The Groundwater Dependent Ecosystems Atlas (BOM 2019b) maps some Estuarine Mangrove Forest downslope of the site as having a high potential to be a GDE (see Figure 3-3). No other vegetation at the site is identified as being a GDE, however other vegetation types, including Swamp Oak Swamp Forest and Smooth-barked Apple - Coast Banksia / Cheese Tree open forest are identified elsewhere along Wolli Creek as having the potential to be GDEs. Saltmarsh in Estuaries is not identified as a GDE.



LEGEND

- Site boundary
- Construction boundary
- Remediation works
- Ancillary site
- Potential GDE
- Waterway
- Contours (2m)

Paper Size ISO A4

0 10 20

Metres

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

N

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Jackson Place Remediation
Biodiversity Assessment

Project No. **21-28196**
Revision No. **-**
Date **29 Apr 2020**

Groundwater dependent ecosystems

FIGURE 3.3

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Data source: Aerial imagery - Sixmaps 2019 (); General topo- NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2017. Created by: eibbertson

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4. Threatened species

4.1 Methods

4.1.1 Background research

A desktop database review was undertaken to identify threatened fauna species and populations listed under the BC Act and FM Act, and threatened and migratory species listed under the EPBC Act that could be expected to occur in the locality, based on previous records, known distribution ranges, and habitats present. Additional references were also reviewed. Information sources used in the preparation of this report include:

- Department of Planning, Industry and Environment (DPIE) NSW BioNet (DPIE 2019b) data including NSW Wildlife Atlas database records and Threatened Species Data Collection profiles of threatened species listed under the BC Act.
- DPIE Threatened biodiversity profile search online database for threatened ecological communities listed under the BC Act (DPIE 2019c).
- Department of the Environment and Energy (DEE) Protected Matters Online Search Tool for MNES listed under the EPBC Act and predicted to occur in the locality (DEE 2019a).
- DEE online Species profiles and threats database (SPRAT) (DEE 2019b).
- eBird database of bird sightings for Wolli Creek (Cornell Ornithology Lab 2019).

The threatened biota and migratory species identified in the desktop assessment are presented in Annexure B. Following collation of database records and threatened species and community profiles, a list of threatened species requiring assessment was compiled according to the 'steps for identifying habitat suitability for threatened species' presented in Section 6.4 of the BAM. This was further refined following field surveys and identification and assessment of habitat present within the site. A likelihood of occurrence ranking was attributed to these biota based on this information and used to compile lists of 'predicted threatened species' (i.e. ecosystem credit species) and 'candidate threatened species' (i.e. species credit entities requiring targeted survey) according to Step 2 'assessment of habitat constraints' of Section 6.4 of the BAM.

4.1.2 Threatened species assessment under the BAM

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.

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 present.

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.

4.1.3 Terrestrial flora surveys

Potential candidate threatened flora species were identified in accordance with section 6.3 and section 6.4 of the BAM and based on the results of the desktop assessment (see section 4.1.1), identification of PCTs at the site and initial BAM credit calculations.

Targeted surveys were undertaken for threatened flora species with the potential to occur within the construction boundary given known distributions, previous records in the locality and habitat requirements for each species (refer to the threatened species assessment in Annexure B). Potential candidate threatened flora species that were targeted during these surveys and the appropriate survey period specified in the BAM calculator are listed in Table 4-1.

Targeted searches were completed by systematically walking parallel traverses spaced five metres apart across the construction boundary, with reference to the OEH (2016) threatened plant survey guidelines. Targeted threatened flora surveys were undertaken on 8 and 9 October 2019 which, according to the BAM, is a suitable time of the year to identify each of the candidate threatened flora species identified as having potential to occur.

Table 4-1: Targeted surveys for potential candidate threatened flora

Species	Survey months	Minimum survey requirements	Survey completed
Allocasuarina portuensis	All year	Targeted searches in appropriate habitat	Surveys conducted on 8 and 9 October 2019
Leptospermum deanei	Oct-Nov	Targeted searches in appropriate habitat	Surveys conducted on 8 and 9 October 2019
Melaleuca biconvexa	All year	Targeted searches in appropriate habitat	Surveys conducted on 8 and 9 October 2019
Wilsonia backhousei	All year	Targeted searches in appropriate habitat	Surveys conducted on 8 and 9 October 2019
Zannichellia palustris	Oct-Jan	Targeted searches in appropriate habitat	Surveys conducted on 8 and 9 October 2019 in saltmarsh and margins of Wolli Creek

4.1.4 Terrestrial fauna surveys

Habitat assessment

Fauna habitat assessments were undertaken throughout the site on 8 and 9 October 2019, 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.

Indicative habitat criteria for targeted threatened species (i.e. those determined as having the potential to occur within the construction boundary 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
- Hollow-bearing trees
- 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.

Diurnal surveys

Diurnal fauna surveys were conducted on 8 and 9 October 2019, 1 November 2019 and 21 January 2020. All birds observed and heard were recorded. In addition, bird survey data from eBird (Cornell Ornithology Lab 2019) was reviewed. A survey 'hotspot' is located at Wolli Creek Reserve, Earlwood and includes 62 checklists, collected between 2012 and 2019. Additional eBird survey data from locations upstream and downstream of the site were also reviewed.

Searches for hollow-bearing trees suitable for nesting owls were conducted within the construction boundary, within the wider site, and outside the site, walking at least 200m either side of the site along the Wolli Creek trail to attempt to locate suitable habitat for these species.

Opportunistic and incidental observations of fauna species were recorded during field surveys. This included a conscious focus on suitable areas of habitat during surveys.

Nocturnal surveys

Two Anabat Express units were deployed on the evening of 8 October 2019 in the site and left to record overnight. Comprehensive Anabat surveys were conducted from 22 to 25 January 2019, with one Anabat Express located overlooking the saltmarsh and one at Wolli Creek. The recorded calls of microchiropteran bats were identified using zero-crossing analysis and AnalookW software (version 4.2n, Chris Corben 2017) by visually comparing the time-frequency graph and call characteristics (eg characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material (Pennary et al 2004). Call identification was also assisted by consulting distribution information for possible species (Churchill 2008).

Spotlighting was conducted on the evening of 8 October 2019 by two ecologists and included call playback for the Powerful Owl, as this species is known to occur in the Wolli Creek area.

Note, however, that no hollows suitable for owls or cockatoos are present at the site or in close proximity to the site. Call playback for the Black Bittern (*Ixobrychus flavicollis*), Australasian Bittern (*Botaurus poiciloptilus*) and Bush-stone Curlew (*Burhinus grallarius*) was conducted on the evenings of 21, 22 and 23 January 2020 in the saltmarsh area prior to and during spotlighting surveys.

Targeted surveys for the Green and Golden Bell Frog were conducted on the night of 8 October 2019 and 21, 22, 23 and 25 January 2020. Surveys comprised spotlighting and call playback throughout the saltmarsh area, as well as Swamp Oak swamp forest and mangroves. Surveys were also conducted at the Eve Street Wetland and RTA ponds at Marsh Street (reference site) on the same evenings during the January surveys. Weather conditions are detailed in section 4.1.5.

Predicted threatened species (BC Act)

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 site 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 (BC Act)

Potential candidate threatened fauna species were identified in accordance with section 6.3 and section 6.4 of the BAM and based on the results of the desktop assessment (see section 4.1.1), identification of PCTs at the site and initial BAM credit calculations.

Species that cannot be reliably predicted through habitat surrogates are referred to as 'candidate' threatened species (or 'species credit entities'). Species credit entities can be identified at a site via targeted survey or can be assumed to be present (at a development site). A targeted survey in the appropriate season and consitions or an expert report is required to confirm the absence of the species at a site. 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, 2017a).

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.

'Candidate' threatened species considered for this assessment comprise:

- Southern Myotis
- Green and Golden Bell Frog.

A discussion of survey requirements and surveys conducted in provided in Table 4-2.

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 within the construction boundary, the habitats within the construction boundary was deemed to be substantially degraded such that other candidate threatened species were unlikely to utilise them. For example, no hollows suitable for nesting by owls and cockatoos are present, and thus these species are not considered 'candidate' threatened species for this assessment. For this reason,

no targeted surveys for additional potential candidate threatened species were carried out. Further detail in provided in section 4.2.

Table 4-2: Targeted surveys for potential candidate 'species credit' threatened fauna

Species	Survey months	Minimum survey requirements [1]	Survey completed
Southern Myotis (*Myotis macropus*)	October to March	4 nights of Anabat detection 4 nights of harp nets	2 anabat express units were placed within the site on 8 October 2019. Weather was cool on 8 October. 2 anabat express units were placed within the site on 22-25 January 2020. Weather was warm to hot, with little wind. No harp nets were placed in Wolli Creek due to the depth of the creek. No harp nets were placed in the site due to lack of suitable flyways.
Green and Golden Bell Frog (*Litoria aurea*)	November – March (note that DEE survey guidelines include surveys from September to March)	Surveys over four nights in ideal conditions: - within one week of heavy rainfall (greater than 50 mm in seven days) - on warm and windless nights.	Spotlighting and call playback on the 8th October 2019 on the edges of Wolli Creek and within saltmarsh vegetation. Weather was cool during this survey. Spotlighting and call playback on 21, 22, 23 and 25 January 2020. on the edges of Wolli Creek and within saltmarsh vegetation. Surveys were conducted following a week of hearvy rain, on warm to hot evenings, with little wind (see section 4.1.5).

4.1.5 Weather conditions

Surveys in October were conducted in cool to mild conditions. Winds were light during the day, but increased during the evening. Weather conditions for the survey are showin in Table 4-3. Weather data is from Sydney Airport (station 066037) (BOM 2020).

Rainfall in NSW was substantially below average in 2019. There were no weeks in October, November or December 2019 with greater than 50 mm of rainfall, which is the recommended rainfall for undertaking surveys for the Green and Golden Bell Frog. Heavy rain fell in mid January 2020, and targeted surveys were conducted for the Green and Golden Bell Frog following >50 mm rain in the preceding week. Weather conditions for these surveys are showin in Table 4-4. Weather data is from Sydney Airport (station 066037) (BOM 2020) or the Weatherzone application where shown.

Table 4-3: Weather conditions during October surveys

Date	Tempurature Max (°C)	Rain (mm)	Humidity (3pm)	Comment
Week prior		13.8		
8/10/2019	23.3	0	81%	Windy evening
9/10/2019	17.6	0.8	58%	

Table 4-4: Weather conditions during targeted Green and Golden Bell Frog surveys

Date	Tempurature Max (°C)	Temperature at 8:30pm*	Rain (mm)	Humidity (8:30pm)*	Comment
16/1/2020	28.5	NA	3.20		
17/1/2020	22.6	NA	31.60		
18/1/2020	22.8	NA	14.00		
19/1/2020	24.9	NA	3.40		
20/1/2020	30	NA	0.00		
21/1/2020	30.4	24.4	2.40	61	Mild
22/1/2020	32.7	26.6	0.00	74	Humid, cool
23/1/2020	43.7	30.4	0.00	53	Hot, light rain during survey
24/1/2020	26.6	NA	0.00		
25/1/2020	29.4	27.0	1.00	82	Still, cloudy

* Data from Weatherzone application

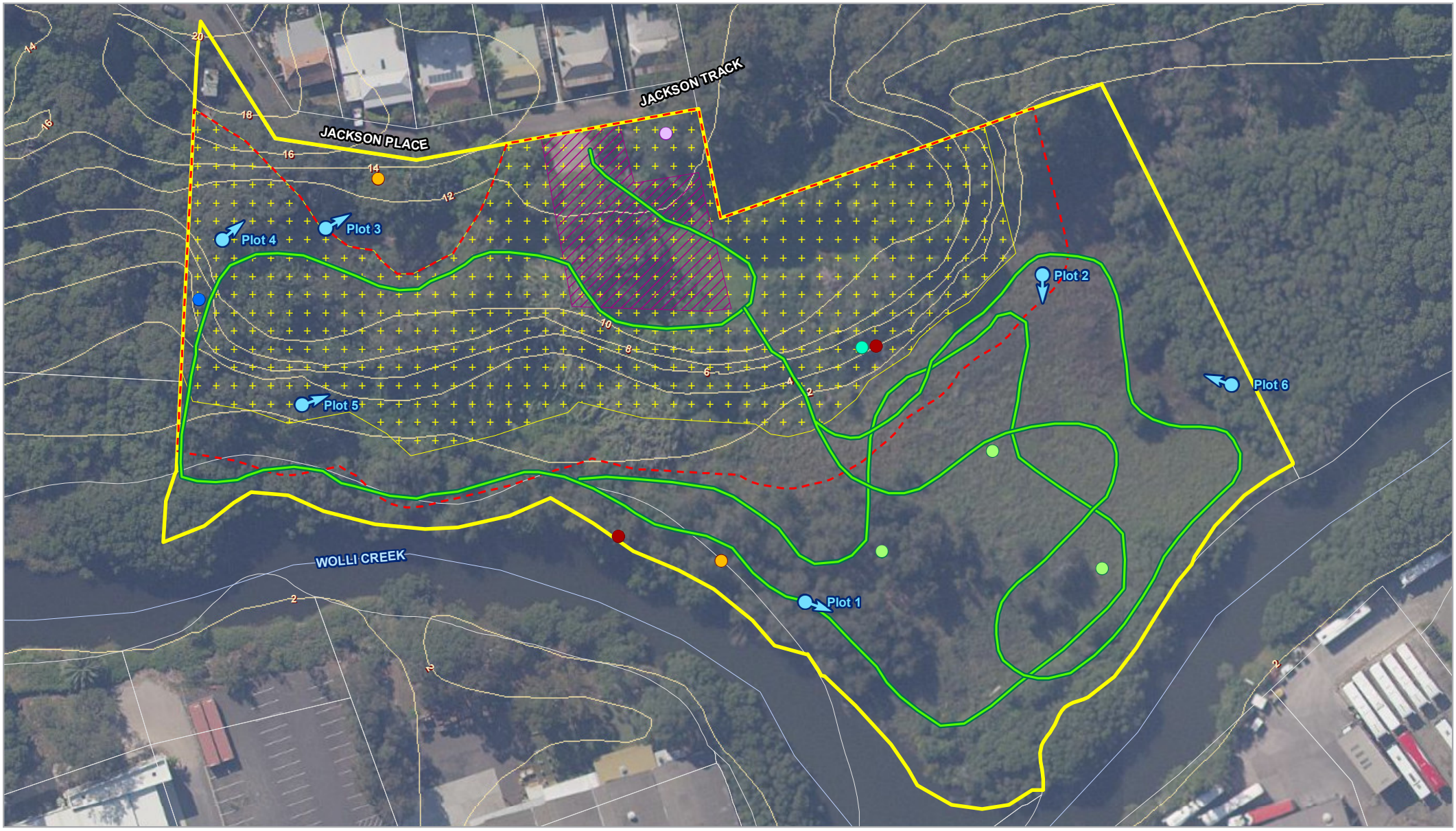
4.1.6 Survey limitations

The rehabilitation area is located in a highly modified industrial area with only limited biodiversity values. Better quality habitat is present in adjacent areas, and thus a higher diversity of faua species is likely to occur in surrounding areas. The desktop assessment provided a list of the threatened biota previously recorded or that could potentially occur in the site or be affected by the proposal (including seasonal, transient or cryptic species). The habitat assessment undertaken allows for identification of habitat resources for those species known or predicted to occur.

Where possible, surveys were conducted in the appropriate season and weather conditions to detect target species predicted to occur in the locality, to assist in determining their likelihood of occurrence in the site. Initial surveys were undertaken in October 2019, which was a suitable survey period for identifying most fauna present at the site, and was a suitable survey period for detecting threatened plant species. Anabat survey results were poor due to noise interference. This may have been due to wind and noise from the nearby train line.

Further surveys were undertaken in January 2020, in particular to target the Green and Golden Bell Frog, as well as microbats and birds. Surveys were undertaken following a week of heavy rain, during warm to hot conditions (see section 4.1.5). Green and Golden Bell Frogs were observed at the reference site at Arncliff, showing that the species was active at this time.

The level of survey undertaken, together with the survey timing and weather conditions, is considered sufficient to inform the preparation of this BDAR.



LEGEND

- Site boundary
- Construction boundary
- Remediation works
- Ancillary site
- Cadastre
- Waterway
- Contours (2m)
- Anabat - January
- Anabat - October
- Call playback - Green and Golden Bell Frog
- Call playback - Powerful Owl
- Call playback - wetland birds
- Rapid assessment
- Plot/transect
- Spotlighting

Paper Size ISO A4

0 10 20

Metres

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

N

TfNSW
Jackson Place Remediation
Biodiversity Assessment

Survey effort

Project No. **21-28196**
Revision No. **-**
Date **29 Apr 2020**

FIGURE 4.1

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Data source: Aerial imagery - Sixmaps 2020 (); General topo- NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2017. Created by: eibbertson

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4.2 Threatened species results

4.2.1 Background research

The Wolli Creek valley has been surveyed by many professional and amateur naturalists over the years (Little et al 2010). Over 150 species of birds, representing over 25% of the bird species listed for New South Wales, have been recorded in the valley since 1940. In any year close to 100 species are observed. Few mammal species are known to occur, with the Common Brushtail possum (*Trichosurus vulpecula*), Gould's Wattled Bat (*Chalinolobus gouldii*), Eastern Bentwing Bat (*Miniopterus orianae oceanensis*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) the only remaining species (Little et al 2010).

Five species of common frogs have been identified at Wolli Creek since 1997 (DECC 2007): the Common Eastern Froglet (*Crinia signifera*), Striped Marsh Frog (*Limnodynastes peronii*), Eastern Dwarf Tree Frog (*Litoria fallax*), Peron's Tree Frog (*Litoria peronii*), and the Green Tree Frog (*Litoria caerulea*). There are no recent records of the threatened Green and Golden Bell Frog (EES 2019a).

4.2.2 Fauna habitat resources

Land within the construction boundary comprises a large disturbed patch of dry shrubby sclerophyll forest on sandstone substrate and fill on the upper platform (see Table 4-5). Saline wetland within the construction boundary comprises a small portion of the community which occurs on the lower platform of the site (see Table 4-6). Outside the construction boundary, patches of mangroves and swamp oak forest also occur. These are not described in detail as they will not be directly impacted.

Native vegetation within the construction boundary is part of a larger patch of vegetation in the locality, connected by the riparian corridors of Wolli Creek and the Cooks River. This patch includes additional areas of sclerophyll woodland on sandstone as well as riparian forest on sandstone substrates.

There are extensive areas of residential housing and commercial development surrounding the site (see Figure 2-1). These areas are buffered from most portions of land within the construction boundary by a narrow linear corridor of native forest along creek lines. The fragmentation of native vegetation in the locality may reduce the potential for fauna to move across the landscape and for threatened species requiring larger tracts of vegetation to occur. Species that may utilise land within the construction boundary in response to favourable conditions include highly mobile and wide ranging fauna such as Grey-headed Flying-fox and the Powerful Owl (*Ninox strenua*), both of which are known from the Wolli Creek area (EES 2019a).

Due to the close to 200 years of development in inner Sydney, most vegetation has been removed, and many species which originally occurred in the area no longer occur due to a lack of suitable habitat. Further more recent disturbance of the site (dumping of fill) has further reduced habitat quality at the site. A number of species with highly specific habitat requirements would not occur within the construction boundary due to the degraded nature of habitats present.

A total of 41 fauna species were recorded at the site during surveys, and comprised 33 bird species (including three exotic species), five mammal species, two reptile species, and one crab species. Three frog species were recorded at the reference site at Arncliff. No frog species were recorded at the site (see Annexure A).

Table 4-5: Fauna habitats: upper fill platform

Habitat values	Description
Description	The dominant over storey trees within the construction boundary are Bangalay, Swamp Mahogany and Sydney Red Gum. One hollow-bearing tree with a medium (<150mm aperture) limb hollow was observed during the field survey, located on the upper fill platform within the construction boundary (refer to Figure 4-2). This tree comprised a salvaged hollow that has been attached to a mature tree using screws and a base plate to create a habitat tree. This tree corresponds with Tree 33 as shown on Figure 1-1. Attempts will be made not to remove this tree however given its position on the proposed embankment, this will be subject to detailed design and for the purposes of this assessment it is assumed it will be removed. One other tree was identified as having some potential hollows, with some spouting and fissuring observed in the upper branches during the field survey. This tree is located near the western edge of the site, and is likely to be removed as a result of the proposed works (refer to Figure 4-2). Midstorey vegetation within the construction boundary comprises a moderate to high density of exotic plant cover including Lantana and White Mulberry interspersed with a more open area on the upper fill platform of exotic grassland. There are small quantities of fallen timber within the construction boundary. Litter cover was moderate near the base of trees, however may be under-stated in patches where a dense midstorey would prevent an accurate measure of leaf litter.
Typical fauna species recorded	Trees at the site provide potential foraging resources for nectarivorous fauna, including common honeyeaters, lorikeets and parrots. A Common Brushtail Possum (*Trichosurus vulpecula*) was observed denning in the created hollow at the site. A range of small birds were observed in the predominantly exotic midstory, including Superb Fairy-wrens (*Malurus superbus*), Red-browed Finches (*Neochmia temporalis*) and Silvereyes (*Zosterops lateralis*). Common reptile species such as skinks and snakes would occur in leaf litter and shrubby vegetation at the site.
Threatened species habitat	Many Grey-headed Flying-foxes were observed flying above the site, and individuals would forage amongst these canopy species on occasion. No roosting individuals were observed at the site, however a breeding colony is located about 0.7 km west of the site. The potential trunk hollow occurring on a side slope may provide roosting, refuge and breeding habitat for threatened micro bat species such as the Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*), recorded at the site, as well as species that may potentially occur such as the Southern Myotis (*Myotis macropus*) and Eastern Free-tail Bat (*Mormopterus norfolkensis*). There are no hollows in the site that are large enough to comprise habitat for cockatoos such as the Glossy-black Cockatoo (*Calyptorhynchus lathami*) or Gang-gang Cockatoo (*Callocephalon fimbriatum*). There are also no large hollows suitable for threatened forest owls such as the Masked Owl (*Tyto novaehollandiae*) and Powerful Owl.

Habitat values	Description
Migratory species habitat	Terrestrial migratory species such as the Rufous Whistler may occur on occasion at the site.
	Fauna habitats of the upper fill platform
	Artificial hollow in mature tree

Table 4-6: Fauna habitats: saltmarsh and Wolli Creek

Habitat values	Description
Description	Saltmarsh is located on the floodplain of Wolli Creek within the site. Saltmarsh in the site was relatively dry at the time of the survey. Wolli Creek is about 5 metres wide near the site. Patches of Mangroves and Swamp Oak forest occur along the creek margins in the site.
Typical fauna species recorded	Common waterfowl such as the Pacific Black Duck were observed in Wolli Creek. The Eastern Water Dragon was seen basking on mangroves alongside the creek.
Threatened species habitat	One threatened microbat, the Yellow-bellied Sheathtail-bat, was recorded via Anabat analysis. Wolli Creek may provide foraging habitat for the Southern Myotis, although none were identified during Anabat surveys. There are no recent records of this latter species in the lower Cooks River area. Potential habitat for the Green and Golden Bell Frog is present in saltmarsh areas, however none were recorded. There are no recent records of this species in Wolli Creek. This species is discussed in further detail in section 0.
Migratory species habitat	Migratory waders may occur on occasion in saltmarsh areas at the site, however none were recorded during surveys.
	Saltmarsh on the lower portion of the site

The BAM assessment of habitat resources within the construction boundary was completed with reference to the above observations. The following specific geographic and habitat features were identified within the site and indicate the potential presence of threatened species that contribute to the credit calculations:

- Fallen/standing dead timber, including logs.
- Semi-permanent/ephemeral wet areas.
- Land within 1 kilometre of wet areas/swamps.
- Hollow-bearing trees.
- Land within 1 kilometre of waterbodies/swamps.
- Land within 200 m of riparian zone.

4.2.3 Predicted threatened species

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

The suite of predicted threatened species associated with ecosystem credits required for impacts within the construction boundary and with relevant habitat resources present on the site are listed in Table 4-7. For each predicted threatened species a sensitivity class rating is also provided. Targeted surveys are not required for these species.

Table 4-7: Predicted threatened species (ecosystem credit species)

Common Name	Scientific Name	Vegetation Type(s)	Sensitivity to gain class	Recorded on site?
Australasian Bittern	*Botaurus poiciloptilus*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	No
Barking Owl	*Ninox connivens*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	High	No
Beach Stone-curlew	*Esacus magnirostris*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Black Bittern	*Ixobrychus flavicollis*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	No
Black-tailed Godwit	*Limosa limosa*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No

Common Name	Scientific Name	Vegetation Type(s)	Sensitivity to gain class	Recorded on site?
Broad-billed Sandpiper	*Limicola falcinellus*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Curlew Sandpiper	*Calidris ferruginea*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	Moderate	No
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney 1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Eastern Osprey	*Pandion cristatus*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney 1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	No
Great Knot	*Calidris tenuirostris*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Greater Sand-plover	*Charadrius leschenaultii*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No

Common Name	Scientific Name	Vegetation Type(s)	Sensitivity to gain class	Recorded on site?
Grey-headed Flying-fox	*Pteropus poliocephalus*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	High	Recorded flying over site
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney 1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Lesser Sand-plover	*Charadrius mongolus*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Little Bent-winged Bat	*Miniopterus australis*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney 1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Little Eagle	*Hieraaetus morphnoides*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney 1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	No
Little Lorikeet	*Glossopsitta pusilla*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	High	No

Common Name	Scientific Name	Vegetation Type(s)	Sensitivity to gain class	Recorded on site?
Little Tern	*Sternula albifrons*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Masked Owl	*Tyto novaehollandiae*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	High	No
Powerful Owl	*Ninox strenua*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	High	Known to occur in Wolli Creek area
Regent Honeyeater	*Anthochaera phrygia*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	High	No
Sanderling	*Calidris alba*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Spotted Harrier	*Circus assimilis*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	No
Spotted-tailed Quoll	*Dasyurus maculatus*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	High	No
Square-tailed Kite	*Lophoictinia isura*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	Moderate	No

Common Name	Scientific Name	Vegetation Type(s)	Sensitivity to gain class	Recorded on site?
Swift Parrot	*Lathamus discolor*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	Moderate	No
Terek Sandpiper	*Xenus cinereus*	1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Varied Sittella	*Daphoenositta chrysoptera*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	Moderate	No
White-bellied Sea- Eagle	*Haliaeetus leucogaster*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney 1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	No
Yellow-bellied Sheathtail-Bat	*Saccolaimus flaviventris*	1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney 1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	High	Yes

4.2.4 Species credit species

Background

Threatened species that cannot reliably be predicted to occur on a development site based on PCT, distribution and habitat criteria are identified by the Threatened Biodiversity Data Collection as 'species credit species'. In some circumstances, the particular habitat components of species assessed for ecosystem credit species, such as the breeding habitat of a cave roosting bat or forest owls, are also assessed for species credits. The credit calculator references geographic, vegetation and habitat data for the subject land to generate a list of the species credit entities predicted to occur and requiring targeted survey.

Searches of threatened species databases were also completed to determine any additional species to those generated by the credit calculator that are known or predicted to occur in the locality (refer to likelihood of occurrence table in Appendix B. These results were reviewed giving consideration to the habitats available on site, to determine the candidate species credit species that may potentially occur within the construction boundary.

The full list of species credit species considered is presented in the threatened species assessment table in Appendix B. A number of species could be reliably discounted as occurring within the site as the habitat was 'degraded', or appropriate habitat components (eg hollow-bearing trees of an appropriate size) were not present. These species are not 'confirmed predicted species' for this assessment. Detailed justification for the conclusion is provided in Appendix B and/or the 'habitat/constraints' fields in the credit calculator.

Candidate species are identified in Table 4-8. Surveys were conducted in the appropriate season for the majority of species credit-type species and so the targeted survey results can be considered a reliable indicator of their presence or absence within the construction boundary. The 'Candidate species credit targeted survey' round in October 2019 included full coverage of land within the construction boundary with systematic, targeted flora and fauna survey techniques. Targeted Green and Golden Bell Frog surveys and additional microbat surveys were conducted in Janary 2020.

No threatened flora were recorded during targeted surveys.

Two candidate threatened species are considered to have the potential to occur. These are discussed in more detail below.

Southern Myotis

No calls attributable to this species were recorded on anabats at the site or along Wolli Creek in either October or January. There are no records of the species in the last 20 years along the Cooks River (EES 2019a), however records are known from wetlands about four kilometres to the south at Monterey. Given that appropriate habitat is present for this species, it is assumed present for the purposes of the BAM calculations as there is community concern regarding biodiversity impacts at the site and another threatened microbat was recorded at the site. The species polygon for this species is shown in Figure 4-2.

Green and Golden Bell Frog

The Lower Cooks River (Arncliffe) Key Population is one of two key populations that fringe the shores of Botany Bay, and one of four that inhabit the south-eastern Sydney region. The Green and Golden Bell Frog is considered to have been a common feature of the numerous swamps and wetlands associated with the Cooks River. Historical records of the Green and Golden Bell Frog also exist in the Wolli Creek valley near Turrella Reserve and were most likely associated with the previous wetlands there. No recent sightings have been recorded and so it is assumed that the Green and Golden Bell Frog has disappeared from the Wolli Creek and Bardwell Creek

valleys (DECC 2008b). While there may be no recent records along Wolli Creek (DECC 2008b, EES 2019a, Mo 2015), the history of other populations in the region suggest that continued presence along Wolli Creek and its tributaries cannot be ruled out in the absence of targeted surveys during appropriate conditions.

Targeted surveys were conducted over four nights in January 2020 following a week of heavy rain. These comprised surveys at the site and at the reference site (Marsh St and Eve Street wetlands in Arncliff). The Green and Golden Bell Frog was observed on two occasions at the Eve Stree wetland during these surveys. Two additional common frogs, the Brown-striped Frog (*Lymnodynastes peroni*) and Peron's Tree Frog (*Litoria peroni*) were observed and were heard calling at the two reference sites. These results show that surveys were conducted in appropriate conditions. No Green and Golden Bell Frogs or any frogs were observed or heard calling at the site. Despite the recent heavy rain, most of the saltmarsh comprised dry ground, and few pools were observed. These were shallow, and unlikely to remain for an extended period of time. No tadpoles were observed in any pools. Semaphore Crabs (*Heloecius cordiformis*) were observed in mangrove areas. Given the lack of evidence of any frogs at the site, and general lack of appropriate breeding habitat, the species is considered to be absent from the site, and no species polygon has been prepared.

Candidate threatened species not on site

A number of potential candidate threatened species did not have surveys conducted as habitat was considered degraded, lacked appropriate habitat features, or the site is outside the usual distributionof these species. The justification for exlusion of potential candidate threatened species is provided in Table 4-9.

Table 4-8: Threatened species survey results (species credit entities)

Species	Ecosystem or species credit species	Identification method	Impact (ha/ individuals)
Allocasuarina portuensis Neilson Park She-oak	Species	No – surveyed	None – no individuals recorded.
Leptospermum deanei	Species	No – surveyed	None – no individuals recorded.
Litoria aurea Green and Golden Bell Frog	Species	No – surveyed	None – no individuals recorded.
Melaleuca biconvexa Biconvex Paperbark	Species	No – surveyed	None – no individuals recorded.
Myotis macropus Southern Myotis	Species	Assumed present	0.67 ha of native vegetation (PCT 1778)
Wilsonia backhousei Narrow-leaved Wilsonia	Species	No – surveyed	None – no individuals recorded.
Zannichella palustris	Species	No – surveyed	None – no individuals recorded.

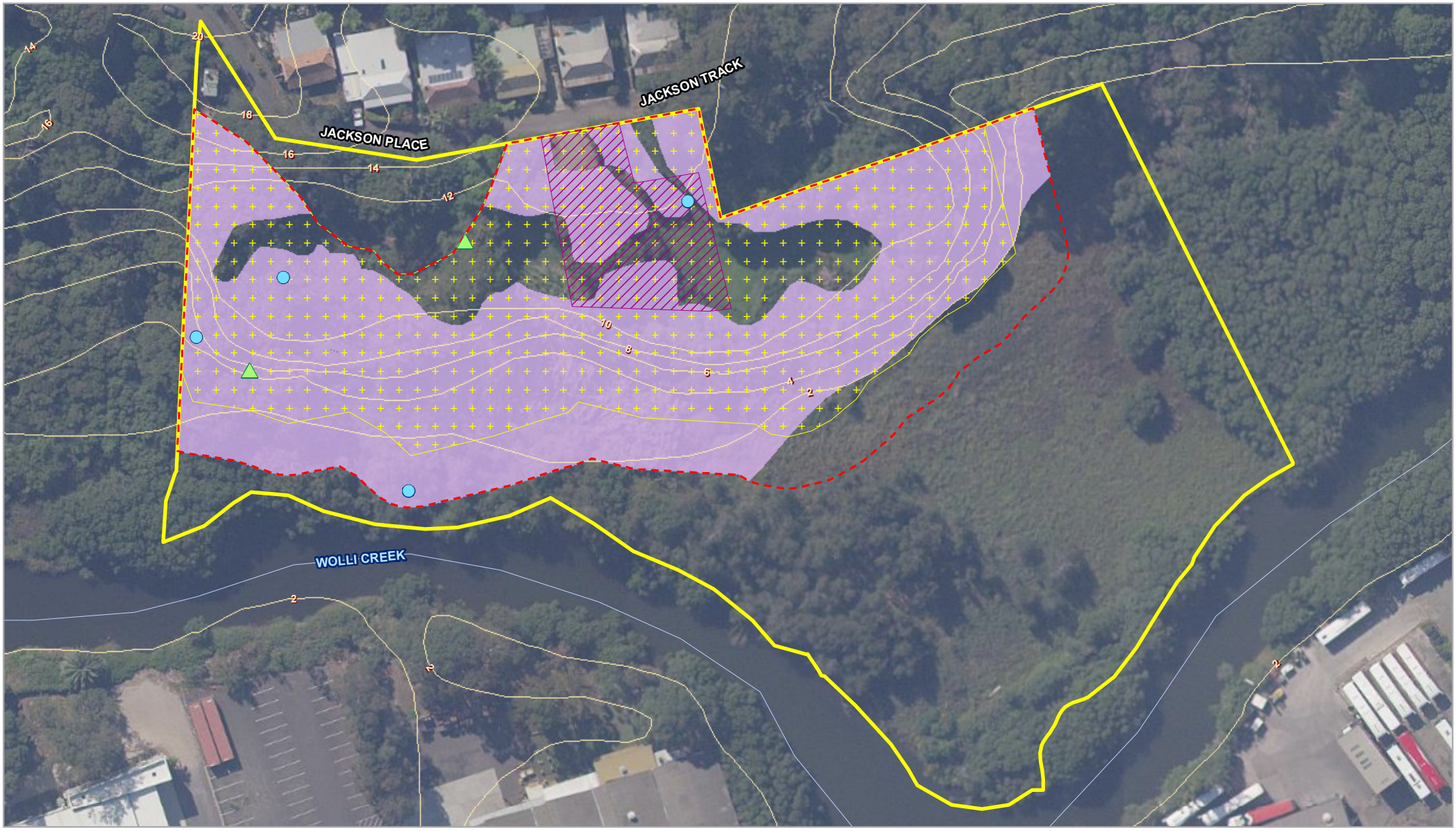
Table 4-9: Threatened species not on site

Species	Credit type	Habitat requirements/Distribution	Justification
Regent Honeyeater *Anthochaera phrygia*	Dual credit species, with the species credit component mapped as an important area	Confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas.	Site not part of an area identified as important habitat for this species
Bush Stone-curlew *Burhinus grallarius*	Species	Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory	Site degraded, weed infested and lacking fallen timber. No records in Wolli Creek area.
Sanderling *Calidris alba*	Dual credit species, with the species credit component mapped as an important area	Coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons	Site not part of an area identified as important habitat for this species
Sharp-tailed Sandpiper *Calidris acuminata*	Dual credit species, with the species credit component mapped as an important area	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation	Site not part of an area identified as important habitat for this species
Great Knot *Calidris tenuirostris*	Dual credit species, with the species credit component mapped as an important area	Prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons.	Site not part of an area identified as important habitat for this species
Curlew Sandpiper *Calidris ferruginea*	Dual credit species, with the species credit component mapped as an important area	Mainly found in intertidal mudflats on sheltered coasts.	Site not part of an area identified as important habitat for this species
Glossy Black-Cockatoo *Calyptorhynchus lathami*	Dual credit species, with the species credit component comprising breeding habitat (nest tree)	Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large hollows in trees.	Habitat degraded – no suitable foraging or breeding habitat (hollows) present

Species	Credit type	Habitat requirements/Distribution	Justification
Eastern Pygmy-possum *Cercartetus nanus*	Species	Inhabits rainforest, sclerophyll forests and heath. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting subject sites in drier habitats.	Habitat degraded – no heathy woodland present. No local records. No connectivity with known populations.
Large-eared Pied Bat *Chalinolobus dwyeri*	Species	Found mainly in areas with extensive cliffs and caves. Forages in nearby high-fertility forest or woodland near watercourses. Records in the Sydney region are associated with areas of extensive sandstone outcropping, such as the Blue Mountains, Illawarra Plateau and Kur-ring-gai/Hawkesbury area.	Habitat degraded – no fertile wooded valley habitat within close proximity to sandstone outcrops. Not recorded on Anabat surveys.
Greater Sand-plover *Charadrius leschenaultii*	Dual credit species, with the species credit component mapped as an important area	Most records are from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks.	Site not part of an area identified as important habitat for this species
Lesser Sand-plover *Charadrius mongolus*	Dual credit species, with the species credit component mapped as an important area	Almost entirely coastal, on beaches of sheltered bays, harbours and estuaries with large intertidal sand or mudflats, occasionally on sandy beaches, coral reefs and rock platforms.	Site not part of an area identified as important habitat for this species
Beach Stone-curlew *Esacus magnirostris*	Species	Occurs mainly north of the Manning River. Forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves.	Outside usual distribution. No evidence during surveys.
Little Penguin in the Manly Point Area *Eudyptula minor*	Species	Restricted to the Manly Point area	Outside distribution of population

Species	Credit type	Habitat requirements/Distribution	Justification
White-bellied Sea-eagle *Haliaeetus leucogaster*	Dual credit species, with the species credit component comprising breeding habitat (nest tree)	Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees.	No breeding habitat present.
Little Eagle *Hieraaetus morphnoides*	Dual credit species, with the species credit component comprising breeding habitat (nest tree)	Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland.	No breeding habitat present.
Swift Parrot *Lathamus discolor*	Dual credit species, with the species credit component mapped as an important area	Breeds in Tasmania. Non-breeding flocks occasionally seen in coastal areas.	Site not part of an area identified as important habitat for this species
Black-tailed Godwit *Limosa limosa*	Dual credit species, with the species credit component mapped as an important area	Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats.	Site not part of an area identified as important habitat for this species
Broad-billed Sandpiper *Limicola falcinellus*	Dual credit species, with the species credit component mapped as an important area	Occurs on sheltered parts of the coast, favouring estuarine mudflats but also occasionally in saltmarshes, freshwater lagoons, saltworks and sewerage farms.	Site not part of an area identified as important habitat for this species
Little Bent-winged Bat *Miniopterus australis*	Species/Ecosystem (breeding habitat)	Require maternity caves with specific temperature and humidity regimes.	No maternity caves present
Large Bent-winged Bat *Miniopterus orianae oceanensis*	Species/Ecosystem (breeding habitat)	Require maternity caves with specific temperature and humidity regimes.	No maternity caves present
Barking Owl *Ninox connivens*	Dual credit species, with the species credit component comprising breeding habitat (nest tree)	Inhabits woodland and open forest, including fragmented remnants. Roosts and breeds in large hollows.	Habitat degraded – no breeding habitat (suitable hollows) present.

Species	Credit type	Habitat requirements/Distribution	Justification
Powerful Owl *Ninox strenua*	Dual credit species, with the species credit component comprising breeding habitat (nest tree)	Inhabits woodland and open forest, including fragmented remnants. Roosts and breeds in large hollows.	Habitat degraded – no breeding habitat (suitable hollows) present.
Koala *Phasolarctos cinereus*	Dual credit species, with the species credit component identified as important habitat	Important' habitat is defined by the density of koalas and quality of habitat determined by on-site survey	Important habitat not present – no local records. No connectivity with known populations. Limited potential foraging habitat present.
Red-crowned Toadlet *Pseudophryne australis*	Species	Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings.	Habitat degraded – no suitable sandstone ridgetop habitat present. No local records. No connectivity with known populations.
Little Tern *Sternula albifrons*	Species/Ecosystem (breeding habitat)	Nests in low dunes or sandy beaches just above high tide mark near estuary mouths/ adjacent to coastal lakes and islands	No breeding habitat present.
Masked Owl *Tyto novaehollandiae*	Dual credit species, with the species credit component comprising breeding habitat (nest tree)	Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies	No breeding habitat present.
Xenus cinereus Terek Sandpiper	Dual credit species, with the species credit component mapped as an important area	The two main sites for this species in NSW are the Richmond River and Hunter River estuaries. Inhabits coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks near mangroves, also observed on rocky pools and reefs.	Site not part of an area identified as important habitat for this species



LEGEND

- Site boundary
- Construction boundary
- Remediation works
- Ancillary site
- Waterway
- Contours (2m)
- Grey-headed Flying-fox (vulnerable species under the BC and EPBC Acts)
- Hollow-bearing Tree
- Southern Myotis species polygon

Paper Size ISO A4

0 10 20

Metres

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

N

TfNSW
Jackson Place Remediation
Biodiversity Assessment

Project No. **21-28196**
Revision No. **-**
Date **29 Apr 2020**

Threatened species

FIGURE 4.2

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Data source: Aerial imagery - Sixmaps 2020 (); General topo- NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2017. Created by: eibbertson

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4.3 Aquatic habitat and threatened species

4.3.1 Aquatic surveys

A rapid assessment of aquatic habitats was undertaken along the drainage line to the east of the construction boundary, as well as along Wolli Creek. This assessment aimed to collect data to describe the character and condition of the drainage line, Wolli Creek and associated wetland areas. No macroinvertebrate or fish surveys were conducted as there would be no direct impact on Wolli Creek.

An assessment of potential habitat for threatened aquatic species was based on the habitat assessments undertaken during the field survey and published habitat preferences of threatened biota. Key fish habitat maps for the area (DPI 2007) were reviewed and key fish habitat was identified according to the following classifications as detailed in DPI (2013):

- Type 1 – highly sensitive fish habitat (includes Coastal saltmarsh >5m2 in area and SEPP 14 wetlands)
- Type 2 – moderately sensitive key fish habitat (includes Coastal saltmarsh >5m2 in area and mangroves)
- Type 3 – minimally sensitive key fish habitat (ephemeral aquatic habitat not supporting native aquatic or wetland vegetation)
- Not key fish habitat (includes first and second order streams on gaining streams).

Mapping of Coastal Wetlands (as per DPIE, 2020), estuarine habitats and fish community status was reviewed.

4.3.2 Aquatic results

The aquatic habitat values of Wolli Creek are described in Table 4-10.

Table 4-10: Aquatic habitats: Wolli Creek and associated wetland

Habitat values	Description
Description	Wolli Creek is a second order stream that runs along the southern boundary of the site. It runs in a west-east direction and drains to the Cooks River about 1 kilometre to the east of the site. Wolli Creek is saline at this stretch and tidally influenced. Wolli Creek is mapped as being of poor quality for freshwater fish (DPI 2019). Wolli Creek is about 5-10 metres wide near the site. Patches of Mangroves and Swamp Oak forest occur along the creek margins in parts of the site. Coastal Saltmarsh in the site is mapped as a Coastal Wetland under the State Environmental Planning Policy (Coastal Management) 2018. The proximity area for this Coastal Wetland covers the entirety of the site (see Figure 4-3). Habitat within the site is classified predominantly as Type 1 key fish habitat due to the presence of mangroves and the large area of Saltmarsh.

Habitat values	Description
Typical fauna species recorded	Fish sampling conducted by DPI in the brackish section of the creek in 2017 recorded: Sea Mullett (*Mugil cephalus*), Yellow-fin Bream (*Acanthopagris australia*), Port Jackson Perchlet (*Ambassis jacksoniensis*) and Toadfish (*Tetractenos* sp.). Six native fish species have been recorded in the freshwater section of Wolli Creek further upstream of the Henderson Street Weir (located upstream of the site). Empire Gudgeon (*Hypseleotris compressa*), Flathead Gudgeon (*Philypnodon grandiceps*), Striped Gudgeon (*Gobiomorphus australis*), Firetail Gudgeon (*Hypseleotris galii*), Common Galaxia (*Galaxis maculatus*) and Long-Finned Eel (*Anguilla reinhardtii*) (Little et al 2010, WCPS 2019).
Threatened species habitat	No threatened fish species are likely to occur (see Annexure B).
Migratory species habitat	No migratory aquatic species are likely to occur.
	Wolli Creek near the proposal site

LEGEND

- Site boundary
- Construction boundary
- Remediation works
- Ancillary site
- Coastal wetlands
- Proximity area for coastal wetlands
- Waterway

Paper Size ISO A4

0 50 100

Metres

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

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TfNSW
Jackson Place Remediation
Biodiversity Assessment

Project No. **21-28196**
Revision No. **-**
Date **29 Apr 2020**

Coastal Wetlands

FIGURE 4.3

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Data source: Aerial imagery - Sixmaps 2019 (); General topo- NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2017; Coastal wetlands - SEPP, NSW DPE 2019. Created by: eibbertson

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5. Matters of National Environmental Significance

5.1 Threatened ecological communities

5.1.1 Subtropical and Temperate Coastal Saltmarsh

Subtropical and Temperate Coastal Saltmarsh, listed as a vulnerable ecological community under the EPBC Act, occurs in the lower portions of the site. Vulnerable ecological communities listed under the EPBC Act are not matters of national environmental significance for the purposes of Part 3 of the EPBC Act (requirements for environmental approvals).

5.1.2 Coastal Swamp Oak (*Casuarina glauca*) Forest

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community is listed as endangered under the EPBC Act.

To be considered part of this EEC, areas or patches of PCT 1234 must meet both the key diagnostic characteristics AND at least the minimum condition thresholds. The small stands of Swamp Oak Floodplain Forest on the river flats adjacent to Wolli Creek do not meet the condition thresholds for the EPBC Act listed community, due to their small size. As such, vegetation mapped as PCT 1234 within the site does not meet the condition thresholds for the EEC as listed under the EPBC Act, and as a result, is not a matter of national environmental significance.

5.2 Threatened species

5.2.1 Threatened flora species

No threatened flora species listed under the EPBC Act are likely to occur or be impacted by the proposal (see Annexure B).

5.2.2 Threatened fauna species

One threatened fauna species listed under the EPBC Act, the Grey-headed Flying-fox, is known to occur along Wolli Creek and was observed flying above the site during surveys. A Grey-headed Flying-fox colony is located in Wolli Creek at Turrella, about 0.7 km west of the site. The Wolli Valley camp was first inhabited in mid-2007 and was initially a seasonal camp – with the Flying-foxes leaving the camp during the cooler months and in response to available food sources. Since winter 2013 onwards, the camp has been continuously occupied (aside for a brief period in 2016 when Spotted Gums were flowering prolifically on the NSW south coast), suggesting it has moved from being a seasonal camp to a permanent one (WCPS 2019). Numbers present fluctuate. The camp initially numbered in the hundreds, but more recently many thousands of individuals have been present. In November 2016 around 24,000 Flying-foxes were counted. The camp has been classified as a camp of National Importance (WCPS 2019). The Grey-headed Flying-fox would likely forage in remnant eucalypts on site when trees are flowering or fruiting but roost does not extend within the site.

The Green and Golden Bell Frog previously occurred in the lower Cooks River, however there have been no records of the species in Wolli Creek and surrounding areas for many years. The only remaining individuals of the Cooks River key population occur in the Rockdale and Arncliff area. No individuals were recorded, despite targeted surveys in appropriate conditions, and it is considered unlikely that this species would occur at the site. The proposal would remove a very

small area (less than 0.1 ha) of potential habitat (saltmarsh) for this species and would not break the continuity of any vegetation connecting areas of potential habitat. 0.45 hectares of saltmarsh (greater than 80 percent of the patch) would be retained within the site, and would provide connectivity along the foreshore of Wolli Creek for birds and terrestrial fauna species.

No other threatened fauna species listed under the EPBC Act are likely to rely on habitats present at the site (see Annexure B).

5.3 Migratory fauna species

No migratory waders are likely to occur at the site, except as transient visitors (see Annexure B).

A critical consideration in assessing the significance of potential impacts on listed migratory shorebird species, according to the significant impact guidelines for migratory shorebird species (DEE 2017), is whether or not a proposed action is likely to affect 'important habitat'. Important habitat is defined separately for 36 of the migratory shorebird species and Latham's Snipe (*Gallinago hardwickii*). An area of 'important habitat' for the 36 migratory shorebird species is either:

- A site that is identified as internationally important, or
- A site that supports either:
    - at least 0.1 % of the flyway population of a single species, or
    - at least 2000 migratory shorebirds, or
    - at least 15 shorebird species.

Important habitat for Latham's Snipe is described as:

- areas that have previously been identified as internationally important for the species, or
- sites that support at least 18 individuals of the species.

No important habitat for migratory waders is present at the site or along the adjacent Wolli Creek. Vagrant individuals may occur on occasion at the saltmarsh along Wolli Creek below the site. eBird data for the Wolli Creek valley notes two migratory waders in the 1950s (Sharp-tailed Sandpiper and Greenshank). None of the more recent bird lists (2012-2019) include migratory waders at Wolli Creek Reserve, Earlwood. In total, 112 bird species have been recorded in 62 checklists at this location (Cornell Ornithology Lab 2019).

The primary shorebird habitat areas in the locality are Eve Street Wetlands, Landing Lights Wetland, the northern end of Lady Robinsons Beach and the southern end of Lady Robinsons Beach at Sandringham Bay and Riverside Drive, Sans Souci (Rockdale Council 2014). No important shorebird habitat was identified by Rockdale Council (now Bayside Council) along the lower Cooks River, nor elsewhere on the lower Cooks River in the Inner West Council area (AMBS 2011). Towra Point Nature Reserve Ramsar Site is located on the southern side of Botany Bay, about 6.5 kilometres from the site and provides large areas of much better quality foraging habitat for migratory shorebirds (OEH 2013).

Migratory woodland birds may occur on occasion at the site during their migration as the site is part of a vegetated corridor through the predominantly urban landscape. This site is highly disturbed and unlikely to provide important habitat for any of these species (see Annexure B).

5.4 Wetlands of international national importance

Towra Point Nature Reserve Ramsar Site is located on the southern side of Botany Bay, about 8 km downstream of the site. Towra Point Nature Reserve and adjacent areas regularly support around 34 of the 80 species of migratory birds listed under the various migratory agreements and provides large areas of high quality foraging habitat for these migratory waders (OEH 2013).

6. Avoid and minimise impacts

The site has been used as an illegal dumping ground and there is a need to remediate the existing soil contamination to make it suitable for use as a green corridor. Impacts cannot be avoided if the site is to be made safe for future use.

Seven remediation options for the site were assessed and then three strategies were shortlisted for further consideration. A summary of the shortlisted options (including the do-nothing option) is provided below:

- **Shortlist option 1 – Do nothing**
  The do nothing option involves not undertaking any remediation works at the site. The adoption of a Contamination Management Plan would be considered as part of this option to manage the existing contamination on the site.
  This option was not considered suitable because it would not address the potential risks to human health and the environment.
- **Shortlist option 2 - Fencing contaminated land and rehabilitating with native vegetation**
  This option involves fencing off affected land to contain the contamination. The remainder of the site would then be rehabilitated with native vegetation. Approximately 4000 m^2 would be revegetated after the completion of remediation works.
  This option was not considered appropriate because it would not address the contamination issues across the site nor potential groundwater and leachate impacts. Land access to the local community would be reduced due to the area being excluded
- **Shortlist option 3 - Capping of contaminated fill in-situ (Preferred option)**
  This option involves capping of the contamination as is on the site. The works would involve the use of a geotextile and clay layer to contain the contamination. The site would then be revegetated.
  This option is identified as ‘option 4’ in the Preferred Remedial Option Report and in the RAP. A detailed description of this option is located in Section 3.
  This option would require the removal of weeds, shrubs and some trees. Overall there would be minimal disturbance of soil with minimal cut and fill works required to re-profile the site. It is expected there would be minimal generation of dust and spread of any contaminated material. The capping would reduce the potential for leaching to occur and reduce the overall risks to human health and impacts to the surrounding environment.
- **Shortlist option 4 - Excavation of contaminated fill for offsite disposal**
  This option involves excavation of the contaminated soil. The excavated soil would then be transported off site for disposal. Clean material would be brought in to replace the contaminated soil prior to revegetation of the site.
  There are a range of environmental hazards associated with the earthworks required for this option. There would be considerable dust and noise generation to adjacent residents, and the perceived risks in moving contaminated material off site.

The preferred option was to remediate the site by capping the contaminated fill in-situ (Option 3). In the long term, the remediation area would be improved as a result of the proposal. The following measures are included to avoid and minimise impacts of the proposal:

- Reduces the potential for leaching and exposure to humans and the environment through capping
- The remedial works are proposed predominantly for the upper fill platform and slopes only
- Capping works exclude the sandstone outcrop area and lower floodplain area
- Capping works exclude structural root zones for any of the remnant native trees identified on Figure 1-1.
- Works in saltmarsh areas would be restricted as far as possible

- Once capping is complete, the site would be revegetated to make it suitable for public use as a green corridor and would be managed through implementation of a Long Term Environmental Management Plan.

Further mitigation measures are described in section 8.

7. Impact assessment

7.1 Removal of native vegetation and habitat

7.1.1 Direct impacts on native vegetation and habitat

The majority of the vegetation to be removed for the proposal comprises disturbed vegetation on fill material. A small area (0.09 ha) of Saltmarsh, an EEC listed under the BC Act falls within the construction boundary. Native vegetation and habitat within the construction boundary is in moderate to low condition, reflecting historical disturbance, and is already subject to impacts from edge effects and weed infestation.

Works within the construction boundary would remove a small number of individuals of non-threatened native plants, including planted trees, and priority and environmental weeds. Few threatened or migratory fauna species are likely to occur within the construction boundary except on a transient basis (refer to Annexure B).

In total, the proposal would remove about 0.9 hectares of native vegetation as summarised in Table 7-1

Table 7-1: Direct impacts to native vegetation

Vegetation zone	BC Act status	EPBC Act status	Area to be impacted (ha)	Future value	Change (loss) in vegetation integrity score	Number of hollow-bearing trees impacted
Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (medium) (PCT 1778)	Not listed	Not listed	0.20	0	8.7	1
Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (poor) (PCT 1778)	Not listed	Not listed	0.47	0	0.6	None
Smooth-barked Apple - Coast Banksia / Cheese Tree open forest (low) (PCT 1778)	Not listed	Not listed	0.14	0	0.8	1. Tree 33 (as shown on Figure 1.1) supports a created hollow*.
Saltmarsh in estuaries (medium) (PCT 1126)	Endangered	Vulnerable	0.09	0	72	None

Vegetation zone	BC Act status	EPBC Act status	Area to be impacted (ha)	Future value	Change (loss) in vegetation integrity score	Number of hollow-bearing trees impacted
Total			**0.90**			**2**

* Attempts will be made not to remove this tree however given its position on the proposed embankment, this will be subject to detailed design and for the purposes of this assessment it is assumed it will be removed.

7.1.2 Impacts on fauna and habitat

Potential direct effects on fauna habitats are detailed in Table 7-3.

Table 7-2: Indirect impacts on biodiversity values

Impact	Description
Removal of habitat resources	Construction of the proposal would remove 0.90 ha of modified fauna habitat, as most land within the construction boundary has been cleared previously and has been subject to ongoing disturbances. The vegetation that would be removed or modified provides limited habitat resources for native fauna species due to its existing highly modified nature and the surrounding urban environment. Fauna habitat resources that would be removed include foraging and shelter resources for mainly common native fauna typical of urban environments. The proposal would remove a small number of forage trees of the Grey-headed Flying-fox and foraging habitat for microbats.
Removal of hollow-bearing trees	One potential hollow-bearing tree would be removed. The tree to be removed had some spouting and fissuring evident, however no distinct hollows were observed. The conservative approach has been taken and it has been assumed that this tree could support small (<5cm) hollows. One tree with an artificial hollow may also be removed (tree 33 on Figure 1.1). Attempts will be made not to remove this tree however given its position on the proposed embankment, this will be subject to detailed design and for the purposes of this assessment it is assumed it will be removed. No large hollow-bearing trees suitable for nesting by threatened owls were recorded in the vicinity of the site.
Injury and mortality	Remediation works have the potential to result in the injury or mortality of some individuals of less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the site during clearing activities and unable to move out of the area. This could include nestlings, small lizards and frogs. More mobile native fauna such as native birds, bats, terrestrial and arboreal mammals that may be sheltering in vegetation within the construction boundary are likely to evade injury during works as they are likely to move away ito adjoining areas.
Fragmentation and isolation of habitat.	The proposal would require the removal of vegetation and habitat and would create or increase small gaps in habitat. The vegetation within the construction boundary is already modified and sparse, with scattered canopy trees and either an absent midstorey or one dominated by exotic woody weeds. It is unlikely that the proposal would create an additional barrier to the movement of pollinator and seed dispersal vectors, such as insects and birds. Following remediation, the area would be revegetated, and any fragmentation of habitat would therefore be temporary.

Impact	Description
Impacts on key fish habitat and marine vegetation	The proposal would remove 0.09 ha of saltmarsh, which is key fish habitat under the FM Act. 0.45 ha of saltmarsh would be retained on the site. There would be no effect on aquatic connectivity or fish passage along Wolli Creek.
Impact on wetland habitat	The proposal would impact 0.09 ha of saltmarsh vegetation. A total of 0.07 ha of this saltmarsh vegetation falls within the mapped extent of coastal wetlands (as per DPIE, 2020), with 0.02 ha within the proximity area for coastal wetlands. A total of 0.07 ha of mapped coastal wetlands would be impacted, and a total of 0.85 ha of proximity area for coastal wetlands would be impacted by the proposal.

7.1.3 Indirect impacts on native vegetation and habitat

Indirect effects on biodiversity values that may result from remediation works are detailed in Table 7-3. Measures to mitigate the risk of indirect impacts are provided in section 8.1

Table 7-3: Indirect impacts on biodiversity values

Impact	Description
Weed invasion and edge effects	'Edge effects' include increased noise and light, erosion and sedimentation, and introduction of weeds. These effects cause degradation of vegetation at the interface of intact vegetation and cleared areas.Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Altered environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge effects would result from construction activities and then continue to affect vegetation and habitats adjoining the site. Land within the construction boundary has been extensively cleared historically, however a combination of planted, regrowth and weedy vegetation is present. Adjacent areas are vegetated with native vegetation. Due to the patchiness of vegetation in the site, adjacent areas are already severely affected by edge effects and associated negative impacts such as weed infestation. The proposal would create few novel edge effects and is unlikely to result in a significant increase in the impact of existing edge effects. In the long-term, introduction of weeds should be minimised through revegetation activities.
Pests and pathogens	Construction activities, in general, have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into native vegetation and habitats. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys, however Chytrid fungus is likely to have contributed to the extinction of the Green and Golden Bell Frog from much of the Cooks River area (DECC2008b). The potential for impacts associated with these pathogens is low, given the existing disturbed nature of the site and regular visitation in the Wolli Creek area.

Impact	Description
Noise and vibration	Remediation would require the use of vehicles and plant on the site. Fauna that occupy habitats within the site and adjacent areas are likely to be accustomed to existing high noise and vibration levels originating from road traffic, trains and nearby industrial areas. Similarly, fauna and fauna habitats are already exposed to existing light from trains, cars, street lights and residential and industrial areas. While there would be localised increases in noise and vibration that would temporarily create substantial disturbance, increases above existing background levels during construction are unlikely to result in a significant impact on fauna that occur in the site.
Sedimentation, erosion and pollution	Saltmarsh, mangroves and swamp oak forest and Wolli Creek are sensitive environments located downslope of the construction boundary. Remediation works have the potential to result in sedimentation and erosion and mobilisation of contaminants into adjoining native vegetation and aquatic habitats, through soil disturbance and remediation activities. Sediment laden runoff to waterways can alter water quality and adversely affect aquatic life. The aim of the remediation is to improve conditions at the site and prevent further leaching of contaminants.
Aquatic disturbance and pollution	There would be no direct impacts on Wolli Creek. Construction of the proposal has the potential to result in indirect impacts, such as the mobilisation of contaminated sediments into waterways, or chemical spills from vehicles or plant, if suitable mitigation measures are not adopted. The introduction of pollutants from the proposal into the surrounding environment, if uncontrolled, could potentially impact on water quality further downstream. The existing environment is already highly contaminated due to the history of dumping at the site and the ongoing degree of disturbance in the local area around Wolli Creek. Mitigation measures recommended to limit the potential for aquatic disturbance include retention and encapsulation of contaminated material on site. The proposal has been scoped and developed with the aim of improving water-related impacts.

7.1.4 Operational impacts

The aim of the proposal is to improve environmental values at the site through remediation. Being a remediation project, the proposal has been scoped and developed to improve conditions on the site. Evidence of the attempts made to minimise any potential operational impacts of the proposal have been shown though the development of the REF (GHD 2012), RAP (GHD 2019) and also in the process of undertaking this assessment. The proposed remediation works as outlined in the RAP were endorsed by the appointed NSW EPA accredited auditor in December 2018 (GHD 2019).

Activities associated with the proposal would result in long-term environmental benefits with respect to surface water and groundwater quality and reduction in risk of contamination of both surface water and groundwater (refer to the Hydrology technical paper).

Once remediation is complete, the site would be revegetated for public use as part of a green corridor.

7.1.5 Impacts to threatened species

Impacts of the rehabilitation works on threatened species are likely to be negligible. The area has previously been cleared and contaminated fill has been dumped over many years. Despite this, there is potential for threatened species to occur on occasion at the site. Two threatened species have the potential to occur and are confirmed candidate threatened species for the calculation of credits (Table 7-4).

Table 7-4: Threatened species impacts

Threatened species	Status (BC Act)	Habitat or individuals to be impacted	Habitat or individuals in the site
Southern Myotis	Vulnerable	0.2 ha of forest habitat, representing potential habitat for this species. Note that 11 large trees that may provide temporary roosting habitat and connectivity of vegetation will be retained.	0.3 ha in the site which is contiguous with a larger area of forested habitat to the east and west
Green and Golden Bell Frog	Endangered	0.08 ha of saltmarsh habitat, representing potential habitat for this species.	0.79 ha of potential habitat comprising saltmarsh, mangroves and swamp oak forest.

7.2 Aquatic impacts

There would be no direct impacts on Wolli Creek as a result of the proposal. There would be no instream works, no blockage of fish passage and no disturbance of snags.

The removal of 0.09 ha of saltmarsh constitutes direct impacts on a mapped Coastal Wetland.

As part of the remedial works at the site as documented in the RAP, a stormwater management system would be established to collect sheet flow generated on the site by a diversion bund, constructed at the batter crest. Collected sheet flow drains by gravity to the east and western extents of the site where it is intercepted by an energy dissipator with outlet protection included as required. Additional engineered controls included in the proposal, include:

- Stepping the re-graded batter to reduce potential for soil slippage and sedimentation into the salt marsh below the batter, and subsequently Wolli Creek
- Construction of a diversion berm at the crest of the batter to direct flows away from the capping profile
- Installation of erosion control matting over the capping profile to reduce soil loss potential.
- Installation of sandstone boulders at the toe of the batter to minimise potential erosion at the toe of the batter from runoff and flooding of Wolli Creek.

- Installation of perforated polyethylene pipework at the crest of the batter slope to minimise soil slippage and sedimentation into the salt marsh below the batter, and subsequently Wolli Creek.

The water related risks associated with the proposal may result in potential impacts to surface-water quality as a result of exposure of contaminated fill during the reprofiling works. Detailed mitigation measures have been recommended to address any unexpected behaviour of fill materials during construction and to further-lower any potential risk of water-related impacts by exposure of fill materials. In particular, a mandatory performance standard will be imposed stipulating that no runoff from exposed historical fill material shall be discharged from the site. Regular surface water quality monitoring would be conducted throughout the construction phase.

Following the reprofiling works, the contaminated fill will be covered and the ongoing risk during the remainder of the works, and in the long-term is not considered significant. Re-established vegetation and grass cover will provide ongoing erosion and sediment controls. Ongoing management of the site will be undertaken as described in the long-term site management plan, as outlined in the RAP. It should be noted that with effective establishment and maintenance of vegetation cover additional long-term erosion and sediment control measures will not be required.

There is no evidence of any linkages in respect to migration of leached contaminants to Wolli Creek via groundwater. Leaching of contaminants in the fill is not currently considered to be resulting in any unacceptable impacts, but the intent of the proposal is to further reduce the potential for this to occur.

Given the site's proximity to Wolli Creek and likelihood of tidal influence on groundwater, the groundwater system and waterway are anticipated to be closely linked. Changes to groundwater generation by reducing infiltration is unlikely to significantly affect groundwater quantities as rainwater which previously infiltrated into the groundwater system would be conveyed by the surface water system that reports directly into Wolli Creek, or infiltrate into groundwater down-gradient of the proposed works before entering the creek.

Therefore, the local groundwater quality is expected to benefit from the proposed works, with the groundwater quantity not significantly impacted and potential risks to groundwater quality further reduced.

7.3 Serious and irreversible impacts

No entities subject to serious and irreversible impacts are present or likely to occur at the site.

7.4 Prescribed biodiversity impacts

Prescribed biodiversity impacts are impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. Those of relevance to this proposal are discussed in Table 7-5 below.

Table 7-5: Prescribed impacts

Prescribed impact	Description of impacts	Magnitude of impacts
Non-native vegetation	Site reprofiling and remediation activities would result in the removal of disturbed vegetation, including weed thickets. These provide habitat for common fauna species, such as small birds and reptiles. Threatened species are unlikely to use these areas. Once capping is complete, the site would be revegetated to potentially be incorporated into a proposed river-valley park as part of a green corridor. This would replace lost habitat, and thus impacts would be temporary only.	Low
Caves and crevices	The Wolli Creek valley is bordered by sandstone cliffs in some areas. These would provide habitat for a range of species, including geckos and snakes. No large cliffs or crevices are located at the site. A sandstone outcrop occurs in the north of the site. Much of this outcrop has been covered with fill. A small crevice at ground level shows rubble and rubbish in the outcrop. The sandstone outcrop is not part of the remediation area. The proposal will not impact the large cliffs and associated caves and crevices that are located along other parts of the Wolli Creek valley. These areas provide high quality habitat values for cave-dwelling fauna. Rehabilitation may impact the small crevice located at the site as it is located near the edge of the proposed works. This crevice is unlikely to be utilised by any threatened species given its location at ground level.	Low
Connectivity	The proposal site is located within the Wolli Creek valley. Parts of the valley (predominantly to the west of the proposal site) are part of Wolli Creek Regional Park. Small isolated lots to the east of the proposal site are also part of the regional park. Wolli Creek Regional Park and other land alongside the creek provide a vegetated corridor to the Cooks River. This vegetated area is important in the locality, providing one of the main areas of remnant vegetation remaining in inner Sydney. Bayside Council recognises the Wolli Creek corridor as an important natural asset (Bayside Council 2019). The majority of the Cooks River catchment is highly developed, so the remnant bushland and surrounding modified areas are regionally important (CRCMC 1999). The proposal would result in removal of predominantly the shrublayer and groundlayer to allow for rehabilitation and capping of contaminated land. Eleven large trees are	Low

Prescribed impact	Description of impacts	Magnitude of impacts
	proposed to be retained within the construction boundary (see Figure 1-1). Following completion of rehabilitation, the site would be revegetated to make it suitable for public use and for the site to continue to form part of the vegetated corridor along Wolli Creek. Connectivity would be temporarily disrupted on the upper fill area during remediation activities. This would mainly affect small, less mobile fauna species such as small reptiles and frogs. These would remain and provide stepping stone connectivity across the cleared portion of the site. Mobile fauna species would be able to move across the site and around the site to access habitats elsewhere. Saltmarsh to be removed as a result of the proposal is located on the edge of the slope, away from Wolli Creek. Large areas of saltmarsh would be retained between Wolli Creek and the proposal site providing connectivity along the river flats for wetland fauna.	
Hydrology	A small area of saltmarsh would be directly impacted by the proposal. Areas of saltmarsh, mangroves, and Swamp Oak Swamp Forest are located on the site downslope of the proposed remediation area, alongside Wolli Creek. Saltmarsh provides habitat for wetland birds, waterfowls, and other fauna species. Remediation works have the potential to result in mobilisation of sediments and contaminated soils if not managed appropriately. Being a remediation project, the proposal has been scoped and developed in consideration of improving water related impacts. Activities associated with the proposal would result in long-term environmental benefits with respect to surface water and groundwater quality and reduction in risk of contamination of both surface water and groundwater (see section 7.2 for more detail). A large proportion of the saltmarsh patch would be retained along Wolli Creek as shown in Figure 3-1. This provides additional buffer areas between the proposal site and the creek, further minimising the potential for hydrological impacts.	Low

Prescribed impact	Description of impacts	Magnitude of impacts
Vehicle strike	Movement of vehicles and plant during remediation works has a potential to result in the injury or mortality of some individuals of less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the site during clearing activities and unable to move out of the area. No threatened fauna species are likely to be at risk of vehicle strike. The risk of vehicle strike would be restricted to a small area and during remediation works only. Following remediation, risk of vehicle strike would return to very low levels.	Low

7.5 Matters of National Environmental Significance

7.5.1 Threatened ecological communities

Subtropical and Coastal Saltmarsh is listed as a vulnerable ecological community under the EPBC Act. Impacts on this vegetation have been assessed in sections 7.1 to 7.4 above. Vulnerable ecological communities listed under the EPBC Act are not MNES for the purposes of Part 3 of the EPBC Act (requirements for environmental approvals). No assessment of significance is therefore required for impacts on this community.

As outlined in Section 5.1.2, PCT 1234 Swamp Oak Swamp Forest is not commensurate with the EPBC Act-listed EEC Coastal Swamp Oak (*Casuarina glauca*) Forest.

There would be no impacts on any threatened ecological community that is listed as a matter of national environmental significance as a result of the proposal.

7.5.2 Threatened species

No threatened flora species listed under the EPBC Act are likely to occur or be affected by the proposal.

The Wolli Creek Grey-headed Flying-fox camp is located 0.7 km west of the site. An assessment of significance has been prepared (Annexure F) given the close proximity of this camp. The proposal is unlikely to have a significant impact on this species as:

- There would be no direct impact on the breeding camp
- Removal of native vegetation on the site would be limited, with remnant eucalypts that provide potential foraging habitat for this species being retained.
- Increases in noise and vibration during rehabilitation works would be negligible given the distance of the proposal from the camp. There is unlikely to be any disturbance of foraging activities.
- The proposal would not fragment habitat for the species.
- Planting of additional feed trees following remediation is also recommended.

No other threatened fauna are likely to rely on habitats present for their survival. No other assessments of significance have been prepared.

7.5.3 Migratory species

Wolli Creek is not 'important habitat' for any migratory waders that may occur in the Botany Bay area (see section 5.3). The proposal is unlikely to significantly impact migratory waders as only a small area of saltmarsh would be impacted by the proposal and this area does not constitue important habitat for these species. No extensive mudflats are located along Wolli Creek. There is unlikely to be any impact on important habitat for migratory waders associated with the Towra Point Wetland Ramsar site given its location well away from the proposal and on the other side of Botany Bay. An assessment of significance for migratory waders is not considered necessary.

7.5.4 Wetlands of international significance

The proposal would not impact Towra Point Nature Reserve given its location about 8 kilometres from the site.

7.6 Groundwater dependent ecosystems

Given the site's proximity to Wolli Creek and likelihood of tidal influence on groundwater, the groundwater system and waterway are anticipated to be closely linked. Changes to groundwater generation by reducing infiltration within the proposed remediation area of the site is unlikely to significantly affect groundwater quantities as rainwater which previously infiltrated into the groundwater system would be conveyed by the surface water system that reports directly into Wolli Creek, or infiltrate into groundwater down-gradient of the proposed works before entering the creek. Excavation works undertaken on the upper platform for re-profiling are unlikely to impact groundwater or the shallow aquifer. Given the slope of the site, the proposal is unlikely to alter drainage flows or patterns towards Wolli Creek. As such, GDEs in the vicinity of the remediation area are unlikely to be impacted by the proposal.

7.7 Cumulative impacts

The site and surrounding region have been extensively cleared and developed. The Wolli Creek riparian corridor is one of the few extensive patches of native vegetation and associated biodiversity value in the locality. The proposal would mainly impact modified and disturbed vegetation.

Road projects in the locality such as the Sydney Gateway Motorway, the New M5 and future M4–M5 Link would result in the removal of mainly planted vegetation and associated fauna habitats, as well as potentially impact aquatic habitats. These major projects, residential development and other activities would result in cumulative and facilitated impacts, including:

- additional removal of native vegetation and habitat resources
- additional injury, displacement or mortality of individuals within local flora and fauna populations
- increased fragmentation of habitat and creation of novel edge effects in remnant native vegetation
- increased generation of noise and light and increased risk of vehicle strike associated with transport infrastructure
- increased risk of the spread of weeds, pathogens or pest fauna and/or increased negative impacts arising from these factors
- increased risk of toxicity or degradation of habitat due to the generation of contaminants
- further alterations to the hydrology of catchments.

The biodiversity values that are likely to be affected by major projects and other development in the region have relatively low ecosystem resilience because of the existing cumulative impacts of development in inner Sydney. Remnant vegetation is severely fragmented at a regional scale.

The proposal would have a minor impact on the cumulative impacts on biodiversity values arising from development in the inner west and inner south of Sydney. The project is unlikely to increase the extent, duration or magnitude of any of the cumulative impacts on biodiversity values occurring in the site and region to the extent that would result in a significant negative effect on biodiversity values. The impact would be temporary, and the proposal is being undertaken to improve environmental values at the site in the long term, and the intent for the site is for it to become part of a green corridor for use by the public.

A summary of cumulative impacts of local road projects is provided in Table 7-6.

Table 7-6: Past, present and future road projects

Project	Biodiversity value impacted	Construction impacts	Operational impacts
Sydney Gateway Motorway (G2S JV 2019). Located between Tempe and Mascot.	PCT 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	Removal of 0.82 ha of vegetation (does not meet condition criteria for EPBC Act listing)	Limited operational impacts given highly modified industrial environment of the area
	PCT 920 Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Removal of 0.04 ha of vegetation	Limited operational impacts given highly modified industrial environment of the area
	Miscellaneous Ecosystems (weeds, planted natives etc)	Removal of 23.28 ha of exotic or planted vegetation	Limited operational impacts given highly modified industrial environment of the area
	Aquatic habitat	There would be no loss of key fish habitat. There would be no effect on aquatic connectivity or fish passage.	Appropriate design features will be implemented to effectively manage any potential adverse water quality impacts associated with the operation phase of the proposal

Project	Biodiversity value impacted	Construction impacts	Operational impacts
M4-M5 link (Ecological Australia 2017). Various locations, including Rozelle Bay and St Peters.	All vegetation in the study area was mapped as 'urban exotic and native cover' and considered to be in a low ecological condition.	Around 1,675 trees would potentially require removal to facilitate the proposal. Construction has the potential to spread weeds.	Opportunities presented by the new open space would be used for compensatory planting where possible.
	The vegetation is of limited habitat for fauna species, although there is potential for microbats and other species to occur.	Construction has the potential to disturb potential microbat roosts.	Planting of Grey-headed Flying-fox feed trees is proposed.
	Highly modified aquatic habitats are present.	No marine vegetation would be impacted. There may be temporary obstruction of fish passage during construction. There would be no net loss of aquatic habitat in the medium to long term.	Re-establishment of riparian vegetation would occur post-construction.
New M5 (Ecological 2015). Located between St Peters and Narwee, including sites near Wolli Creek.	Native vegetation including three forest PCTs were present.	Removal of 3.31 hectares native vegetation (forest communities) and removal of nine hollow-bearing trees.	Potential for spread of weeds.
	Potential habitat for the Green and Golden Bell Frog was located in the proposal site. The Grey-headed Flying-fox was likely to forage at the site.	Removal of up to 7.82 hectares of foraging, dispersal and sheltering habitat for the Green and Golden Bell Frog at Kogarah Golf Course. Removal of about 10.76 ha of foraging habitat for the Grey-headed Flying-fox.	Ongoing noise and vibration. Operation impacts on the known breeding habitat for the Green and Golden Bell Frog and unlikely.

Project	Biodiversity value impacted	Construction impacts	Operational impacts
	The proposal passes under Wolli Creek and the Cooks River, but crosses over Alexandra Canal.	Potential for temporary impacts to hydrology from increased runoff and changes to flow regimes. No impacts on fish passage.	Increased runoff and discharges into the Cooks River would occur. No impacts on fish passage.

8. Mitigation

8.1 Mitigation measures

In order to address the potential impacts of the proposal on biodiversity values, the recommended mitigation measures outlined in Table 8-1 below will be implemented. In accordance with 3.2(e) of the Secretary's Environmental Assessment Requirements, this section details how likely impacts that have not been avoided through design will be minimised, and the predicted effectiveness of these measures.

A Construction Environmental Management Plan (CEMP) will be required for the construction phase of the proposal. The CEMP will include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as proposal-specific measures. The proposed mitigation measures will include environmental safeguards for protection of neighbouring properties and waterways in accordance with relevant policy documentation and Government guidelines.

The site would be revegetated up to a certain extent by TfNSW, before its handover to NPWS, to make it suitable for public use as a green corridor and would be managed through implementation of a Long Term Environmental Management Plan. The proposal would likely improve biodiversity values at the site in the long term.

Table 8-1: Mitigation measures

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
Removal of native vegetation and habitat	Native vegetation removal will be minimised through detailed design.	Detailed design	Effective	Loss of native vegetation	Project designer
	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Prior to construction	Effective	Loss of native vegetation	Project ecologist
	Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	Loss of native vegetation	Contractor
	Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011). The following are proposed to improve habitat values at the site: • planting of feed trees for the Grey-headed Flying-fox should be considered.	Post construction	Effective	None	Contractor/Bush regenerator
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the site.	During construction	Proven	None	Project ecologist
	Habitat removal will be minimised through detailed design. Where possible retain hollow-bearing trees, in particular, tree 33 as shown on Figure 1.1.	Detailed design	Effective	Loss of potential threatened fauna habitat	Project designer

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
	Fauna will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	Loss of potential threatened fauna habitat	Project ecologist
	Habitat removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	Loss of potential threatened fauna habitat	Project ecologist
	Habitat will be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Nest boxes* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Proven	None	Project ecologist
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the subject site.	During construction	Proven	Loss of threatened fauna habitat	Project ecologist
Indirect impacts on native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	None	Project ecologist, Contractor
	Weed species will be managed in accordance with *Guide 6: Weed management* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	None	Contractor

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
	Pest species will be managed within the subject site.	During construction	Effective	None	Contractor
	Pathogens will be managed in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	None	Contractor
Removal of threatened plants	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Proven	None	Project ecologist
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the subject site.	During construction	Proven	None	Project ecologist
Impacts to hydrology	Changes to existing surface water flows will be minimised through detailed design.	Detailed design	Effective	Potential for indirect impacts on Wolli Creek during construction	Project designer

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
Aquatic impacts	Aquatic habitat will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures* of the *Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	During construction	Effective	Potential for indirect impacts on Wolli Creek during construction	Contractor
Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems will be minimised through detailed design.	Detailed design	Effective	None	Project designer

8.2 Adaptive management for uncertain impacts

No management of uncertain impacts is proposed.

9. Offsetting

9.1 BC Act – offsets for affected threatened biota

Biodiversity offset obligations have been determined using the BAM calculator. The required ecosystem and species credit obligations based on the current design are outlined below.

9.1.1 Ecosystem credits

The required ecosystem credits, as determined using the BAM calculator, for the proposal are provided in Table 9-1.

Table 9-1: Ecosystem credits

Vegetation Zone	Plant community type (PCT)	Area impacted (ha)	Ecosystem credits required
1778_Mod/Good Medium	Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	0.2	0
1778_Mod/Good Poor	Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	0.5	0
1778_Low	Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	0.1	0
1126_Mod/Good Medium	Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	0. 1	3
TOTAL			**3**

9.1.2 Species credits

Offset are required for the potential threatened species impacted by the development that require species credits, identified at Step 5 in Section 6.4 of the BAM.

The offset requirement for impacts on threatened species and threatened species habitat is determined in accordance with Chapter 11 of the BAM. The required ecosystem credits for the proposal, as determined using the BAM calculator, are provided in Table 9-2.

Table 9-2: Species credits

Species	Loss of habitat (ha) or individuals	Species credits required
Southern Myotis	0.2	1

The full biodiversity credit report is included in Annexure E.

9.1.3 Offsetting strategy

The biodiversity offset strategy for this proposal comprises two options. These options are, the purchase and retirement of existing biodiversity credits currently available on the biodiversity credit register or making a payment into the Biodiversity Conservation Fund (BCF). Given the small number of credits required, payment to the BCF is the most likely option. An indication of likely costs are shown in Table 9-3. It should be noted that payment for offsets are subject to change and that credit payment prices are reviewed quarterly. The payment amounts presented within this report were calculated and are valid as of 13 January 2020.

Table 9-3: Credit requirements and pricing

Credit Type required	Offset trading group	Estimated credit price/ credit	Biodiversity Risk Weighting	Payment required (GST inc)
PCT 1126 Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Saltmarshes >=50 and 70%	$7,652.00	2	$25,251.61
Southern Myotis		$919.15	2	$1,011.07

9.2 FM Act – offsets for impacts on key fish habitat

Saltmarsh is classified as 'marine vegetation' under the FM Act. A permit is required from NSW DPI to harm marine vegetation. NSW DPI enforces a 'no net loss' habitat policy as a permit condition or condition of consent. This may require proponents to conduct habitat rehabilitation and/or provide environmental compensation. A monetary bond or payment may be required to be lodged with NSW DPI to ensure the works are completed in accordance with the permit conditions (DPI 2013).

NSW DPI calculates habitat compensation on a minimum 2:1 basis for all key fish habitat to help redress other indirect impacts of development. A greater compensation ratio may be considered if opportunities for compensation are not available in the vicinity of, or of the type of, habitat that has been lost. Please note that a ratio of 10:1 generally applies for compensation for disturbances to SEPP 14 coastal wetlands. This is calculated at the rate of $51/m^2 for marine vegetation which equates to $510/m^2 to meet the 10:1 habitat offset requirement.

There is 728 m^2 of Saltmarsh within the Coastal Wetland extent in the construction boundary. Based on the ratios provided above, the cost of offsets would be over $370,000. These offsets are separate to those calculated by the BAM for saltmarsh.

It is recommended that impacts on saltmarsh are minimised as far as possible in order to protect this key fish habitat and to minimise offset costs. TfNSW will liaise with DPI Fisheries to determine permit and offsetting requirements.

9.3 EPBC Act – offsets for affected threatened biota

Under the EPBC Act Environmental Offsets Policy (DSEWPaC, 2012) biodiversity offsets are required to compensate for significant residual effects on MNES. This BDAR includes the identification and assessment of potentially affected MNES, including an assessment of the likely significance of effects on the Grey-headed Flying-fox pursuant to the EPBC Act significant impact guidelines 1.1 (DotE, 2013). The outcome of this assessment of significance is that the proposal would not be likely to result in a significant impact on the Grey-headed Flying-fox or on any other MNES. The proposal is unlikely to impact Towra Point Ramsar site as it is located about 8 km away on the southern side of Botany Bay. No biodiversity offsets for effects on MNES are therefore required.

10. References

AMBS (2011). Marrickville Biodiversity Strategy 2011-2021. Report prepared for Marrickville Council by Australian Museum Business Services, Sydney.

AWC (2015). Weeds of National Significance. Australian Weeds Committee.

Bayside Council (2019). Biodiversity. https://www.bayside.nsw.gov.au/area/environment/biodiversity

BOM (2019a). Sydney Airport, New South Wales, Daily Weather Observations http://www.bom.gov.au/climate/dwo/IDCJDW2125.latest.shtml.

BOM (2019b). Atlas of Groundwater Dependent Ecosystems (GDE). Australian Bureau of Meteorology. http://www.bom.gov.au/water/groundwater/gde/

Churchill, S (2008). Australian Bats, Allen and Unwin, Australia.

CRCMC (1999). Cooks River Catchment Management Strategy. Cooks River Catchment Management Committee. http://www2.canterbury.nsw.gov.au/cooknet/resources/documents/crcmc_strat_1999.pdf

Cropper, S.C. (1993). Management of Endangered Plants. CSIRO Publications Victoria.

DECC (2008a). NSW (Mitchell) Landscapes Version 3 (2008). NSW DECC Hurstville, NSW. Department of Environment and Climate Change.

DECC (2008b). Management Plan for the Green and Golden Bell Frog Key Population on the lower Cooks River. Department of Environment and Climate Change (NSW), Sydney.

DECC (2008c) Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area. Department of Environment and Climate Change, Hurstville. https://www.environment.nsw.gov.au/resources/nature/surveys/080345RapdFaunaOviewSMCMA.pdf

DECC (2008d). Hygiene protocol for the control of disease in frogs. Department of Environment and Climate Change, NSW, Sydney South. http://www.environment.nsw.gov.au/resources/nature/hyprfrog.pdf

DECC (2008e), Managing Urban Stormwater – Soils and Construction. Volume 2D – Main road construction. Department of Environment and Climate Change NSW. http://www.environment.nsw.gov.au/resources/stormwater/08207soilsconststorm2d.pdf

DECCW (2010). Towra Point Nature Reserve Ramsar site. Ecological character description. Department of Environment, Climate Change and Water, Sydney.

DEE (2016). An Interim Biogeographic Regionalisation of Australia (IBRA) - Version 7. Canberra, Department of the Environment and Energy.

DEE (2017). EPBC Act Policy Statement 3.21: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species. Department of the Environment and Energy. Accessed at: http://www.environment.gov.au/system/files/resources/67d7eab4-95a5-4c13-a35e-e74cca47c376/files/bio4190517-shorebirds-guidelines.pdf.

DEE (2019a). Protected Matters Search Tool. Department of the Environment and Energy. http://www.environment.gov.au/epbc/pmst

DEE (2019b). Directory of Important Wetlands of Australia (DIWA). Department of the Environment and Energy. Accessed at: http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf.

DEE (2019c). Species Profiles and Threats Database. Online resource. Department of Sustainability. Environment, Water, Population and Communities. Accessed at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

DEE (2019d). Weeds in Australia – Weeds of National Significance (WoNS). Department of the Environment and Energy. Accessed at: http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html.

DEE (2020). National Flying-fox monitoring viewer. http://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf

DEWHA (2010a). Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the EPBC Act. Department of Environment, Water, Heritage and the Arts.

DEWHA (2010b). Significant impact guidelines for the vulnerable green and golden bell frog (*Litoria aurea*). Department of Environment, Water, Heritage and the Arts. Accessed at: http://www.environment.gov.au/system/files/resources/e882f6c7-a511-4fba-9116-2f2f7ef941aa/files/litoria-aurea-policy.pdf.

DEWHA (2013), Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia. http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

DPE (2018). State Environmental Planning Policy (Coastal Management) 2018 – Coastal Wetlands. Department of Planning & Environment.

DPI (2013). Policy and Guidelines for Fish Habitat Conservation and Management. Department of Primary Industries. Accessed at http://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/fish-habitat-conservation.

DPI (2018). Priority weed listings for the Greater Sydney region. Department of Primary Industries.

DPIE (2019a). NSW BioNet Vegetation Classification Database. Office of Environment and Heritage. Accessed at: http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx.

DPIE (2019b). NSW BioNet. The Website for the Atlas of NSW Wildlife. Accessed at: http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx.

DPIE (2019c). NSW Threatened Species profiles. Accessed at: http://www.environment.nsw.gov.au/threatenedspecies/.

DPIE (2019e), eSPADE. NSW Soil and Land Information. https://www.environment.nsw.gov.au/eSpade2WebApp

DPIE (2020) Biodiversity Values Map and Threshold (BMAT) Tool https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap

DSEWPAC (2013). *Conservation Advice for SUBTROPICAL AND TEMPERATE COASTAL SALTMARSH.* Canberra: Department of Sustainability, Environment, Water, Population and Communities. http://www.environment.gov.au/biodiversity/threatened/communities/pubs/118-conservation-advice.pdf

Duffy, AM, Lumsden, LF, Caddle, CR, Chick, RR & Newell, GR (2000). The efficacy of Anabat ultrasonic detectors and harp traps for surveying microchiropterans in southeastern Australia, Acta Chiropterologica 2: 127-144.

Ecological Australia (2015). New M5 Biodiversity Technical Paper. Report prepared for Roads and Maritime Services.

Ecological Australia (2017). WestConnex M4-M5 Link Biodiversity Technical Paper. Report prepared for Roads and Maritime Services.

G2S JV (2019). Sydney Gateway Biodiversity Technical Paper. Report prepared for Transport for NSW.

GHD (2011) Jackson Place Site Remediation Project. Arboricultural Implications Study and Biodiversity Impact Assessment. October 2011.

GHD (2012). Jackson Place Remediation Project Review of Environmental Factors – Roads and Maritime Services, May 2012.

GHD (2019). Remedial Action Plan – Jackson Place, Earlwood, NSW, May 2019.

GSLLS (2019) Greater Sydney Regional Strategic Weed Management Plan 2017-2022. Published by Greater Sydney Local Land Services. Developed in partnership with the Greater Sydney Regional Weed Committee. https://www.lls.nsw.gov.au/__data/assets/pdf_file/0010/722368/Greater-Sydney-Regional-Weed-Mgmt-Plan-FINAL-Sept-2019.pdf

Landcom (2004). Managing Urban Stormwater: Soils and Construction – Volume 1. 4th Edition, March 2004.

Little, D., Stevens, P., Gatenby, G and O'Brien, V (2010). Fauna of the Wolli Valley in Inner south-west Sydney. Pp326 - 331 in The Natural History of Sydney, edited by Daniel Lunney, Pat Hutchings and Dieter Hochuli. Royal Zoological Society of NSW, Mosman, NSW, Australia. 2010

LPI (2019). Aerial photographic imagery. Land and Property Information.

LPI (2019). NSW Mitchell Landscapes. Land and Property Information.

Marcus Lincoln Smith (2003). Aquatic ecology in environmental impact assessment EIA guidelines.

Mills, DJ, Norton, TW, Parnaby, HE, Cunningham, RB & Nix, HA (1996). Designing surveys for microchiropteran bats in complex forest landscapes – a pilot study from south-east Australia. Forest Ecology and management 85 (1-3):149-161.

Mo, M. (2015). Herpetofaunal community of the constructed Lime Kiln Bay Wetland, south Sydney, New South Wales. The Victorian Naturalist 132 (3): 64–72.

OEH (2011). Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing. Office of Environment and Heritage. Accessed at: http://www.environment.nsw.gov.au/determinations/SwampOakFloodplainEndSpListing.htm.

OEH (2013). The Vertebrate Fauna of Towra Point Nature Reserve. Office of Environment and Heritage. Accessed at: https://www.environment.nsw.gov.au/resources/nature/surveys/130724-towra-point-vertebrate-fauna.pdf.

OEH (2016a). NSW Guide to surveying threatened plants. State of NSW and Office of Environment and Heritage.

OEH (2016b). The Native Vegetation of the Sydney Metropolitan Area. Office of Environment and Heritage.

OEH (2017a). Biodiversity Assessment Method. Office of Environment and Heritage.

OEH (2017b). Biodiversity Assessment Method Calculator Users Guide, Office of Environment and Heritage

OEH (2017c). Biodiversity Assessment Method Calculator Version 1.2.1., Office of Environment and Heritage.

Pennay, M., Law, B., and Lunney, D. (2011). Review of the Distribution and status of the bat fauna of NSW and the ACT. Pp. 226-256 in The Biology and Conservation of Australian Bats, edited by Law., B, Eby., P, and Lunney., D.

RGBT (2018). PlantNET - The Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney, Australia. Royal Botanic Gardens and Domain Trust. Accessed at: http://plantnet.rbgsyd.nsw.gov.au.

Rockdale Council (2014). Rockdale Biodiversity Strategy 2014. https://www.bayside.nsw.gov.au/sites/default/files/2018-08/Rockdale%20Biodiversity%20Strategy%202014%20Volume%201.pdf

RTA (2011). Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects. Roads and Traffic Authority, NSW.

Tozer, M.G., Turner, K. Keith, D.A, Tindall, D., Pennay, C. Simpson, C., Mackenzie, B, Beukers, P. and Cox, S. (2010). Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands, *Cunninghamia*, **11**(3) 359-406.Tozer et al. (2010). Native vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands.

Turak, E., Waddell, N. & Johnstone, G. (2004). New South Wales (NSW) Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual. Department of Environment and Conservation (NSW), Sydney.

Wolli Creek Preservation Society (2019). Grey-headed Flying-foxes. http://www.wollicreek.org.au/plants_animals/flying_foxes

Annexure A

Species recorded

Recorded flora

Scientific Name	Common name	Growth Forms	Status		Cover in each plot*					
			BC Act	EPBC Act	1234	1126	1778			920
					P1	P2	P3	P4	P5	P6
Acacia longifolia		SG			0.1					
Acetosa sagittata	Rambling Dock	HT					0.5			
Ageratina adenophora	Crofton Weed	HT					0.2	20	1	
Anagallis sp.		EX					0.1			
Angophora costata	Sydney Red Gum	TG						10	1	
Anredera cordifolia	Madeira Vine	HT			0.2			5	0.5	0.2
Araujia sericifera	Moth Vine	HT					0.1			
Arundo donax	Giant Reed	HT							0.5	
Asparagus aethiopicus	Asparagus Fern	HT			5		0.1	2		5
Asparagus asparagoides	Bridal Creeper	HT			0.5				0.5	0.1
Asparagus plumosus	Climbing Asparagus Fern	HT							0.1	
Asphodelus sp.		EX					0.1			
Atriplex sp.	A Saltbush	SG				0.1				
Avicennia marina subsp. *australasica*	Grey Mangrove	TG			0.5	0.5				40
Banksia integrifolia	Coast Banksia	TG						0.5		

Scientific Name	Common name	Growth Forms	Status		Cover in each plot*					
			BC Act	EPBC Act	1234	1126	1778			920
					P1	P2	P3	P4	P5	P6
Bidens pilosa	Cobbler's Pegs	HT					0.1			
Breynia oblongifolia	Coffee Bush	SG						0.1		
Briza minor	Shivery Grass	EX					0.2			
Bromus catharticus	Praire Grass	EX			2		75			
Bromus diandrus	Great Brome	HT					0.5			
Cardiospermum grandiflorum	Balloon Vine	HT						0.2	60	
Casuarina glauca	Swamp Oak	TG			30				0.5	
Celtis sinensis	Japanese Hackberry	EX						2		
Cerastium glomeratum	Mouse-ear Chickweed	EX					0.2			
Cestrum parqui	Green Cestrum	HT					0.2		2	
Commelina cyanea	Native Wandering Jew	FG					0.1			
Conyza bonariensis	Flaxleaf Fleabane	EX			0.1		0.2			
Cyclospermum leptophyllum	Slender Celery	EX					0.1			
Cymbalaria muralis subsp. *muralis*	Ivy-leaved Toadflax	EX					0.1			
Cynodon dactylon	Common Couch	GG					0.1			
Delairea odorata	Cape Ivy	HT					2	20	20	
Dianella caerulea	Blue Flax-lily	FG						0.1		

Scientific Name	Common name	Growth Forms	Status		Cover in each plot*					
			BC Act	EPBC Act	1234	1126	1778			920
					P1	P2	P3	P4	P5	P6
Ehrharta erecta	Panic Veldtgrass	HT			5		0.1	0.5	0.5	0.2
Entolasia stricta	Wiry Panic	GG							0.2	
Erythrina crista-galli	Cockspur Coral Tree	HT						5		
Eucalyptus botryoides	Bangalay	TG						20		
Glochidion ferdinandi	Cheese Tree	TG						0.5		
Hypochaeris radicata	Catsear	EX					0.1			
Juncus acutus subsp. *acutus*	Sharp Rush	HT				0.5				0.5
Lantana camara	Lantana	HT			0.2		5	60	60	
Ligustrum lucidum	Large-leaved Privet	HT						0.5		
Ligustrum sinense	Small-leaved Privet	HT						0.1	0.5	
Lolium perenne	Perennial Ryegrass	EX					0.2			
Lomandra longifolia	Spiny-headed Mat-rush	GG					0.1			
Malva parviflora	Small-flowered Mallow	EX					0.5			
Medicago sp.	A Medic	EX					0.5			
Melaleuca linariifolia	Flax-leaved Paperbark	SG						0.1		
Melia azedarach	White Cedar	TG						1		
Microlaena stipoides	Weeping Grass	GG			1		0.5			

Scientific Name	Common name	Growth Forms	Status		Cover in each plot*					
			BC Act	EPBC Act	1234	1126	1778			920
					P1	P2	P3	P4	P5	P6
Morus alba	White Mulberry	EX						10	0.5	
Morus sp.		EX					5			
Ochna serrulata	Mickey Mouse Plant	HT			0.1					
Oplismenus aemulus		GG						0.1		
Oxalis pes-caprae	Soursob	EX					0.1			
Parietaria judaica	Pellitory	EX					5	10		
Petrorhagia dubia		EX					0.1			
Phragmites australis	Common Reed	GG			2	60				2
Pittosporum undulatum	Sweet Pittosporum	SG						5		
Plantago lanceolata	Lamb's Tongues	EX					0.2			
Sarcocornia quinqueflora subsp. *quinqueflora*		SG				2				2
Senecio madagascariensis	Fireweed	HT			0.1					
Senna pendula var. *glabrata*		HT			1					0.1
Sida rhombifolia	Paddy's Lucerne	EX					0.2			
Solanum nigrum	Black-berry Nightshade	EX			0.1		0.1			
Sonchus oleraceus	Common Sowthistle	EX			0.1		0.5	0.1		

Scientific Name	Common name	Growth Forms	Status		Cover in each plot*					
			BC Act	EPBC Act	1234	1126	1778			920
					P1	P2	P3	P4	P5	P6
Suaeda australis		SG				50				2
Tetragonia tetragonioides	New Zealand Spinach	FG			25					0.5
Tradescantia fluminensis	Wandering Jew	HT					0.2	5	5	
Trifolium campestre	Hop Clover	EX					1			
Trifolium repens	White Clover	EX					0.5			
Trifolium sp.	A Clover	EX					0.1			
Vicia sativa	Common vetch	EX					0.5			

Note: *Cover (C) should be determined in accordance with the BAM.

Fauna species recorded at the site

Fauna group	Common Name	Scientific name	Status		Ecosystem or species credit species?
			BC Act	EPBC Act	
Birds	Brown Thornbill	*Acanthiza pusilla*			
Birds	Eastern Spinebill	*Acanthorhynchus tenuirostris*			
Birds	Mallard	*Anas platyrhynchos*			
Birds	Pacific Black Duck	*Anas superciliosa*			
Birds	Australasian Darter	*Anhinga novaehollandiae*			
Birds	Red Wattlebird	*Anthochaera carunculata*			
Birds	Sulphur-crested Cockatoo	*Cacatua galerita*			
Birds	Yellow-faced Honeyeater	*Caligavis chrysops*			
Birds	Yellow-tailed Black-cockatoo	*Calyptorhynchus funereus*			
Birds	Australian Wood Duck	*Chenonetta jubatus*			
Birds	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*			
Birds	Australian Raven	*Corvus coronoides*			
Birds	Australian Magpie	*Cracticus tibicen*			
Birds	Laughing Kookaburra	*Dacelo novaeguineae*			
Birds	Eastern Koel	*Eudynamys orientalis*			
Birds	Bar-shouldered Dove	*Geopelia humeralis*			

Fauna group	Common Name	Scientific name	Status		Ecosystem or species credit species?
			BC Act	EPBC Act	
Birds	Magpie-lark	*Grallina cyanoleuca*			
Birds	Superb Fairy-wren	*Malurus cyaneus*			
Birds	Noisy Miner	*Manorina melanocephala*			
Birds	Red-browed Finch	*Neochmia temporalis*			
Birds	Nankeen Night Heron	*Nycticorax caledonicus*			
Birds	Crested Pigeon	*Ocyphaps lophotes*			
Birds	Spotted Pardalote	*Pardalotus punctatus*			
Birds	Pied Cormorant	*Phalacrocorax varius*			
Birds	Red-whiskered Bulbul	*Pycnonotus jocosus*	*		
Birds	Willie Wagtail	*Rhipidura leucophrys*			
Birds	Pied Currawong	*Strepera graculina*			
Birds	Spotted Turtle-dove	*Streptopelia chinensis*	*		
Birds	Australian White Ibis	*Threskiornis molucca*			
Birds	Rainbow Lorikeet	*Trichoglossus haematodus*			
Birds	Silvereye	*Zosterops lateralis*			
Mammals	White-striped Freetail Bat	*Austronomus australis*			

Fauna group	Common Name	Scientific name	Status		Ecosystem or species credit species?
			BC Act	EPBC Act	
Mammals	Gould's Wattled Bat	*Chalinolobus gouldii*			
Mammals	Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Dual credit
Mammals	Yellow-bellied Sheathtail-Bat	*Saccolaimus flaviventris*	V		Ecosystem
Mammals	Common Brushtail Possum	*Trichosurus vulpecula*			
Reptiles	Eastern Water-skink	*Eulamprus quoyii*			
Reptiles	Eastern Water Dragon	*Intellegama lesueuri*			
Reptiles	Dark-flecked Garden Sunskink	*Lampropholis delicata*			

Key: * exotic, V – vulnerable

Fauna species recorded at the reference site (Marsh St and Eve Stree Wetlands)

Fauna group	Common Name	Scientific name	Status		Ecosystem or species credit species?
			BC Act	EPBC Act	
Frogs	Green and Golden Bell Frog	*Litoria aurea*	E	V	Species
Frogs	Peron's Tree Frog	*Litoria peroni*			
Frogs	Brown-striped Frog	*Lymnodynastes peroni*			
Birds	Pied Currawong	*Strepera graculina*			
Birds	Pacific Black Duck	*Anas superciliosa*			
Mammals	Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Dual credit

Key: E – endangered, V – vulnerable

Plot transect data

				Composition (species richness)							Structure (% cover)						Function													
Veg Zone	PCT	Condition	Plot	TG	SG	GG	FG	EG	OG	Total	TG	SG	GG	FG	EG	OG	Large trees	Hollow trees	Litter cover (%)	Fallen logs (m)	Tree DBH 5-10 (cm)	Tree DBH 10-20 (cm)	Tree DBH 20-30 (cm)	Tree DBH 30-50 (cm)	Tree DBH 50-80 (cm)	Tree regen	HTE cover (total)	Zone	Easting	Northing	Bearing
			Benchmark	**7**	**27**	**9**	**8**	**2**	**5**	**58**	**51**	**70**	**33**	**5**	**1**	**4**	**3**		**62**	**45**											
1	1778	Medium	4	4	3	1	1	0	0	9	12.0	5.2	0.1	0.1	0.0	0.0	1	0	20.0	0.0	0	0	0	1	1	0	118.3	56	328278	6244389	50
			Benchmark	**7**	**27**	**9**	**8**	**2**	**5**	**58**	**51**	**70**	**33**	**5**	**1**	**4**	**3**		**62**	**45**											
2	1778	Poor	5	2	0	1	0	0	0	3	1.5	0	0.2	0	0	0	0	0	8	0	0	1	0	0	0	0	150.6	56	328294	6244357	70
			Benchmark	**7**	**27**	**9**	**8**	**2**	**5**	**58**	**51**	**70**	**33**	**5**	**1**	**4**	**3**		**62**	**45**											
3	1778	Low	3	0	0	3	1	0	0	4	0	0	0.7	0.1	0	0	0	0	14	0	0	1	1	1	0	0	9.0	56	328298	6244391	60
			Benchmark	**1**	**3**	**3**	**2**	**0**	**0**	**9**	**0**	**6**	**23**	**1**	**0**	**0**	**0**		**20**	**0**											
4	1126	Medium	2	1	3	1	0	0	0	5	0.5	52.1	60	0	0	0	0	0	40	0	0	0	0	0	0	0	0.5	56	328437	6244382	180
			Benchmark	**2**	**2**	**2**	**2**	**0**	**1**	**9**	**62**	**4**	**0**	**0**	**0**	**0**	**0**		**20**	**0**											
5	920	Medium	6	1	2	1	1	0	0	5	40	4	2	0.5	0	0	0	0	54	0	1	1	1	0	0	0	6.1	56	328473	6244361	290
			Benchmark	**4**	**8**	**8**	**8**	**2**	**4**	**34**	**22**	**22**	**70**	**3**	**1**	**1**	**1**		**40**	**12**											
6	1234	Medium	1	2	1	2	1	0	0	6	30.5	0.1	3.0	###	0.0	0.0	0	0	76.0	9.0	1	1	1	1	0	1	12.1	56	328391	6244319	110

*TG=Tree; SG=Shrub; GG=Grass and grass-like; FG=forb; EG=Fern; OG=Other; HTE=High Threat Exotic

Anabat analysis

Analysis method

Bat calls were recorded during field surveys using Anabat Express Zero Crossing detectors (Titley Scientific).

The full night zero crossing analysis file (zca file) recorded using the detector was converted to zc sequence files using Anabat Insight (version 1.9.1) for analysis and in order to add metadata (e.g. species label etc). During the conversion process an 'all bats' filter was applied to identify bat sequences and remove noise files. Noise files were moved to a separate folder for later checking.

The Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats (Pennay et al. 2004) was used to assist call analysis. Call identification was also assisted by consulting distribution information for potential species (Pennay et al 2011; Churchill 2008; Van Dyck et al. 2013) and records from BioNet (December 2019). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills et al. 1996 & Duffy et al. 2000 for similar process) as summarised in Table 1. Due to the absence of reference calls from the study area, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows van Dyck et al. (2013) and Reardon et al (2014).

Confidence rating assigned to bat calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG - Species Group	Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species for e.g. *Chalinolobus gouldii /Mormopterus ozimops* sp. *Nyctophilus* sp. The calls of *Nyctophilus geoffroyi / gouldi* cannot be distinguished during the analysis process and are therefore lumped together. *Nyctophilus* sp/*Myotis macropus*. The calls of these species can be easily confused during the analysis process and are therefore often lumped together.

Summary of results and survey effort

Anabat detector surveys were completed for within the study area at 6 sites for 6 nights during the 22-25 January 2020. Approximately 1910 zc files were recorded and analysed of which approximately 13% (n=252) were identified as bat call of some description. Three species were positively (Definite) identified of the 25 or so species that are known to occur from the locality of the study area (BioNet 2019, Pennay et al, 2011; Van Dyck et al. 2013). As many as four other species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species.

One species (two Definite) listed under the Biodiversity Conservation Act 2016 (BC Act) was recorded as a result of call analysis.

Saccolaimus flaviventris – Vulnerable BC Act – One call for the night of the 22/01/2020 was definitely identified to this species. Call characteristics were typical of those described in Pennay et al (2004), being flat with characteristic frequency of 18-19 kHz. See Appendix 1 for example time/frequency graph.

Summary of bat call analysis

Species/ Species group	**Anabat - saltmarsh**	**Anabat - saltmarsh**	**Anabat - saltmarsh**	**Anabat - saltmarsh**	Anabat – **creek**	Anabat – **creek**	Anabat – creek	Anabat – creek
Date	22/01/2020	23/01/2020	24/01/2020	25/01/2020	22/01/2020	23/01/2020	24/01/2020	25/01/2020
Austronomus australis						D		
Chalinolobus gouldii	D	D	D		D	D		
Chalinolobus gouldii/ Mormopterus ozimops ridei/ Micronomus norfolkensis	SG	SG	SG		SG			
Mormopterus ozimops ridei/ Micronomus norfolkensis (v)	SG							
Nyctophilus geoffroyi/gouldi		D						
Saccolaimus flaviventris (v)	D							
Scoteanax rueppellii (v)/ Scotorepens orion/ Falsistrellus tasmaniensis (v)			SG					
Number of species	2	2	1	0	1	2	0	0
Bat call(s)	92	78	48	0	10	24		

Species/ Species group	Anabat - saltmarsh	Anabat - saltmarsh	Anabat - saltmarsh	Anabat - saltmarsh	Anabat – creek	Anabat – creek	Anabat – creek	Anabat – creek
Anabat files	267	446	773	55	35	334		

References

BioNet- NSW Government, Department of Environment and Heritage (2019) BioNet – the website for the Atlas of NSW wildlife. http://www.bionet.nsw.gov.au/

Churchill, S. (2008). Australian Bats, Allen and Unwin, Australia.

Duffy, A.M., Lumsden, L.F., Caddle, C.R., Chick, R.R. & Newell, G.R. (2000). The efficacy of Anabat ultrasonic detectors and harp traps for surveying microchiropterans in southeastern Australia, *Acta Chiropterologica* 2: 127-144.

Mills, DJ, Norton, TW, Parnaby, HE, Cunningham, RB & Nix, HA (1996). Designing surveys for microchiropteran bats in complex forest landscapes – a pilot study from south-east Australia. *Forest Ecology and Management* 85 (1-3):149-161.

Pennay, M., Law, B., and Lunney, D. (2011). Review of the Distribution and status of the bat fauna of NSW and the ACT. Pp. 226-256 in The Biology and Conservation of Australian Bats, edited by Law., B, Eby., P, and Lunney., D.

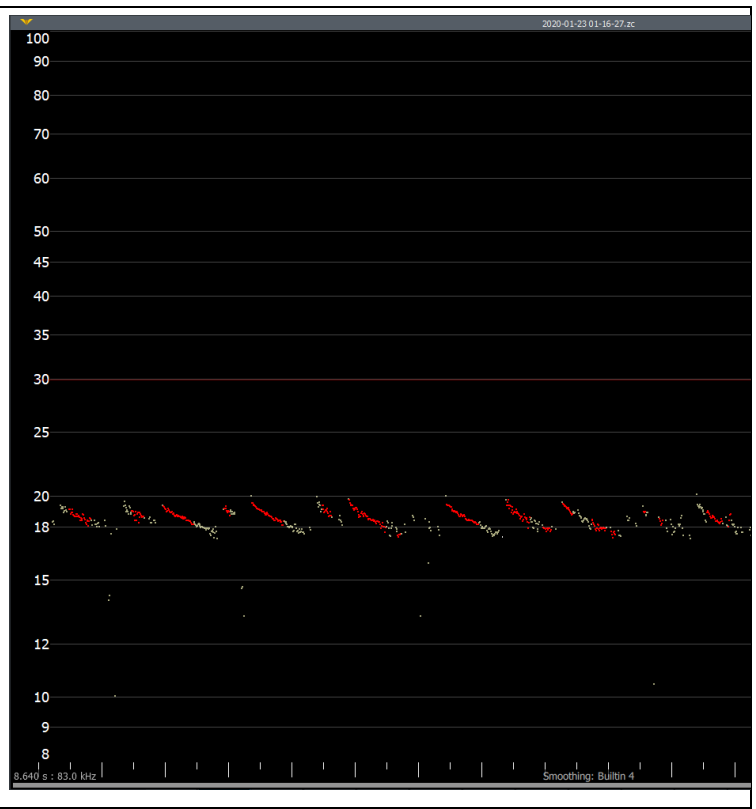
Pennay, M., Law, B., Reinhold, L. (2004). Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats, NSW Department of Environment and Climate Change, Hurstville.

Reardon, T. B., McKenzie, N. L., Cooper, S. J. B., Appleton., B., Carthew, S. and Adams, M (2014). A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats Mormopterus (Chiroptera : Molossidae). *Australian Journal of Zoology* 62: 109-136.

Van Dyke. S, Gynther. I, and Baker. A. (2013). Field Companion To The Mammals of Australia. New Holland Publishers.

Appendix 1 - Example time-frequency graphs

Figure 1. Example time-frequency graphs of files for threatened species positively identified (Definite) as a result of call analysis. Note: Log scale, displayed in compressed mode - F7.



Saccolaimus flaviventris (Definite)

Annexure B

Likelihood of occurrence of threatened and migratory biota

Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the site during the current survey
High	It is highly likely that a species inhabits the site and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10km) and is known or likely to maintain resident populations in the site. Also includes species known or likely to visit the site during regular seasonal movements or migration.
Moderate	Potential habitat is present in the site. Species unlikely to maintain sedentary populations, however may seasonally use resources within the site opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the site, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the site and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the site is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the site or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the site. Based on a field assessment of the habitat constraints or microhabitats on the subject land, the habitat is identified as being substantially degraded such that the species is unlikely to utilise the subject land (or specific vegetation zones), or an expert report that is prepared that states the species is unlikely to be present on the subject land or specific vegetation zones.

Flora habitat assessment table

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Ecosystem or species credit species?
Acacia bynoeana	Bynoe's Wattle	E	V	Species or species' habitat may occur within 10km (DEE 2019a)	Endemic to central eastern NSW, known a limited number of locations, often comprising populations of few plants. Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. Flowers September to March, and fruit matures in November.	Unlikely. No local records. Highly modified site. No suitable habitat present.	Species
Acacia prominens	Gosford Wattle, Hurstville and Kogarah Local Government Areas		EP	3 records within 10km (DPIE 2019b)	Occurs at a few sites along the railway line at Penshurst, at Carss Bush Park, Carss Park and there is an unconfirmed sighting at Oatley Park, Oatley. Grows in open situations on clayey or sandy soils. Habitats mostly cleared and occurs as isolated or small groups of trees.	Nil. Outside LGAs associated with listed occurrence.	Species
Acacia pubescens	Downy Wattle	V	V	932 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravely, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers August to October.	Unlikely. No suitable habitat present as lacks intact shale/sandstone intergrade.	Species

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Ecosystem or species credit species?
Acacia terminalis subsp. terminalis	Sunshine Wattle	E	E	34 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Occurs in near-coastal areas from northern shores of Sydney Harbour south to the northern and western shores of Botany Bay. Occurs on sandy soil on creek banks, hillslopes of in shallow soil in rock crevices and sandstone platforms on cliffs. Grows in scrub and open eucalypt woodland or forest.	Unlikely. Highly modified site. No unidentified Acacia species present.	Species
Allocasuarina glareicola		E	E	Species or species' habitat may occur within 10km (DEE 2019a)	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Nil. No suitable habitat present. No local records.	Species
Allocasuarina portuensis	Nielson Park She-oak	E	E	NA	Restricted to within Nielsen Park (part of Sydney Harbour NP) in Woollahra. Cultivars have been planted throughout Sydney Harbour NP e.g. Gap Bluff, Hermit Point and Vaucluse House. Originally found on a sandstone shelf approximately 20 m above the harbour, on shallow sandy soils in tall closed woodland. Has been planted in a variety of habitats.	Nil. Outside known range. No history of planting of this species on the site. No local records.	Species
Asterolasia elegans		E	E	Species or species' habitat may occur within 10km (DEE 2019a)	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. 7 known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	Nil. Outside known range. No local records. Does not occur within this LGA.	Species

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Ecosystem or species credit species?
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs from Central Coast NSW to southern Victoria. Mostly coastal but extends inland to Braidwood in southern NSW. In NSW grows in grassy dry sclerophyll woodland on clay loam or sandy soils, and less commonly in heathland on sandy loam soils.	Unlikely. No suitable habitat in Saltmarsh vegetation. Vegetation above the cliff line is too modified and the soil profile is too modified. No local records.	Species
Callistemon linearifolius	Netted Bottle Brush		V	2 records within 10km (DPIE 2019b)	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Unlikely. Highly modified site. No unidentified Callistemon species present.	Species
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with Large Tongue Orchid and the Bonnet Orchid. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	Unlikely. No suitable habitat in Saltmarsh vegetation. Vegetation above the cliff line is too modified and the soil profile is too modified. No local records.	Species

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Ecosystem or species credit species?
Darwinia biflora		V	V	Species or species' habitat may occur within 10km (DEE 2019a)	Known from north and north-western Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai LGAs. Grows on the edges of weathered shale-capped ridges, at the intergrade with Hawkesbury Sandstone. Occurs in woodland, open forest and scrub/heath. Associated overstorey species include Scribbly Gum, Red Bloodwood and/or Scaly Bark.	Nil. Outside known range. No local records.	Species
Deyeuxia appressa		E	E	Species or species' habitat likely to occur within 10km (DEE 2019a)	Known only from two pre-1942 records in Sydney, at Saltpan Creek and Killara. May be extinct in the wild. Thought to occur in moist conditions.	Nil. Presumed to be extinct.	Species
Doryanthes palmeri	Giant Spear Lily		V	1 record within 10km (DPIE 2019b)	Giant Spear Lily occurs in far north-east NSW and south-east Queensland. In NSW, it occurs on the coastal ranges that are part of the Mt Warning Caldera. Its southern distributional limit is Mount Billen. The species is currently known from eleven sites within NSW, five of which are conservation reserves. Most populations consist of only a few hundred individuals. Giant Spear Lily occurs on exposed rocky outcrops on infertile soils or on bare rock. It grows in a narrow band of vegetation along the cliff-tops and on steep cliff-faces or rocky ledges in montane heath next to subtropical rainforest, warm temperate rainforest or wet eucalypt forest.	Nil. Outside known range.	Species
Epacris purpurascens var. purpurascens			V	17 records within 10km (DPIE 2019b)	Occurs from Gosford in the north, Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Grows in a range of sclerophyll forest, scrubs and swamps, most of which have a strong shale soil influence.	Unlikely. Highly disturbed site. No unidentified Epacrid species present.	Species

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Ecosystem or species credit species?
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	7 records within 10km (DPIE 2019b)	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Nil. Outside known range. Commonly planted street tree.	Species
Eucalyptus scoparia	Wallangarra White Gum	V	E	3 records within 10km (DPIE 2019b)	Occurs mostly in Queensland with only three known occurrences in NSW near Tenterfield. In NSW it is found on well-drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland.	Nil. Outside known range. Commonly planted street tree.	Species
Genoplesium baueri	Yellow Gnat-orchid	E	E	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone	Nil. No local records. No suitable habitat present.	Species
Leptospermum deanei		V	V	NA	Occurs in NW Sydney, in the Hornsby, Warringah, Ku-ring-gai and Ryde LGAs. Grows in woodland on lower hill slopes or near creeks, in sandy alluvial soil or sand over sandstone. Occurs in riparian scrub , woodland and open forest.	Possible. Broadly suitable habitat present, although no local records. No unidentified Leptospermum species within the site. Not found despite targeted survey.	Species

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Ecosystem or species credit species?
Melaleuca biconvexa	Biconvex Paperbark	V	V	Species or species' habitat may occur within 10km (DEE 2019a)	Scattered, disjunct populations in coastal areas from Jervis Bay to Port Macquarie, with most populations in the Gosford-Wyong areas. Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Possible. Broadly suitable habitat present, although no local records. No unidentified Melaleuca species within the site. Not found despite targeted survey.	Species
Persicaria elatior	Knotweed	V	V	Species or species' habitat likely to occur within 10km (DEE 2019a)	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Unlikely. No local records. Highly modified site. No unidentified Persicaria species present. Not known from the vegetation types present on site.	Species
Persoonia hirsuta	Hairy Geebung	E	E	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600m above sea level.	Unlikely. No local records. Highly modified site. No unidentified Persoonia species present. Not known from the vegetation types present on site.	Species

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Ecosystem or species credit species?
Pimelea curviflora var. curviflora		V	V	Species or species' habitat may occur within 10km (DEE 2019a)	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Nil. No intact shale/lateritic soil over sandstone or shale/sandstone geology present on site.	Species
Pimelea spicata	Spiked Rice-flower	E	E	Species or species' habitat likely to occur within 10km (DEE 2019a)	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs.	Unlikely. No shale soils present in the site.	Species
Pomaderris prunifolia	P. prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas		EP	12 records within 10km (DPIE 2019b)	Known from only 3 sites within population range: at Rydalmere, within Rookwood Cemetery and at The Crest of Bankstown. At Rydalmere occurs along a road reserve near a creek, among grass species on sandstone. At Rookwood Cemetery occurs in small gully of degraded Cooks River / Castlereagh Ironbark Forest on shale soils.	Unlikely. No shale soil associated vegetation present at the site. No unidentified Pomaderris species present in the site.	Species

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Ecosystem or species credit species?
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Unlikely. No suitable habitat in Saltmarsh vegetation. Vegetation above the cliff line is too modified and the soil profile is too modified. No local records.	Species
Senecio spathulatus	Coast Groundsel		E	1 record within 10km (DPIE 2019b)	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). Grows on frontal dunes.	Unlikely. No frontal dunes present in the site.	Species
Syzygium paniculatum	Magenta Lilly Pilly	V	E	100 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Occurs in narrow coastal strip from Bulahdelah to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.	Unlikely. No suitable remnant littoral or gallery rainforest present within the site.	Species
Thelymitra sp. Kangaloon	Kangaloon Sun Orchid	CE	CE	Species or species' habitat may occur within 10km (DEE 2019a)	Only known from three locations near Robertson in the Southern Highlands. Grows in seasonally swampy sedgeland on grey silty clay loam at 600–700 m above sea level. Flowers in late October and early November.	Nil. Outside known range.	Species

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Ecosystem or species credit species?
Thesium australe	Austral Toadflax	V	V	Species or species' habitat may occur within 10km (DEE 2019a)	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass.	Nil. No local records. No suitable Themeda australis dominated habitat present.	Species
Wahlenbergia multicaulis	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield		EP	67 records within 10km (DPIE 2019b)	Found in disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. Typically occurs in damp, disturbed sites (with natural or human disturbance of various forms), typically amongst other herbs rather than in the open.	Unlikely. Not known to be found in the PCTs present on site.	Species
Wilsonia backhousei	Narrow-leafed Wilsonia		V	2 records within 10km (DPIE 2019b)	In NSW it is scattered along the coast with a northern limit of Wamberal, north of Sydney. Most extensive stands at Jervis Bay. Grows on the margins of saltmarshes and lakes.	Possible. Broadly suitable habitat within Saltmarsh and Mangrove vegetation. Not located despite targeted surveys.	Species
Zannichellia palustris		E		NA	Known from the Lower Hunter and Sydney Olympic Park. A submerged aquatic plant that grows in fresh or slightly saline water.	Possible. Broadly suitable habitat within aquatic environment of Wolli Creek. No habitat within the disturbance footprint.	Species

Fauna habitat assessment table

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Anthochaera phrygia	Regent Honeyeater	CE	CE	Species or species' habitat known to occur within 10km (DEE 2019a)	In NSW, confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	Unlikely. Negligible potential foraging habitat present. Not within an important area.	Species/ Ecosystem (mapped important areas)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Artamus cyanopterus cyanopterus	Dusky Woodswallow		V,P	2 records within 10km (DPIE 2019b)	The Dusky Woodswallow is widespread from the coast to inland. It is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse shrubs, often with coarse woody debris. The nest is an open shallow untidy cup frequently built in an open hollow, crevice or stump. Individuals may spend most of their time in about a 2 ha range and defend an area about 50 m around the nest. Dusky Woodswallows prefer larger remnants over smaller remnants	Unlikely. Negligible potential foraging habitat present. Few local records.	Ecosystem	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Botaurus poiciloptilus	Australasian Bittern	E	E	2 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly Typha spp.and *Eleocharis* spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	Possible. Suitable habitat present in saltmarsh areas. Few local records.	Ecosystem	Yes	NA
Burhinus grallarius	Bush Stone-curlew		E	6 records within 10km (DPIE 2019b)	Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory.	Unlikely. Degraded habitat present in saltmarsh and woodland areas. Few local records. Not recorded during surveys. Not recorded in Wolli Creek area in any eBird surveys.	Species	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Calidris alba	Sanderling	V	C,J,K	N/A	Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes.	Unlikely. Negligible potential foraging habitat present. Not within an important area.	Species/ Ecosystem (mapped important areas)	Yes	No
Calidris canutus	Red Knot		E,C,J,K	34 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Breeds in northern hemisphere. Occurs in coastal areas around Australia, with important sites in VIC, SA, WA, NT and Qld. Mainly inhabits intertidal mudflats, sandflats and sandy beaches. Occasionally seen in terrestrial saline wetlands but rarely in freshwater wetlands. Forage in soft substrates in intertidal areas.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.	Species/ Ecosystem (mapped important areas)	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Calidris ferruginea	Curlew Sandpiper	E	CE,C,J,K	39 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.	Species/ Ecosystem (mapped important areas)	Yes	No
Calidris tenuirostris	Great Knot	V	CE,C,J,K	6 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within area (DEE 2019a)	Breeds in northern hemisphere. In Australia, prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, mangroves, saltwork ponds, near-coastal swamps, saltlakes and non-tidal lagoons. Rarely occurs on inland lakes and swamps. Roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding areas.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.	Species/ Ecosystem (mapped important areas)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Callocephalon fimbriatum	Gang-gang Cockatoo		V	1 record within 10km (DPIE 2019b)	Restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the Southwestern Slopes, south to and contiguous with the Victorian population. Inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. The Gang-Gang Cockatoo nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. The Gang-gang Cockatoo feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles.	Unlikely. Negligible potential foraging habitat present. Few local records. No breeding habitat present.	Species/ Ecosystem (breeding)	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	4 records within 10km (DPIE 2019b)	Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of *Allocasuarina* species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts.	Unlikely. Negligible potential foraging habitat present. Few local records. No breeding habitat present.	Species/Ecosystem (breeding)	Yes	No
Charadrius leschenaultii	Greater Sand-plover	V	V,C,J,K	2 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within area (DEE 2019a)	Does not breed in Australia. In NSW, recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; forage on wet ground at low tide.	Nil. No suitable habitat present.	Species/ Ecosystem (mapped important areas)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Charadrius mongolus	Lesser Sand-plover		E,C,J,K	2 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within area (DEE 2019a)	Does not breed in Australia. Found along the entire coast of Australia, most common in northern NSW, QLD and the Gulf of Carpentaria. Rarely recorded south of the Shoalhaven. In NSW almost entirely coastal, on beaches of sheltered bays, harbours and estuaries with large intertidal sand or mudflats, occasionally on sandy beaches, coral reefs and rock platforms.	Nil. No suitable habitat present.	Species/ Ecosystem (mapped important areas)	Yes	No
Circus assimilis	Spotted Harrier	V		N/A	Most common in N and NE Australia, but recorded in all mainland states. In NSW most likely to be resident in the NE. Inhabit areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. Nests on the ground in trodden grass, and are often accessed by tunnels through vegetation.	Unlikely. No local records. Negligible amount of foraging habitat. No breeding habitat present.	Ecosystem	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Dasyornis brachypterus	Eastern Bristlebird	E	E	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Illawarra population comprises birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Nil. No suitable habitat present. Does not occur in Sydney area.	Species	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Ephippiorhynchus asiaticus	Black-necked Stork		E	1 record within 10km (DPIE 2019b)	In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north-east. Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. Breeds during summer, nesting in or near a freshwater swamp.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Epthianura albifrons	White-fronted Chat	V		1 record within 10km (DPIE 2019b)	This species occurs from southern Queensland to Western Australia and down to Tasmania, mostly in temperate to arid climates and very rarely in sub-tropical areas. It is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands. Along the coast they are found in estuarine and marshy habitats with vegetation <1m tall, and in open grasslands and areas bordering wetlands. Inland, they are often observed in grassy plains, saltlakes and saltpans along waterway margins.	Unlikely. Only known to occur at Homebush and Kurnell in the Sydney area.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Epthianura albifrons	White-fronted Chat population in the Sydney Metropolitan Catchment Management Area	EP		1 record within 10km (DPIE 2019b)	This species occurs from southern Queensland to Western Australia and down to Tasmania, mostly in temperate to arid climates and very rarely in sub-tropical areas. It is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands. Along the coast they are found in estuarine and marshy habitats with vegetation <1m tall, and in open grasslands and areas bordering wetlands. Inland, they are often observed in grassy plains, saltlakes and saltpans along waterway margins.	Unlikely. Only known to occur at Homebush and Kurnell in the Sydney area.	Species	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Esacus magnirostris	Beach Stone-curlew	CE		2 records within 10km (DPIE 2019b)	In NSW occurs regularly from the Manning River north, with occasional vagrants to South-east NSW and VIC. Inhabit a range of beaches, islands, reefs and in estuaries. Often seen near mangroves. Forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Nests in shallow scrapes above the littoral zone, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves or on sandbanks.	Nil. No suitable habitat present. Outside usual range.	Species/ Ecosystem (mapped important areas)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Glossopsitta pusilla	Little Lorikeet		V	3 records within 10km (DPIE 2019b)	Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts. Most breeding records are from the western slopes.	Unlikely. Negligible potential foraging habitat present. Few local records.	Ecosystem	Yes	NA
Grantiella picta	Painted Honeyeater	V	V	Species or species' habitat may occur within 10km (DEE 2019a)	Nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Inhabits Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests. Specialist forager on the fruits of mistletoes, preferably of the Amyema genus. Nests in outer tree canopy.	Nil. No suitable habitat present. Outside usual range.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Haematopus fuliginosus	Sooty Oystercatcher		V	5 records within 10km (DPIE 2019b)	Evenly distributed along NSW coast, including offshore islands. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide. Breeds almost exclusively on offshore islands, and occasionally on isolated promontories.	Unlikely. Preferred habitat not present. No mudflats present in site. Not recorded along Wolli Creek by DPIE (2019b) or on any eBird checklists for the area.	Species/ Ecosystem (breeding)	Yes	No
Haematopus longirostris	Pied Oystercatcher	E		297 records within 10km (DPIE 2019b)	Scattered along NSW coast. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide. Nests mostly on coastal or estuarine beaches; occasionally saltmarsh or grassy areas.	Unlikely. Preferred habitat not present. Unlikely to occur in saltmarsh areas given lack of suitable mud and sandflats. Not recorded along Wolli Creek by DPIE (2019b) or on any eBird checklists for the area.	Species	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Haliaeetus leucogaster	White-bellied Sea-Eagle	V		29 records within 10km (DPIE 2019b)	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	Possible. May forage along Wolli Creek on occasion. No nest trees present.	Species/ Ecosystem (breeding)	Yes	No
Hieraaetus morphnoides	Little Eagle		V	2 records within 10km (DPIE 2019b)	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	Unlikely. Limited potential habitat present. Few local records. No breeding habitat present.	Species/Eco system (breeding)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Hirundapus caudacutus	White-throated Needletail		V, C, J, K	5 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	Likely. Could forage on occasion above the site.	N/A	No	NA
Ixobrychus flavicollis	Black Bittern	V		2 records within 10km (DPIE 2019b)	Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	Possible. May occur in saltmarsh or surrounding vegetation. Few local records.	Ecosystem	Yes	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Lathamus discolor	Swift Parrot	CE	E	4 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	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 inland slopes and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.	Unlikely. Negligible potential foraging habitat present. Not within an important area.	Species/ Ecosystem (mapped important areas)	Yes	No
Limicola falcinellus	Broad-billed Sandpiper	V	C,J,K	2 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Breds in the northern hemisphere. In the non-breeding season most common in north and north west of Australia, but is a regular visitor in small numbers to the NSW coast from Ballina to Shoalhaven Heads. Occurs on sheltered parts of the coast, favouring estuarine mudflats but also occasionally in saltmarshes, freshwater lagoons, saltworks and sewerage farms. Forage on exposed mudflats or wet sand.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.	Species/ Ecosystem (mapped important areas)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Limosa lapponica	Bar-tailed Godwit	V	C,J,K	312 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Breeds in the north of Scandinavia, Russia and north-west Alaska. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	Nil. No suitable habitat present. Not within an important area.	Species/ Ecosystem (mapped important areas)	No	No
Limosa lapponica menzbieri	Northern Siberian Godwit		CE	Species or species' habitat may occur within 10km (DEE 2019a)	The Northern Siberian Bar-tailed Godwit is a non-breeding migrant to Australia. During the non-breeding period, the distribution is predominantly in the north and north-west of Western Australia and in south-eastern Asia. Usually forages near the edge of water or in shallow	Nil. Outside usual range. Suitable foraging habitat not present. Not within an important area.	N/A	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Limosa limosa	Black-tailed Godwit	V	C,J,K	4 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas. Not within an important area.	Species/ Ecosystem (mapped important areas)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Lophoictinia isura	Square-tailed Kite		V	3 records within 10km (DPIE 2019b)	Occurs across NSW, resident in north, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km2.	Unlikely. Preferred habitat not present. No nest trees present.	Species/ Ecosystem (breeding)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	C		1 record within 10km (DPIE 2019b)	Widespread in NSW, but rarely recorded east of Great Dividing Range except in Richmond and Clarence River areas and scattered sites in the Hunter, Central Coast and Illawarra regions. Mostly in upper levels of drier open forests /woodlands dominated by box and ironbark eucalypts, or less commonly smooth-barked gums, stringybarks and tea-treas. Forage over home range of >5 ha. Tend to occur within largest woodland patches in the landscape. They forage for insects, nectar and honeydew. The nest is hidden by foliage high in the crown of a tree.	Unlikely. Preferred habitat not present.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Neophema chrysogaster	Orange-bellied Parrot	CE	CE	Species or species' habitat may occur within 10km (DEE 2019a)	Breeds in Tasmania and migrates in winter to SE South Australia and southern Victoria. There are occasional reports from NSW, including Shellharbour, Maroubra and the Shoalhaven. In winter, usually found within 3 km of the coast in saltmarsh and strandline/ foredune vegetation. May also occur on golf-courses and other grassy areas, including improved pasture.	Unlikely. Outside usual range. Site not located within 3 km of coast.	Species	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Neophema pulchella	Turquoise Parrot	V		2 records within 10km (DPIE 2019b)	Occurs from coast to inland slopes. In coastal area, most common between Hunter and Northern Rivers, and further south in S Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat. Nests in tree hollows, logs or posts from August to December.	Unlikely. Limited habitat present. Few local records.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Ninox connivens	Barking Owl	V		N/A	Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including Eucalyptus camaldulensis, Eucalyptus albens, Eucalyptus polyanthemos and Eucalyptus blakelyi. Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	Unlikely. May forage on the site on occasion but no breeding habitat is present.	Species/ Ecosystem (breeding)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Ninox strenua	Powerful Owl	V		95 records within 10km (DPIE 2019b)	Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. 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. 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.	Likely. May forage on the site. No breeding habitat present.	Species/ Ecosystem (breeding)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Numenius madagascariensis	Eastern Curlew		CE,C,J,K	179 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Within Australia, the species has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Breeds in Russia and north-eastern China. Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas. Not within an important area.	Species/ Ecosystem (mapped important areas)	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Onychoprion fuscata	Sooty Tern	V		1 record within 10km (DPIE 2019b)	Occurs over tropical and subtropical seas and islands around northern NSW. Occasionally seen along coastal NSW, especially after cyclones. Breeds in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	Nil. No suitable habitat present.	Species	No	No
Pachyptila turtur subantarctica	Fairy Prion		V	Species or species' habitat known to occur within 10km (DEE 2019a)	The fairy prion (southern) breeds on Macquarie Island and a number of other subantarctic islands outside of Australia. The subspecies digs burrows among rocks or low vegetation in which to nest. Burrows may be dug below mat forming herbs. Fairy Prion feed by plucking food from the ocean surface. Some individuals may migrate towards New Zealand and southern Australia in winter.	Nil. No suitable habitat present.	N/A	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Pandion cristatus	Eastern Osprey	V		6 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea, though there are a handful of records from inland areas.	Unlikely. No suitable habitat present. No breeding habitat present.	Species/Ecosystem (breeding)	Yes	No
Petroica boodang	Scarlet Robin		V	3 records within 10km (DPIE 2019b)	In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.	Possible. Could occur at the site outside the breeding season.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Petroica phoenicea	Flame Robin		V	1 record within 10km (DPIE 2019b)	Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.	Unlikely. May occur on occasion during winter. Few local records.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Ptilinopus superbus	Superb Fruit-Dove		V	4 records within 10km (DPIE 2019b)	Occurs mainly north from NE NSW, much less common further south and largely confined to pockets of habitat south to Moruya. Vagrants occur south to VIC and TAS. Inhabits rainforest and closed forests, may also forage in eucalypt or acacia woodland with fruit-bearing trees. Nests 5-30 m above ground in rainforest/rainforest edge tree and shrub species. Part of the population migratory/nomadic.	Unlikely. Preferred habitat not present.	Ecosystem	No	NA
Rostratula australis	Australian Painted Snipe	E	E	1 record within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Unlikely. Preferred habitat not present. May occur on occasions in saltmarsh area.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Stagonopleura guttata	Diamond Firetail		V	3 records within 10km (DPIE 2019b)	Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in shrubby understorey or higher up under nests of other species.	Unlikely. Preferred habitat not present.	Ecosystem	No	NA
Sternula albifrons	Little Tern	E	E, C,J,K	758 records within 10km (DPIE 2019b)	In NSW occurs mainly north of Sydney, with smaller numbers south to VIC. Almost exclusively coastal, preferring sheltered environments; may occur several kilometres from the sea in harbours, inlets and rivers. Nests in low dunes or sandy beaches just above high tide mark near estuary mouths/ adjacent to coastal lakes and islands. Forage in shallow waters of estuaries, coastal lagoons and lakes, also along open coasts, less often at sea, and usually within 50 m of shore.	Nil. No suitable habitat present.	Species/Ecosystem (breeding)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Sternula nereis	Australian Fairy Tern		V	Species or species' habitat known to occur within 10km (DEE 2019a)	Occurs along NSW coast. Inhabit offshore, estuarine or lake islands, wetlands, beaches and spits. Nests on coral shingle on continental islands or coral cays, on sandy islands and beaches inside estuaries and on open sandy beaches.	Nil. No suitable habitat present.	N/A	No	NA
Stictonetta naevosa	Freckled Duck		V	1 record within 10km (DPIE 2019b)	Breeds in large, ephemeral swamps in the Murray-Darling, particularly along the Paroo and Lachlan Rivers and other Riverina rivers. In drier times moves to more permanent waters. Disperses during extensive inland droughts and may be found in coastal areas during such times. Prefers freshwater swamps/creeks with dense Cumbungi, Lignum or tea-tree. Nests in dense vegetation at or near water level.	Nil. No suitable habitat present.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Thinornis rubricollis	Hooded Plover	CE	V	Species or species' habitat likely to occur within 10km (DEE 2019a)	The Hooded Plover is endemic to southern Australia and is nowadays found mainly along the coast from south of Jervis Bay. It has not been seen in the Sydney area since the 1940s. Occasionally, individual birds are sighted slightly further north to the Shoalhaven River and Comerong Beach and one bird was sighted at Lake Illawarra in March 2001. Hooded Plovers prefer sandy ocean beaches backed by sparsely vegetated sand-dunes for shelter and nesting. Hooded Plovers display high nest site fidelity and nest solitarily. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas, however has not been recorded in Sydney for many years.	Species/ Ecosystem (mapped important areas)	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Tyto novaehollandiae	Masked Owl		V	2 records within 10km (DPIE 2019b)	Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.	Possible. May forage on occasion at the site. No breeding habitat present.	Species/Eco system (breeding)	Yes	No
Xenus cinereus	Terek Sandpiper	V	C,J,K	6 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	The two main sites for this species in NSW are the Richmond River and Hunter River estuaries. Inhabits coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks near mangroves, also observed on rocky pools and reefs and up to 10 km inland around brackish pools. Roost communally in mangroves or dead trees. Forages in open intertidal mudflats.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas. Not within an important area.	Species/ Ecosystem (mapped important areas)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Daphoenositta	Varied Sittella	V		N/A	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. 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.	Unlilkely. High prevalence of Noisy Miners in an urban area.	Ecosystem	Yes	NA
Epinephelus daemelii	Black Rockcod		V	Species or species' habitat likely to occur within 10km (DEE 2019a)	Found in warm temperate/sub-tropical parts of south-western Pacific. Naturally occur along NSW Coastincl. Lord Howe Island. Adults generally found on rocky reefs. Juveniles found in coastal rock pools and around rocky shores in estuaries.	Nil. No suitable habitat present.	NA	NA	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Macquaria australasica	Macquarie Perch	V	E	Species or species' habitat may occur within 10km (DEE 2019a)	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas.Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	Nil. No suitable habitat present.	NA	NA	NA
Prototroctes maraena	Australian Grayling		V	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea.	Nil. No suitable habitat present.	NA	NA	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Heleioporus australiacus	Giant Burrowing Frog	V	V	Species or species' habitat may occur within 10km (DEE 2019a)	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	Nil. No suitable habitat present.	Species	No	No
Litoria aurea	Green and Golden Bell Frog	E	V	236 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (Typha spp.) or spike rushes (Eleocharis spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. Gambusia holbrooki is a key threat as they feed on Green and Golden Bell Frog eggs and tadpoles.	Possible. No records known from Wolli Creek, however appropriate habiat is present in the saltmarsh. No evidence during surveys in appropriate conditions.	Species	Yes	Yes

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Litoria raniformis	Growling Grass Frog	E	V	Species or species' habitat may occur within 10km (DEE 2019a)	Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral swamps and billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat.	Nil. No suitable habitat present. Outside known range.	Species	No	No
Mixophyes balbus	Stuttering Frog	E	V	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs along the east coast of Australia. Has undergone a massive range reduction particularly in the south of its range. Inhabits rainforest and wet, tall, open forest. Shelter in deep leaf litter and thick understorey vegetation on the forest floor. Feeds on insects and smaller frogs, breeding in streams during summer after heavy rain. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts.	Nil. No suitable habitat present. Outside known range.	Species	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Pseudophryne australis	Red-crowned Toadlet	V		N/A	Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	Unlikely. No ephemeral feeder creeks or rocky drainage lines present. No local records. Site polluted and impacted by suburban runoff.	Species	Yes	No
Pommerhelix duralensis	Dural Land Snail	E	E	Species or species' habitat likely to occur within 10km (DEE 2019a)	This species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringes of the Cumberland Plain on shale-sandstone transitional landscapes. The majority of confirmed records for the species occur within The Hills Shire Local Government Area. The species is also found within the Local Government Areas of Blue Mountains City, Penrith City, Hornsby Shire and Parramatta City	Nil. No suitable habitat present. Outside known range.	Species	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Petalura gigantea	Giant Dragonfly	E		1 record within 10km (DPIE 2019b)	The Giant Dragonfly is found along the east coast of NSW from the Victorian border to northern NSW. There are known occurrences in the Blue Mountains and Southern Highlands. They live in permanent swamps and bogs with some free water and open vegetation.	Nil. No suitable habitat present. Outside known range.	Species	No	No
Arctocephalus pusillus doriferus	Australian Fur-seal		V	2 records within 10km (DPIE 2019b)	Reported from New South Wales to South Australia. Breeds at ten known locations in Bass Strait, may have historically bred at Seal Rocks. Haul out sites are present along the NSW coast, notably Montague Island, Steamers Beach and Green Cape. Uses flat or sloping rocky sites for breeding and haul out sites. Preys on squid, school fish and bottom-dwelling fish, octopus and crustaceans.	Nil. No suitable habitat present.	NA	NA	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Cercartetus nanus	Eastern Pygmy-possum		V	2 records within 10km (DPIE 2019b)	Occurs along the east coast of NSW. Inhabits range of habitats from coastal heath and woodland though open and closed forests, subalpine heath and rainforest. Inhabits rainforest, sclerophyll forests and heath. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting subject sites in drier habitats. Nests in hollows in trees, under the bark of Eucalypts, forks of tea-trees, abandoned bird nests and Xanthorrhoea bases.	Nil. No suitable habitat present.	Species	Yes	No
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	1 record within 10km (DPIE 2019b)	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley. Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds. In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	Nil. No suitable habitat present.	Species	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Eubalaena australis	Southern Right Whale	E	E	1 record within 10km (DPIE 2019b)	Southern Right Whales are seasonally present on the Australian coast between about May and November. The major calving grounds are located in near-shore waters off the southern coasts of Australia and South Africa, and the Argentine coast of South America.	Nil. No suitable habitat present.	NA	NA	NA
	Little Pengiun in the Manly Point Area	EP		N/A	This endangered population occurs from just north of Smedley's Point to Cannae Point, North Sydney Harbour, Manly. Only known breeding population on the mainland in NSW.	Nil. Outside known distribution	Species	Yes	No
Miniopterus australis	Little Bent-winged Bat	V		1 record within 10km (DPIE 2019b)	Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats.	Possible. May forage on occasion at the site. No breeding habitat present.	Species/Eco system (breeding)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Miniopterus orianae oceanensis	Large Bent-winged Bat	V		56 records within 10km (DPIE 2019b)	Generally occurs east of the Great Dividing Range along NSW coast. 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.	Likely. May forage on occasion at the site. No breeding habitat present.	Species/Ecosystem (breeding)	Yes	No
Mormopterus norfolkensis	Eastern Coastal Free-tailed Bat		V	10 records within 10km (DPIE 2019b)	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark.	Possible. May forage on occasion at the site. Potential roost habitat present.	Ecosystem	Yes	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Myotis macropus	Southern Myotis	V		20 records within 10km (DPIE 2019b)	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.	Possible. Foraging habitat present along Wolli Creek. Potential roost habitat present.	Species	Yes	Yes
Perameles nasuta	Long-nosed Bandicoot population in inner western Sydney	EP		25 records within 10km (DPIE 2019b)	Occurs within Marrickville and Canada Bay LGAs, and may also occur in the Canterbury, Ashfield and Leichhardt LGAs. Shelter mostly under older houses and buildings, and forage in parkland and backyards.	Nil. Outside known range. No records known from Wolli Creek.	Species	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Phascolarctos cinereus	Koala	V	V	9 records within 10km (DPIE 2019b)	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.	Nil. No suitable habitat present.	Species/ Ecosystem (important habitat)	Yes	No
Phascolarctos cinereus	Koala in the Pittwater Local Government Area	EP	V	N/A	Recent records occur around the Barrenjoey Peninsula. In Pittwater Eucalyptus punctata is the most important food tree, with other favoured trees including E. haemastoma, E. robusta, E. racemosa.	Nil. Outside the LGA the population is known to occur in.	Species	Yes	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	2587 records within 10km (DPIE 2019b)	Roosts in camps within 20 km 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 and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	Known camp is located 700m to the west of the site. Individuals from this camp would forage in trees on site on occasion when in fruit or flower.	Species/ Ecosystem (breeding)	Yes	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		1 record within 10km (DPIE 2019b)	Migrates from tropics to SE Aus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings.	Present. Would forage on occasion at the site. Potential roost habitat present.	Ecosystem	No	No
Scoteanax rueppellii	Greater Broad-nosed Bat		V	1 record within 10km (DPIE 2019b)	Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable hollow trees.	Possible. May forage on occasion at the site. Potential roost habitat present.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Dasyurus maculatus	Spot-tailed Quoll	E	E	Species or species' habitat likely to occur within 10km (DEE 2019a)	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are 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, usually traversed along densely vegetated creek lines.	Unlikely. No records known from Wolli Creek.	Ecosystem	Yes	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs mainly in 2 areas: Ku-ring-gai Chase and Garigal National Parks N of Sydney, and far SE NSW including Ben Boyd National Park, East Boyd State Forest, Nadgee Nature Reserve, Nadgee State Forest, South East Forest and Yambulla State Forest but also occurs between these areas. Inhabits scrubby vegetation, including heath, shrubland, and heathy forest and woodland. Often associated with well-drained soils and dry heathland communities, and prefers periodically burnt areas as this increases insect abundance.	Nil. No suitable habitat present.	Ecosystem	No	No
Petauroides volans	Greater Glider		V	Species or species' habitat may occur within 10km (DEE 2019a)	The Greater Glider is restricted to eastern Australia, occurring from north Queensland through to central Victoria, with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Nil. No suitable habitat present.	N/A	No	No

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Species or species' habitat may occur within 10km (DEE 2019a)	Occurs from the Shoalhaven north to the Queensland border. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Nil. No suitable habitat present.	Species	No	No
Pseudomys novaehollandiae	New Holland Mouse		V	Species or species' habitat likely to occur within 10km (DEE 2019a)	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes. Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath.	Nil. No suitable habitat present.	Ecosystem	No	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Caretta caretta	Loggerhead Turtle	E	E	1 record within 10km (DPIE 2019b)	In Australia, the Loggerhead Turtle occurs in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia. Nesting populations are known from southern Queensland and Western Australia. Loggerhead Turtles are carnivorous, feeding primarily on benthic invertebrates in habitat ranging from nearshore to 55 m.	Nil. No suitable habitat present.	NA	NA	NA
Chelonia mydas	Green Turtle	V	V	1 record within 10km (DPIE 2019b)	Usually found in tropical and sub-tropical waters, but also occurs off the NSW coast, usually on the north and central coast with occasional records from the south. Key nesting areas occur in Queensland, Northern Territory and Western Australian waters but there are scattered records of nesting along the NSW coast. Eggs are laid in nests dug in beaches.	Nil. No suitable habitat present.	NA	NA	NA

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence	Credit type	Predicted by the BAM calculator?	Targeted 'speces credit' threatened fauna?
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Species or species' habitat likely to occur within 10km (DEE 2019a)	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Nil. No suitable habitat present.	Species/ Ecosystem	No	No
Varanus rosenbergi	Rosenberg's Goanna	V		1 record within 10km (DPIE 2019b)	In NSW mainly occurs on the mid coast region from Wollemi NP to Nowra; the ACT and Goulburn regions and the South-west Slopes. Inhabits coastal heathlands, wet and dry sclerophyll forests, woodlands and mallee communities. Termite mounds are an important habitat feature: eggs are laid in the mounds in summer and incubate till spring, when the young dig themselves out. Young may return to the mound as a refuge for some months, while adults shelter in burrows dug under rocks or logs, or in rock crevices, hollow logs or even rabbit burrows.	Nil. No suitable habitat present.	Ecosystem	No	No

Key. CE – critically endangered, E – endangered, V – vulnerable, M – migratory.

Migratory fauna habitat assessment table

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Apus pacificus	Fork-tailed Swift		C,J,K	1 record within 10km (DPIE 2019b)	Recorded in all regions of NSW. Non-breeding, and almost exclusively aerial while in Australia. Occurs over urban and rural areas as well as areas of native vegetation.	Unlikely. May forage on occasion above the site.
Ardenna grisea	Sooty Shearwater		C,J	4 records within 10km (DPIE 2019b)	The Sooty Shearwater breeds on islands off NSW and Tasmania. It forages in pelagic (open ocean) sub-tropical, sub-Antarctic and Antarctic waters.	Nil. No suitable habitat present.
Ardenna tenuirostris	Short-tailed Shearwater		J,K	14 records within 10km (DPIE 2019b)	This species breeds on Tasmania and off the coast of south Australia, with the bulk of the population in the south-east. Breeding occurs mainly on coastal islands, typically in areas of grassland or other vegetation, but sometimes cliffs or bare ground.	Nil. No suitable habitat present.
Hydroprogne caspia	Caspian Tern		C,J	75 records within 10km (DPIE 2019b)	Found in coastal and inland areas. In NSW, widespread east of the divide, mainly in coastal regions as well as the Riverina and Western regions, with occasional records elsewhere. Breeding has been recorded in the Menindee Lakes. Mostly found in sheltered coastal embayments, preferring areas with sandy or muddy margins. Usually forages in open wetlands, including lakes and rivers.	Possible. May forage on occasion along Wolli Creek.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Phaethon lepturus	White-tailed Tropicbird		C,J	1 record within 10km (DPIE 2019b)	In Australia, the Hwite-tailed Tropicbird breeds in the Cocos-Keeling Islands, Ashmore reef and Rowley Shoals off the northern coast of WA. In Australia, the White-tailed Tropicbird (Indian Ocean) nests in Pisonia trees amongst Pisonia-coconut vegetation, and on sandy ground.	Nil. No suitable habitat present.
Stercorarius parasiticus	Arctic Jaeger		C,J,K	1 record within 10km (DPIE 2019b)	Non-breeding migrant to Australia. This marine species is predominately coastal, but will migrate over land. Most or all of its food is obtained by kleptoparasitism when nesting near other seabird colonies. Otherwise, its diet can include microtine rodents, adult and fledgling passerines, wader chicks, birds eggs, insects and berries.	Nil. No suitable habitat present.
Sterna hirundo	Common Tern		C,J,K	23 records within 10km (DPIE 2019b)	Non-breeding migrant to Australia. Widespread and common along the east coast from SE Qld to Victoria,though less often recorded south of Port Hacking. Utilise marine, pelagic and coastal habitats, but are commonly observed in near-coastal waters, on ocean beaches, platforms and headlands and in sheltered waters (bays, harbours and estuaries). Forage in marine environmetns and near-coastal terrestrial wetlands. Roost on beaches, rock platforms, islands and banks of estuaries and lagoons.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Actitis hypoleucos	Common Sandpiper		C,J,K	5 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.	Unlikely. Could occur on rare occasions in saltmarsh areas. Few local records.
Arenaria interpres	Ruddy Turnstone		C,J,K	6 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Breeds in northern Hemisphere. In non-breeding season, widespread in most coastal regions of Australia with occasional inland records. Strongly prefers rocky shores or beaches with large seaweed deposits.	Nil. No suitable habitat present.
Calidris acuminata	Sharp-tailed Sandpiper		C,J,K	45 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Breeds in northern Siberia.	Unlikely. Could occur on rare occasions in saltmarsh areas.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Calidris alba	Sanderling	V	C,J,K	6 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	anderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes.	Nil. No suitable habitat present.
Calidris melanotos	Pectoral Sandpiper		J,K	Species or species' habitat known to occur within 10km (DEE 2019a)	Widespread but scattered records across NSW, east of the divide and in the Riverina and Lower Western regions. Breeds in the northern hemisphere. In Australasia, prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually in coastal or near-coastal habitats, and prefers wetlands with open mudflats and low emergent or fringing vegetation such as grass or samphire.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Calidris ruficollis	Red-necked Stint		C,J,K	72 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	"Distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. Breeds in Siberia and sporadically in north and west Alaska. In Australasia, mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals.	Nil. No suitable habitat present.
Calidris subminuta	Long-toed Stint		C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Widely scattered records around coastal NSW. They prefer shallow freshwater or brackish wetlands including lakes, swamps, river floodplains, streams, lagoons and sewage ponds. The species is also fond of areas of muddy shoreline, growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. They roost or loaf in sparse vegetation at the edges of wetlands and on damp mud near shallow water and forage on wet mud or in shallow water.	Unlikely. Could occur on rare occasions in saltmarsh areas.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Charadrius bicinctus	Double-banded Plover		C,J,K	39 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	"Found in both coastal and inland areas. During the non-breeding season, it is common in eastern and southern Australia. Breeds only in New Zealand. Found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.
Charadrius veredus	Oriental Plover		C,J,K	2 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	The Oriental Plover is a non-breeding visitor to Australia, where the species occurs in both coastal and inland areas, mostly in northern Australia. Most records are along the north-western coast, between Exmouth Gulf and Derby in Western Australia. Oriental Plovers spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland. Oriental Plovers usually forage among short grass or on hard stony bare ground (McCrie 1984), but also on mudflats or among beachcast seaweed on beaches.	Unlikely. Outside usual range. Could occur on rare occasions in saltmarsh areas.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Cuculus optatus	Oriental Cuckoo		C	Species or species' habitat may occur within 10km (DEE 2019a)	This species migrates to northern and eastern Australia in the warmer months. Occurs south to the Shoalhaven area. Occurs in a range of habitats, including monsoon forest, rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves.	Unlikely. Limited suitable habitat present. No local records.
Gallinago hardwickii	Latham's Snipe		C,J,K	10 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabit permanent and ephemeral wetlands up to 2000 m asl. Typically in open, freshwater wetlands with low, dense vegetation (incl. swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.
Gallinago megala	Swinhoe's Snipe		C,J,K	Foraging, feeding or related behaviour likely to occur within 10km (DEE 2019a)	"Swinhoe's Snipe is recorded in north Australia, particularly the Kimberley region, from October–April. It is a non-breeding migrant to Australia and occurs at the edges of wetlands, such as wet paddy fields, swamps and freshwater streams. The species is also known to occur in grasslands, drier cultivated areas (including crops of rapeseed and wheat) and market gardens (Higgins & Davies 1996).	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Gallinago stenura	Pin-tailed Snipe		C,J,K	Foraging, feeding or related behaviour likely to occur within 10km (DEE 2019a)	The species distribution within Australia is not well understood. There are confirmed records from NSW, south-west Western Australia, Pilbara and the Top End. In NSW a single banded bird was reported near West Wyalong. During non-breeding period the Pin-tailed Snipe occurs most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. The species is also found in drier, more open wetlands such as claypans in more arid parts of species' range. It is also commonly seen at sewage ponds; not normally in saline or inter-tidal wetlands.	Nil. No suitable habitat present. Outside usual range.
Monarcha melanopsis	Black-faced Monarch		M	27 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	"Found along the coast of eastern Australia, becoming less common further south. Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter.	Likely. Could occur at site on occasion. May breed along Wolli Creek.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Motacilla flava	Yellow Wagtail		C,J,K	Species or species' habitat known to occur within 10km (DEE 2019a)	This species breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.
Myiagra cyanoleuca	Satin Flycatcher		M	1 record within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally not in rainforests.	Likely. Could forage or breed at the site.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Numenius minutus	Little Curlew		C,J,K	Foraging, feeding or related behaviour likely to occur within 10km (DEE 2019a)	Generally spend the non-breeding season in northern Australia. In NSW, most records are from Casino south to Greenwell Point, with a few scattered records west of the Great Dividing Range. Most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.
Numenius phaeopus	Whimbrel		C,J,K	90 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	A regular migrant to Australia and New Zealand, with a primarily coastal distribution. There are also scattered inland records in all regions. It is found in all states but is more common in the north. It is found along almost the entire coast of Queensland and NSW. Breeds in north and west Alaska, Eurasia and Iceland. Often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Philomachus pugnax	Ruff		C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	In NSW the species has been recorded at Kurnell, Tomki, Casino, Ballina, Kooragang Island, Broadwater Lagoon and Little Cattai Creek. The species has also found around the Riverina. Most NSW records come from the Sydney region. In Australia the Ruff is found on generally fresh, brackish of saline wetlands with exposed mudflats at the edges. It is found in terrestrial wetlands including lakes, swamps, pools, lagoons, tidal rivers, swampy fields and floodlands. They are occasionally seen on sheltered coasts, in harbours, estuaries, seashores and are known to visit sewage farms and saltworks. They are sometimes found on wetlands surrounded by dense vegetation including grass, sedges, saltmarsh and reeds.	Unlikely. Could occur on rare occasions in saltmarsh areas.
Pluvialis fulva	Pacific Golden Plover		C,J,K	38 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Breeds in the northern hemisphere. In Australia occurs mainly in coastal areas but also recorded inland. Important sites in NSW include the Hunter and Shoalhaven River estuaries. Usually occur on beaches, mudflats and sandflats in sheltered areas.	Nil. No suitable habitat present.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Pluvialis squatarola	Grey Plover		C,J,K	5 records within 10km (DPIE 2019b) Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Breed in the northern Hemisphere. Widespread on Australian coasta in the non-breeding season. Occur almost entirely in coastal areas, usually in sheltered embayments with mud or sandflats and occasionally on rocky coasts or near-coastal lakes and swamps. Very occasionally recorded further inland. Forage on exposed mudflats and beaches.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.
Rhipidura rufifrons	Rufous Fantail		M	24 records within 10km (DPIE 2019b); Species or species' habitat known to occur within 10km (DEE 2019a)	Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas (Birds Australia 2008).	Likely. Could forage or breed at the site.
Symposiachrus trivirgatus	Spectacled Monarch		M	Species or species' habitat may occur within 10km (DEE 2019a)	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. Prefers thick understorey in rainforest, wet gullies and waterside vegetation as well as mangroves.	Possible. Could forage or breed at the site. No local records.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Tringa brevipes	Grey-tailed Tattler		C,J,K	53 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Non-breeding visitor to Australia. In NSW occurs along the coast from the Queensland border south to Tilba Lake, and has been recorded as far south as Gippsland.In NSW it is recorded more frequently north of Sydney. Found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. Inland records are rare. Forages in shallow water in intertidal areas. Usually roosts in the branches of mangroves or rocks which may be partly submerged. Also rarely recorded in dense shrubs, on driftwood or sand dunes.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.
Tringa incana	Wandering Tattler		J	Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Breeds in N Hemisphere. Generally found on rocky coasts, occasionally on coral reefs or beaches, and tends to avoid mudflats. Forages among rocks or shingle or in shallow pools, mainly along the tideline. Roost and perch on top of boulders surrounded by or close to water.	Nil. No suitable habitat present.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Tringa nebularia	Common Greenshank		C,J,K	Species or species' habitat known to occur within 10km (DEE 2019a)	Does not breed in Australia, but occurs in all types of wetlands. In NSW has been recorded in most coastal regions and is widespread west of the Great Dividing Range, particularly in the north-west, Macquarie Marshes and areas between the Lachlan and Murray Rivers and Darling River drainage basin. The Hunter River estuary is an internationally important site for the species. In coastal areas typically occurs in sheltered habitats with large mudflats and saltmarsh,mangroves or seagrass.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.
Tringa stagnatilis	Marsh Sandpiper		C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	Breeds in N Hemisphere. Occurs in coastal and inland wetlands, including freshwater and estuarine habitats, throughout Australia. All regions of NSW but particularly central and south coasts and western slopes and plains. Sites of national importance in NSW include Parkes wetlands, Macquarie Marshes and Tullakool Evaporation Ponds.	Unlikely. Could occur on rare occasions in saltmarsh areas.

Scientific name	Common name	BC Act	EPBC Act	Source	Habitat description	Likelihood of occurrence
Sternula albifrons	Little Tern	E	E, C,J,K	758 records within 10km (DPIE 2019b)	In NSW occurs mainly north of Sydney, with smaller numbers south to VIC. Almost exclusively coastal, preferring sheltered environments; may occur several kilometres from the sea in harbours, inlets and rivers . Nests in low dunes or sandy beaches just above high tide mark near estuary mouths/ adjacent to coastal lakes and islands. Forage in shallow waters of estuaries, coastal lagoons and lakes, also along open coasts, less often at sea, and usually within 50 m of shore.	Nil. No suitable habitat present.
Xenus cinereus	Terek Sandpiper	V	C,J,K	6 records within 10km (DPIE 2019b); Foraging, feeding or related behaviour known to occur within 10km (DEE 2019a)	The two main sites for this species in NSW are the Richmond River and Hunter River estuaries. Inhabits coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks near mangroves, also observed on rocky pools and reefs and up to 10 km inland around brackish pools. Roost communally in mangroves or dead trees. Forages in open intertidal mudflats.	Unlikely. Preferred habitat not present. Could occur on rare occasions in saltmarsh areas.

Annexure C

Field data sheets

Plot ID 1

BAM Plant Species Richness Plot Survey data sheet

Project no.	21/28196	Field Staff	KSC + MW	Signature	CQl	Date	8/10/19
Proposal Name	Jackson Place.	Vegetation Zone ID	-9- 6	PCT / BVT	1234 /	Condition	M/G.

Sample	ID'd	Stratum	Species	Cover	Sample	ID'd	Stratum	Species	Cover
		O	Casuarina glauca	30					
		G	Tetragonia tetragonoides.	25					
		G-M	Phragmites australis	2					
		G	Asparagus aethiopicus	5					
		M	Senna pendula var glabrata.	1					
		G	Bromus cathorticus	2					
		G	Ehrharta erecta	5					
		G	Anredera cordifolia	0.2					
		G	Microlaena stipoides.	1					
		M	Ochna serrulata.	0.1					
		G	Conyza bonariensis	0.1					
		G	Asparagus asparagoides.	0.5					
		M	Acacia longifolia.	0.1					
		M	Lantana camara	0.2					
		G	Solanum nigrum	0.1					
		G	Senecio madagascariensis	0.1					
		G	Sonchus oleraceus.	0.1					
		M	Avicennia marina.	0.5					

Stratum in which each species occurs: E – emergent, o – overstorey; M – midstorey; G – groundcover.

Cover 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Plot ID 2

BAM Plant Species Richness Plot Survey data sheet

Project no.	21/28196	Field Staff	KSC + MW	Signature	CQ.	Date	8/10/19.
Proposal Name	Jackson Place.	Vegetation Zone ID	5-	PCT / BVT	1126 /	Condition	M/G

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Sample	ID'd	Stratum	Species	Cover	Sample	ID'd	Stratum	Species	Cover
		G	Suaeda australis	50					
		G-M	Phragmites australis	60					
		G	Juncus acutus.	0.5					
		G-M	Avicennia marina.	0.5					
		G	Atriplex sp.	0.1					
		G	Sarcocornia quinqueflora	2-					

Stratum in which each species occurs: E – emergent, o – overstorey; M – midstorey; G – groundcover.

Cover 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Plot ID 3

BAM Plant Species Richness Plot Survey data sheet

Project no.	21/28196	Field Staff	MW + KSC	Signature	cel.	Date	8/10/19.
Proposal Name	Jackson Place.	Vegetation Zone ID	~~8~~ 3	PCT / BVT	1778 /	Condition	Low

Sample	ID'd	Stratum	Species	Cover
		G	Bromus catharticus	75
		G	Vicia sativa	0.5
Parietaria judaica →		G	Asthma weed	5
		G	Trifolium repens.	0.5
		G	Commelina cyanea	0.1
		G	Malva parifolia.	0.5
Asphodelus tenuifolius →		G	Onion weed	0.1
		G	Anagallis arvensis	0.1
		G	Hypochaeris radicata	0.1
		G	Deleria odorata.	2
		G	Sanchus oleraceus.	0.5
		G	Ehrharta erecta.	1
		G	Microlaena stipoides	0.5
		G	Tradescantia fluminensis.	0.2
		G	Solanum nigrum	0.1
		G	Asparagus aethiopicus	0.1
		G	Araujia sericifera	0.1
		G	Acetosa Sagittata	0.5
		G	Plantago lanceolata.	0.2
seedling		G-M	~~Mulberry~~ Morus sp.	5
		G	Cynodon dactylon	0.1

Sample	ID'd	Stratum	Species	Cover
ciclospermum leptophyllum →		G	Slender celery	0.1
		G	Bidens pilosa	0.1
		M	Cestrum parqui	0.2
		M	Lantana camara.	~~2~~ 5
		G	Briza minor	0.2
		G	Cauyza bonariensis	0.2
			Microlaena stipoides.	duplicate
		G	Lomandra longifolia	0.1
		G	Sida rhombifolia	0.2
		G	Lolium perenne.	0.2
		G	Bromus diandrus	0.5
		G	Trifolium sp.	0.1
		G	Ageratina adenophora	0.2
		G	Trifolium campestre	1
		G	Medicago sp.	0.5
		G	Petrorhagia dubia	0.1
		G	Cerastium glomeratum	0.2
		G	Cymbalaria muralis	0.1
		G	Oxalis pes-caprae	0.1

Stratum in which each species occurs: E – emergent, o – overstorey; M – midstorey; G – groundcover.

Cover 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Plot ID 4

BAM Plant Species Richness Plot Survey data sheet

Project no.	21 / 28196	Field Staff	KSC + MW	Signature	Lee	Date	8/10/19.
Proposal Name	Jackson Place	Vegetation Zone ID	1	PCT / BVT	1778 /	Condition	

Sample	ID'd	Stratum	Species	Cover	Sample	ID'd	Stratum	Species	Cover
			Angophora costata	10				Melaleuca linearifolia	0.1
			Lantana camara	60				Dianella caerulea	0.1
			Eucalyptus botryoides	20				Ligustrum sinense	0.1
			Ageratina adenophora.	20				Oplismenus aemulus	0.1
			Pittosporum undulatum	5					
parietaria judaica →			Asthma weed	10					
Erythrina crista-galli →			Coral tree	5					
			~~Mulberry~~ Morus alba	10					
			Delaria odorata	20					
			Sonchus deraceus	0.1					
			Elvhorta erecta.	0.5					
			Cardiospermum grandiflorum	0.2					
			Tradescantia fluminensis	5					
			Anredera cordifolia	5					
			Glochidion ferdinandi	0.5					
			Banksia integrifolia	0.5					
Melia azedarach →			White cedar	1					
			Celtis sinensis	2					
			Asparagus aethiopicus	2					
			Breynia oblongifolia	0.1					
			Ligustrum lucidum	0.5					

Stratum in which each species occurs: E – emergent, o – overstorey; M – midstorey; G – groundcover.

Cover 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Plot ID S

Page ..... of .....

BAM Plant Species Richness Plot Survey data sheet

Project no.	21/28196	Field Staff	~~KC~~ + MW	Signature		Date	8/10/19
Proposal Name	Jackson Place	Vegetation Zone ID	-7- 2	PCT / BVT	1778 /	Condition	

Sample	ID'd	Stratum	Species	Cover	Sample	ID'd	Stratum	Species	Cover
			Lantana camara	60					
			Cardiospermum grandiflorum	60					
			Delaria odorata	20					
			Ligustrum sinense	0.5					
			Ageophara costata	1					
			Cestrum parqui	2					
			Asparagus asparagoides	0.5					
			Tradescantia fluminensis	5					
			Arundo donax	0.5					
			Casuarina glauca	0.5					
			Ageratina adenophora	1					
			Ehrharta erecta	0.5					
			Entolasia stricta	0.2					
			Anredera cordifolia	0.5					
white mulberry		→	Morus alba	0.5					
			Asparagus plumosus	0.1					

Stratum in which each species occurs: E – emergent, o – overstorey; M – midstorey; G – groundcover.

Cover 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Q/O

Mangrove Forest.

Plot ID 6.

BAM Plant Species Richness Plot Survey data sheet

Project no.	21/28196	Field Staff	MW + IL	Signature		Date	8/10/19
Proposal Name	Jackson Place.	Vegetation Zone ID	-tf- 5	PCT / BVT	920 /	Condition	M-G.

Sample	ID'd	Stratum	Species	Cover	Sample	ID'd	Stratum	Species	Cover
mangrove			Avicennia marina	40					
reed			Phragmites australis	2					
asparagus fern			Asparagus aethiopicus	5					
bridal creeper			Asparagus asparagoides	0.1					
			Tetragnia tetragonoides	0.5					
			~~Senna pendula var glabrata~~						
vine			~~Anredera cordifolia~~						
			~~Senecio madagascariensis~~						
			~~Ehrharta erecta.~~						
			Seaada australis	2					
			juncus acutus.	0.5					
			Anredera cordifolia	0.2					
			Ehrharta erecta	0.2					
			~~Aspa~~						
			Senna pendulax var glabrata	0.1					
			Sarcocornia quinqueflora	2.					

Stratum in which each species occurs: E – emergent, o – overstorey; M – midstorey; G – groundcover.

Cover 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

BAM Plot / Transect Data Sheet

Entire Vegetation Zone

Site name: Jackson Place	**Job number:** 2128196	**Vegetation zone:** 6
Observer(s): KC + MW	**Date:** 9/10/19	
Vegetation type (ID): 1234	**Condition Class: Sub class (optional);** high *or* medium *or* poor moderate	
Threatened Ecological Community Yes *or* No ? **TEC type:**		
Geomorphic setting:		
Soil depth, colour, texture, gravel content:		
Lithology:		

Over-storey species (total number of species = a)	**Regenerating** (total number of species = b)		**Weed species present and requiring management**	**In plots** (record plot IDs)	**Elsewhere in zone**
	Plot ID	**Elsewhere in zone**			

Over-storey species present (a)		**Management Actions** (erosion, rubbish, fencing, pest fauna etc)
Over-storey species regenerating (dbh<=5cm) (b)		
Regeneration Proportion of over-storey species regenerating (b/a)		

Plot ID 1

Long Lat

Location of plot marker: **GDA94** (Zone) (Easting) 151.1432848 (Northing) -33.9274738 GPS Accuracy: ± m

Position of plot marker on transect: 0 Bearing of transect from plot marker: 110 °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect 20191008_110946, 110936

5 x 1m x1m plots	**10m**	**20m**	**30m**	**40m**	**50m**						**Total**	**Average %**
% litter cover	90	100	90	60	50							76
50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH	1											1
5-9 cm DBH	1											1
10-19 cm DBH	1											1
20-29 cm DBH	1											1
30-49cm DBH	1											1
50-79cm DBH	0											0
80+cm DBH	0											0
Large tree benchmark DBH size class(es) for PCT							Number of large trees					0
50 m x 20 m plot (tally / total)	Trees with hollow(s) 1 0						Total length of logs 5+2+2 1 9					

Plot ID

Location of plot marker: **GDA94** (Zone) (Easting) (Northing) GPS Accuracy: ± m

Position of plot marker on transect: Bearing of transect from plot marker: °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect

5 x 1m x1m plots	**10m**	**20m**	**30m**	**40m**	**50m**						**Total**	**Average %**
% litter cover												
50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH												
5-9 cm DBH												
10-19 cm DBH												
20-29 cm DBH												
30-49cm DBH												
50-79cm DBH												
80+cm DBH												
Large tree benchmark DBH size class(es) for PCT							Number of large trees					
50 m x 20 m plot (tally / total)	Trees with hollow(s) /						Total length of logs /					

BAM Plot / Transect Data Sheet

Entire Vegetation Zone

Site name: Jackson Place	**Job number:** 2128/96	**Vegetation zone:** 4
Observer(s): MW + KC	**Date:** 8/10/19	
Vegetation type (ID): 1126	**Condition Class: Sub class (optional);** high *or* medium *or* poor med	
Threatened Ecological Community Yes *or* No ? **TEC type:**		
Geomorphic setting:		
Soil depth, colour, texture, gravel content:		
Lithology:		

Over-storey species (total number of species = a)	Regenerating (total number of species = b)		Weed species present and requiring management	In plots (record plot IDs)	Elsewhere in zone
	Plot ID	Elsewhere in zone			

Over-storey species present (a)		**Management Actions** (erosion, rubbish, fencing, pest fauna etc)
Over-storey species regenerating (dbh<=5cm) (b)		
Regeneration Proportion of over-storey species regenerating (b/a)		

Plot ID 2

Location of plot marker: **GDA94** (Zone) (Easting) 151 [illegible]340 (Northing) -[illegible] GPS Accuracy: ± m

Position of plot marker on transect: 0 Bearing of transect from plot marker: 140 °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect 20191009_113854, 113801

5 x 1m x1m plots	10m	20m	30m	40m	50m						Total	Average %
% litter cover	40	60	30	30	40							40
50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH	0										—	0
5-9 cm DBH	0										—	0
10-19 cm DBH	0											0
20-29 cm DBH	0										—	0
30-49cm DBH	0										—	0
50-79cm DBH	0										—	0
80+cm DBH	0										—	0
Large tree benchmark DBH size class(es) for PCT							Number of large trees					0
50 m x 20 m plot (tally / total)	Trees with hollow(s) /0						Total length of logs /0					

Plot ID

Location of plot marker: **GDA94** (Zone) (Easting) (Northing) GPS Accuracy: ± m

Position of plot marker on transect: Bearing of transect from plot marker: °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect

5 x 1m x1m plots	10m	20m	30m	40m	50m						Total	Average %
% litter cover												
50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH												
5-9 cm DBH												
10-19 cm DBH												
20-29 cm DBH												
30-49cm DBH												
50-79cm DBH												
80+cm DBH												
Large tree benchmark DBH size class(es) for PCT							Number of large trees					
50 m x 20 m plot (tally / total)	Trees with hollow(s) /						Total length of logs /					

BAM Plot / Transect Data Sheet

Entire Vegetation Zone

Site name: Jackson Place	**Job number:**	**Vegetation zone:** ~~5~~ 3
Observer(s): MW + KC		**Date:** 8/10/19
Vegetation type (ID): 1778		**Condition Class: Sub class (optional);** high *or* medium *or* poor
Threatened Ecological Community Yes *or* No ? **TEC type:**		
Geomorphic setting:		
Soil depth, colour, texture, gravel content:		
Lithology:		

Over-storey species (total number of species = a)	**Regenerating** (total number of species = b)		**Weed species present and requiring management**	**In plots** (record plot IDs)	**Elsewhere in zone**
	Plot ID	**Elsewhere in zone**			

Over-storey species present (a)		**Management Actions** (erosion, rubbish, fencing, pest fauna etc)
Over-storey species regenerating (dbh<=5cm) (b)		
Regeneration Proportion of over-storey species regenerating (b/a)		

Plot ID 3

Lat Long

Location of plot marker: **GDA94** (Zone) (~~Easting~~) 151.1425867 (~~Northing~~) -37.5271970 GPS Accuracy: ± m

Position of plot marker on transect: Bearing of transect from plot marker: 60 °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect 20190028_125027, 125021

5 x 1m x1m plots	**10m**	**20m**	**30m**	**40m**	**50m**						**Total**	**Average %**
% litter cover	15	30	10	10	10							14

50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH	0											
5-9 cm DBH	0											
10-19 cm DBH	1											1
20-29 cm DBH	1											1
30-49cm DBH	1											1
50-79cm DBH	0											
80+cm DBH	0											
Large tree benchmark DBH size class(es) for PCT							Number of large trees					
50 m x 20 m plot (tally / total)	Trees with hollow(s) / 0						Total length of logs / 0					

Plot ID

Location of plot marker: **GDA94** (Zone) (Easting) (Northing) GPS Accuracy: ± m

Position of plot marker on transect: Bearing of transect from plot marker: °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect

5 x 1m x1m plots	**10m**	**20m**	**30m**	**40m**	**50m**						**Total**	**Average %**
% litter cover												

50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH												
5-9 cm DBH												
10-19 cm DBH												
20-29 cm DBH												
30-49cm DBH												
50-79cm DBH												
80+cm DBH												
Large tree benchmark DBH size class(es) for PCT							Number of large trees					
50 m x 20 m plot (tally / total)	Trees with hollow(s) /						Total length of logs /					

BAM Plot / Transect Data Sheet

Entire Vegetation Zone

Site name: Jackson Place	**Job number:** 2128196	**Vegetation zone:** /
Observer(s): MW + KC	**Date:** 8/10/19	
Vegetation type (ID): 1778	**Condition Class: Sub class (optional);** high *or* medium *or* poor	
Threatened Ecological Community Yes *or* No ? **TEC type:**		
Geomorphic setting:		
Soil depth, colour, texture, gravel content:		
Lithology:		

Over-storey species (total number of species = a)	**Regenerating** (total number of species = b)		**Weed species present and requiring management**	**In plots** (record plot IDs)	**Elsewhere in zone**
	Plot ID	**Elsewhere in zone**			

Over-storey species present (a)		**Management Actions** (erosion, rubbish, fencing, pest fauna etc)
Over-storey species regenerating (dbh<=5cm) (b)		
Regeneration Proportion of over-storey species regenerating (b/a)		

Plot ID E

Long Lat

Location of plot marker: **GDA94** (Zone) (~~Easting~~) 151.1420468 (Northing) -32.928559 GPS Accuracy: ± m

Position of plot marker on transect: O Bearing of transect from plot marker: 50 °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect 20191008_132835, 132828

5 x 1m x1m plots	**10m**	**20m**	**30m**	**40m**	**50m**						**Total**	**Average %**
% litter cover	10	30	20	10	30							20
50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH												0
5-9 cm DBH												0
10-19 cm DBH												0
20-29 cm DBH												0
30-49cm DBH	1											1
50-79cm DBH	1											1
80+cm DBH												0
Large tree benchmark DBH size class(es) for PCT							Number of large trees					1?
50 m x 20 m plot (tally / total)	Trees with hollow(s) / 0						Total length of logs / 0					

Plot ID

Location of plot marker: **GDA94** (Zone) (Easting) (Northing) GPS Accuracy: ± m

Position of plot marker on transect: Bearing of transect from plot marker: °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect

5 x 1m x1m plots	**10m**	**20m**	**30m**	**40m**	**50m**						**Total**	**Average %**
% litter cover												
50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH												
5-9 cm DBH												
10-19 cm DBH												
20-29 cm DBH												
30-49cm DBH												
50-79cm DBH												
80+cm DBH												
Large tree benchmark DBH size class(es) for PCT							Number of large trees					
50 m x 20 m plot (tally / total)	Trees with hollow(s) /						Total length of logs /					

BAM Plot / Transect Data Sheet

Entire Vegetation Zone

Site name: Jackson Place	Job number:	Vegetation zone: ~~7~~ 2
Observer(s): MW + KC	Date: 8/10/19	
Vegetation type (ID): 1778	Condition Class: Sub class (optional); high *or* medium *or* poor	
Threatened Ecological Community Yes *or* No ? TEC type:		
Geomorphic setting:		
Soil depth, colour, texture, gravel content:		
Lithology:		

Over-storey species (total number of species = a)	Regenerating (total number of species = b)		Weed species present and requiring management	In plots (record plot IDs)	Elsewhere in zone
	Plot ID	Elsewhere in zone			

Over-storey species present (a)		**Management Actions** (erosion, rubbish, fencing, pest fauna etc)
Over-storey species regenerating (dbh<=5cm) (b)		
Regeneration Proportion of over-storey species regenerating (b/a)		

Plot ID 5

Location of plot marker: GDA94 (Zone) (~~Easting~~) 151.1923632 (~~Northing~~) -33.7272454 GPS Accuracy: ± m

Position of plot marker on transect: 6 Bearing of transect from plot marker: 70 °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect 20191009_140948, 140941

5 x 1m x1m plots	10m	20m	30m	40m	50m						Total	Average %
% litter cover	5	10	5	15	5							8
50 m x 20 m plot (tally / total)	Number of trees in each size class											Total
Tree stem size class <5cm DBH	0											0
5-9 cm DBH	0											0
10-19 cm DBH	1											1
20-29 cm DBH	0											0
30-49cm DBH	0											0
50-79cm DBH	0											0
80+cm DBH	0											0
Large tree benchmark DBH size class(es) for PCT					0		Number of large trees					0
50 m x 20 m plot (tally / total)	Trees with hollow(s) / 0						Total length of logs / 0					

Plot ID

Location of plot marker: GDA94 (Zone) (Easting) (Northing) GPS Accuracy: ± m

Position of plot marker on transect: Bearing of transect from plot marker: °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect

5 x 1m x1m plots	10m	20m	30m	40m	50m						Total	Average %
% litter cover												
50 m x 20 m plot (tally / total)	Number of trees in each size class											Total
Tree stem size class <5cm DBH												
5-9 cm DBH												
10-19 cm DBH												
20-29 cm DBH												
30-49cm DBH												
50-79cm DBH												
80+cm DBH												
Large tree benchmark DBH size class(es) for PCT							Number of large trees					
50 m x 20 m plot (tally / total)	Trees with hollow(s) /						Total length of logs /					

BAM Plot / Transect Data Sheet

Entire Vegetation Zone

Site name: Jackson Place	**Job number:** 2128196	**Vegetation zone:** ~~4~~ 5
Observer(s): MW + KC		**Date:** 8/10/19
Vegetation type (ID): Mangrove 920		**Condition Class: Sub class (optional)**; high *or* medium *or* poor
Threatened Ecological Community Yes *or* No ? **TEC type:**		
Geomorphic setting:		
Soil depth, colour, texture, gravel content:		
Lithology:		

Over-storey species (total number of species = a)	**Regenerating** (total number of species = b)		**Weed species present and requiring management**	**In plots** (record plot IDs)	**Elsewhere in zone**
	Plot ID	**Elsewhere in zone**			

Over-storey species present (a)		**Management Actions** (erosion, rubbish, fencing, pest fauna etc)
Over-storey species regenerating (dbh<=5cm) (b)		
Regeneration Proportion of over-storey species regenerating (b/a)		

Plot ID 6

Long Lat

Location of plot marker: **GDA94** (Zone) ~~(Easting)~~ 151.14430422 (Northing) -37.92723925 GPS Accuracy: ± m

Position of plot marker on transect: 0 Bearing of transect from plot marker: 290 °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect 20191008_143359, 143352

5 x 1m x1m plots	**10m**	**20m**	**30m**	**40m**	**50m**						**Total**	**Average %**
% litter cover	40	60	70	40	80							54

50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH	—											0
5-9 cm DBH	1											1
10-19 cm DBH	1											1
20-29 cm DBH	~~1~~ 1											1
30-49cm DBH	—											0
50-79cm DBH	—											0
80+cm DBH	—											0
Large tree benchmark DBH size class(es) for PCT							Number of large trees					0
50 m x 20 m plot (tally / total)	Trees with hollow(s) / 0						Total length of logs / 0					

Plot ID

Location of plot marker: **GDA94** (Zone) (Easting) (Northing) GPS Accuracy: ± m

Position of plot marker on transect: Bearing of transect from plot marker: °

Transect photo nos. (take 2 [portrait, landscape] from plot marker along transect

5 x 1m x1m plots	**10m**	**20m**	**30m**	**40m**	**50m**						**Total**	**Average %**
% litter cover												

50 m x 20 m plot (tally / total)	**Number of trees in each size class**											**Total**
Tree stem size class <5cm DBH												
5-9 cm DBH												
10-19 cm DBH												
20-29 cm DBH												
30-49cm DBH												
50-79cm DBH												
80+cm DBH												
Large tree benchmark DBH size class(es) for PCT							Number of large trees					
50 m x 20 m plot (tally / total)	Trees with hollow(s) /						Total length of logs /					

Survey ID GGBF SURVEY 1

Fauna survey data sheet

Site JACKSON PLACE Job Number 2128196 Field Staff BIT + MH Signature [signature] Date 21/1/20

Survey Method(s)	Start	Finish	Duration	Waypoint	Location
Spotlighting					
Stag Watch					
Anabat ID					
Anabat ID					
Call Playback REFERENCE SITE	2130	2230	60	~~COLLECTOR~~	EVIA ST. WETLAND, GGBF
Nocturnal streamside search	2240	2310	30	MEANDER	JACKSON PLACE PHRAGMITES REDS IN SALTMARSH
CALL PLAYBACK JACKSON PLACE	2236	2320	44	COLLECTOR	JACKSON PLACE, GGBF, BLACK BITTERN BUSH STONE CURLEW, POW. OWL

Name of person/company analysing ANABAT recordings n/a

Rain last 24 hours <1 mm Cloud cover at start 20 % Temp. at Start 24.4 °C Humidity at start 61 %

Rain last 7 days ____ mm Cloud cover at finish 10 % Temp. at Finish 23.7 °C Humidity at Finish 64 %

Noise LOUD @ EVIA ; MODERATE @ JACKSON Night light MODERATE STREET LIGHTS

Weather

Animal species name	Obs type	Number of individuals	Habitat type	Breeding type	Notes
GREY-HEADED FLYING-FOX	W/O	≈ 2 / 1	PLANTED SCRUB		EVIA STREET
LIM. PERONII	W/O	1 / 2	POND	CALLING	" SLUDGE POND UNDER BRIDGE
LIT. PERONII	W	3	PHRAGMITES WETLAND	CALLING	RMS WETLAND
CORELLA/LIT. AUREA	O	1	" "	SILENT	EVIA STREET
GREY-HEADED FLYING-FOX	O	2	OVERHEAD		JACKSON PLACE
AUST WOOD DUCK	O	9	MANGROVES		" "

Habitat / Breeding Codes

Survey ID Remediation Site

Fauna survey data sheet

Wednesday PM

Site Jacksonplace Job Number 2128196. Field Staff Kirsten Signature _____ Date 22/1

Survey Method(s)	Start	Finish	Duration	Waypoint	Location
Spotlighting					
Stag Watch					
Anabat ID 3	2000				@saltmarsh
Anabat ID Dracula @creek	2020				@creekline
Call Playback					
Nocturnal streamside search	2000	~~2015~~	1.15		Jackson St (GCBF, bittern, bs-curlew, OB)
	21.30	22.15	0.45		Eve St / Marsh St

Name of person/company analysing ANABAT recordings Craig Graham

Rain last 24 hours _____ mm Cloud cover at start 5-10 % Temp. at Start 26.6 °C Humidity at start 74°C. %

Rain last 7 days _____ mm Cloud cover at finish _____ % Temp. at Finish _____ °C Humidity at Finish _____ %

Noise _____ Night light _____

Weather Humid / cool night change SE wind.

Animal species name	Obs type	Number of individuals	Habitat type	Breeding type	Notes
willy wag tail	W				
currawong	W				
superb fairy wren	W				
Grey headed flying fox	O	10+			
Pacific black duck	O	6			
Litoria peronii	OW	1 } Eve St		calling	
Lym peronii	OW	5 }		calling	

Habitat / Breeding Codes

Survey ID_____ Thursday PM

Fauna survey data sheet

Site Jackson Place Job Number 2128196 Field Staff Kirsten Signature_____ Date 23/11

Survey Method(s)	Start	Finish	Duration	Waypoint	Location
Spotlighting					
Stag Watch					
Anabat ID_____					
Anabat ID_____					
Call Playback					
Nocturnal streamside search	2025	2115			Jackson Place
	2130	2215			Eve Street / Marsh St

Name of person/company analysing ANABAT recordings _____

Rain last 24 hours 0 mm Cloud cover at start 90 % Temp. at Start 30.4 °C Humidity at start 53 %

Rain last 7 days _____ mm Cloud cover at finish _____ % Temp. at Finish 30.6 °C Humidity at Finish 61 %

Noise_____ Night light_____

Weather Dust haze. Pending storm Light Rain

Animal species name	Obs type	Number of individuals	Habitat type	Breeding type	Notes
Willie wagtail	W		} Jackson Place		
Pacific Black Duck	O	6			
Grey-headed Flying-fox	O	100+			flying over site
Lit peroni	WO	1	} Eve St	calling	
Lym peroni	WO	10+	} Marsh St	calling	

Habitat / Breeding Codes

Survey ID_____

Fauna survey data sheet

Site Jackson Place Job Number 2128196 Field Staff Kirsten Signature_____ Date 25/1/20

Survey Method(s)	Start	Finish	Duration	Waypoint	Location
Spotlighting					
Stag Watch					
Anabat ID_____					
Anabat ID_____					
Call Playback					
Nocturnal streamside search	20:30	21:15			Jackson Place
	21:35	22:00			Eve St

Name of person/company analysing ANABAT recordings _____

Rain last 24 hours_____mm Cloud cover at start 60 % Temp. at Start 27 °C Humidity at start 78 %

Rain last 7 days _____mm Cloud cover at finish _____% Temp. at Finish 26 °C Humidity at Finish 80 %

Noise_____ Night light_____

Weather

Animal species name	Obs type	Number of individuals	Habitat type	Breeding type	Notes
Pied Currawong	W				
Grey-headed FF	O	50+			Jackson Place
Lit peroni	W	calling			
Lym peroni	O	2 calling		?	
Lit aurea	O	1		?	Eve St

Habitat / Breeding Codes

Annexure D

Secretary's Environmental Assessment Requirements

NSW GOVERNMENT | Planning & Environment

Industry Assessments
Contact: Shaun Williams
Phone: (02) 8275 1345
Email: shaun.williams@planning.nsw.gov.au

Susannah Webb
Roads and Maritime Services
Locked Bag 2030
NSW 2150

EF19/19282
SEAR 1354

Dear Ms Webb

Contaminated Soil Treatment Works
3 Highcliff Road, Earlwood (Lot 1 DP 5527246)
Planning Secretary's Environmental Assessment Requirements (SEAR) 1354

Thank you for your request for the Planning Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Statement (EIS) for the above development proposal. I have attached a copy of these requirements.

In support of your application, you indicated that your proposal is designated development under Part 4 of the *Environmental Planning and Assessment Act 1979* and requires an approval under the *Protection of the Environment Operations Act 1997*. In preparing the SEARs, the Department has consulted with the Environment Protection Authority (EPA), Department of Primary Industries (DPI), the Office of Environment and Heritage (OEH), WaterNSW and the Rural Fire Service (RFS). A copy of their requirements for the EIS are attached.

If other integrated approvals are identified before the Development Application (DA) is lodged, you must undertake direct consultation with the relevant agencies, and address their requirements in the EIS.

If your proposal contains any actions that could have a significant impact on matters of National Environmental Significance, then it will require an additional approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This approval is in addition to any approvals required under NSW legislation. If you have any questions about the application of the EPBC Act to your proposal, you should contact the Commonwealth Department of the Environment and Energy on (02) 6274 1111.

Should you have any further enquiries, please contact Shaun Williams, Planning Services, at the Department on the details above.

Yours sincerely

C. Ritchie

Chris Ritchie
Director
Industry Assessments
as delegate of the Planning Secretary

26/6/19

Planning Secretary's Environmental Assessment Requirements

Section 4.12(8) of the *Environmental Planning and Assessment Act 1979*. Schedule 3 of the *Environmental Planning and Assessment Regulation 2000.*

Designated Development

SEAR Number	1354
Proposal	Remediation of a contaminated landfill site including vegetation clearing, site regrading, fill importation and capping layer.
Location	3 Highcliff Road, Earlwood (Lot 1 DP 557346) in the Canterbury LGA
Applicant	The Road and Maritime Services (RMS)
Date of Issue	28 June 2019
General Requirements	The Environmental Impact Statement (EIS) must meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.*
Key Issues	The EIS must include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts if necessary) and develop appropriate measures to avoid, minimise, mitigate and/or manage these potential impacts. As part of the EIS assessment, the following matters must also be addressed: • **community and stakeholder engagement** – including: - a detailed community and stakeholder participation strategy which identifies who in the community has been consulted and a justification for their selection, other stakeholders consulted and the form(s) of the consultation, including a justification for this approach; - a report on the results of the implementation of the strategy including issues raised by the community and surrounding occupiers and landowners that may be impacted by the proposal; - details of how issues raised during community and stakeholder consultation have been addressed and whether they have resulted in changes to the proposal; - details of the proposed approach to future community and stakeholder engagement based on the results of the consultation. • **strategic context** – including: - a detailed justification for the proposal and suitability of the site for the development; - a demonstration that the proposal is consistent with all relevant planning strategies, environmental planning instruments, development control plans (DCPs), or justification for any inconsistencies; – a list of any approvals that must be obtained under any other Act or law before the development may lawfully be carried out; and – a description of any additional licence(s) or approval(s) required to carry out the proposed development. • **contamination** – including: - a detailed assessment of the extent and nature of any contamination of the soil, groundwater and marine sediments; - conceptual site model detailing the potential risks to human health and the environmental receptors in the vicinity of the site; - the preparation of a Remedial Action Plan (RAP) for the site;

	- a Part B Site Audit Statement and Report, prepared by an accredited NSW EPA Site Auditor, which details the site can be made suitable for a particular land use if remediated in accordance with the approved RAP; and - the site remediation and validation work should be undertaken in accordance with the requirements and procedures of: o *Contaminated Land Management Act 1997;* o *Contaminated Land Management Regulation 2013; and* o *SEPP 55 – Remediation of Land*. • **remediation action plan** – including: – details of the nature and extent of the contaminated material; – comprehensive program of the works proposed, including estimation of the surface area to be disturbed and excavation of contaminated material proposed to be undertaken; – details of the proposed measures to manage any disturbance of contaminated material; – justification for the proposed remediation approach; – details of the proposed remediation process, including equipment to be used and measures to dispose of contaminated material; – justification of the remediation criteria and process for the cleaning/verification of all equipment leaving the site (including workers clothing); – a detailed site validation plan; and – details of the consistency of the Remediation Action Plan with the relevant NSW Government legislation, environmental planning instruments, guidelines and standards. • **waste management** – including: - details of waste handling including, transport, identification, receipt, stockpiling and quality control; and – the measures that would be implemented to ensure that the proposed development is consistent with the aims, objectives and guidelines in the *NSW Waste Avoidance and Resource Recovery Strategy 2014-21*. • **hazards and risk** – including: - an assessment of the risk of bushfire, including addressing the requirements of *Planning for Bush Fire Protection 2006* (RFS). Any proposed Asset Protection Zones must not adversely affect environmental objectives (e.g. buffers); - any geotechnical limitations that may occur on the site and if necessary, appropriate design considerations to address this; and - an assessment of flood risk on the site. The assessment should determine: the flood hazard in the area; address the impact of flooding on the proposed development, and the development's impact (including filling) on flood behaviour of the site and adjacent lands; and address adequate egress and safety in a flood event. • **air quality** – including: - a description of all potential sources of air and odour emissions; - an air quality impact assessment in accordance with relevant Environment Protection Authority guidelines; and - a description and appraisal of air quality impact mitigation and monitoring measures. • **noise and vibration** – including: - a description of all potential noise and vibration sources during construction and operation, including road traffic noise; - a noise and vibration assessment in accordance with the relevant Environment Protection Authority guidelines; and - a description and appraisal of noise and vibration mitigation and monitoring measures. • **soil and water** – including: - a description of local soils, topography, drainage and landscapes; - details of water usage for the proposal including existing and proposed

	water licencing requirements in accordance with the *Water Act 1912* and/or the *Water Management Act 2000;* - an assessment of potential impacts on floodplain and stormwater management and any impact to flooding in the catchment; - details of sediment and erosion controls; - a detailed site water balance; - an assessment in accordance with ASSMAC Guidelines for the presence and extent of acid sulfate soils (ASS) and potential acid sulfate soils (PASS) on the site and, where relevant, appropriate mitigation measures; - an assessment of potential impacts on the quality and quantity of surface and groundwater resources; - details of the proposed stormwater and wastewater management systems (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; - characterisation of the nature and extent of any contamination on the site and surrounding area; and - a description and appraisal of impact mitigation and monitoring measures. • **traffic and transport** – including: - details of road transport routes and access to the site; - road traffic predictions for the development during construction and operation; and - an assessment of impacts to the safety and function of the road network and the details of any road upgrades required for the development. • **biodiversity** – including: - accurate predictions of any vegetation clearing on site or for any road upgrades; - an assessment of the proposal in accordance with the *Biodiversity Assessment Method* (BAM) including the potential impacts on any threatened species, populations, endangered ecological communities or their habitats and groundwater dependent ecosystems; - details of weed management during construction and operation in accordance with existing State, regional or local weed management plans or strategies; and - a detailed description of the measures to avoid, minimise, mitigate and offset biodiversity impacts. • **visual** – including an impact assessment at private receptors and public vantage points. • **heritage** – including Aboriginal and non-Aboriginal cultural heritage.
Environmental Planning Instruments and other policies	The EIS must assess the proposal against the relevant environmental planning instruments, including but not limited to: • State Environmental Planning Policy No 55–Remediation of Land • State Environmental Planning Policy (Coastal Management) 2018 • State Environmental Planning Policy No 19–Bushland in Urban Areas • State Environmental Planning Policy No 33–Hazardous and Offensive Development • State Environmental Planning Policy No 44–Koala Habitat Protection • Canterbury Local Environmental Plan 2012 • relevant development control plans and section 94 plans.
Guidelines	During the preparation of the EIS you should consult the Department's Register of Development Assessment Guidelines which is available on the Department's website at planning.nsw.gov.au under Development Proposals/Register of Development Assessment Guidelines. Whilst not exhaustive, this Register contains some of the guidelines, policies, and plans that must be taken into account in the environmental assessment of the proposed development.
Consultation	During the preparation of the EIS, you must consult the relevant local, State and Commonwealth government authorities, service providers and community groups, and address any issues they may raise in the EIS. In particular, you should consult

	with the: • Environment Protection Authority • Office of Environment and Heritage • Department of Industry • WaterNSW • Rural Fire Service • Fire & Rescue NSW • Canterbury-Bankstown Council • the surrounding landowners and occupiers that are likely to be impacted by the proposal. Details of the consultation carried out and issues raised must be included in the EIS.
Further consultation after 2 years	If you do not lodge an application under Section 4.12(8) of the *Environmental Planning and Assessment Act 1979* within 2 years of the issue date of these SEARs, you must consult with the Planning Secretary in relation to any further requirements for lodgement.

Annexure E

Biodiversity credit report

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00018211/BAAS17011/20/00018212

Proposal Name
Jackson Place Rehabilitation EIS

BAM data last updated *
26/11/2019

Assessor Name

Assessor Number

BAM Data version *
22

Proponent Names

Report Created
09/02/2020

BAM Case Status
Open

Assessment Revision
0

Assessment Type
Major Projects

Date Finalised
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
Rostratula australis / Australian Painted Snipe

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
1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	Not a TEC	0.8	0.00
1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.1	3.00

1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

Like-for-like credit retirement options

Name of offset trading group	Trading group	HBT	IBRA region
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 915, 916, 917, 918, 919, 920, 1125, 1126, 1235, 1746	-	No	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1126-Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	
1778-Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	**Like-for-like credit retirement options**

Class	Trading group	HBT	IBRA region
Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1778	Sydney Coastal Dry Sclerophyll Forests - ≥ 90% cleared group (including Tier 2 or higher).	No	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Area	Credits
Myotis macropus / Southern Myotis	0.7	1.00

Myotis macropus/ Southern Myotis	1778_medium	**Like-for-like credit retirement options**

Spp	IBRA region
Myotis macropus/Southern Myotis	Any in NSW

Myotis macropus/ Southern Myotis	1778_medium	
	1778_poor	**Like-for-like credit retirement options**

Spp	IBRA region
Myotis macropus/Southern Myotis	Any in NSW

Annexure F

EPBC Act assessments of significance

Grey-headed Flying-fox

According to the DotE (2013) 'significant impact criteria' for vulnerable species, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will: *Lead to a long-term decrease in the size of an important population of a species*
All of the Grey-headed Flying-fox populations in eastern NSW are linked and hence can be considered one important population. A Grey-headed Flying-fox colony is located in Wolli Creek at Turrella, about 0.7 km west of the site. The Wolli Valley camp was first inhabited in mid-2007 and was initially a seasonal camp – with the Flying-foxes leaving the camp during the cooler months and in response to available food sources. Since winter 2013 onwards, the camp has been almost continuously occupied, suggesting it has moved from being a seasonal camp to a permanent one (WCPS 2019). Numbers of Grey-headed Flying-fox at the camp fluctuate. The camp initially numbered in the hundreds, but more recently many thousands of individuals have been present. In November 2016, around 24,000 Flying-foxes were counted. The camp has been classified as a camp of National Importance (WCPS 2019). There would be no direct impact on this camp. Rehabilitation works at the site are unlikely to disturb the Wolli Creek roost. This roost is located adjacent to an industrial area and rail line, and as such the Grey-headed Flying-fox would be accustomed to noise and vibration during the day. Given the distance to the camp, additional noise and vibration as a result of the rehabilitation works would be a negligible increase in background levels. Additional noise at the ste would be temporary during remediation works during the day only and would not affect foraging at the site. Foraging habitat for the Grey-headed Flying-fox within the construction boundary comprise remnant and planted eucalypts. Individuals from the Wolli Creek roost camp are likely to forage in the site on an opportunistic basis when food trees are flowering or fruiting. Large eucaypts are to be retained at the site, and as such, foraging habitat would not be removed. Given the above considerations, the proposal is highly unlikely to result in a long term decline in an important population of the species.
Reduce the area of occupancy of an important population
The proposal will not directly impact the Wolli Creek camp. There would be negligible removal of foraging habitat for the species from within the construction boundary. The species is likely to forage on site if food is available during and following remediation works. The proposal will not affect the ability of this highly mobile and wide-ranging species to move between local camps and foraging habitats. Given the minimal impacts of the proposal, it is not expected to substantially reduce the area of occupancy of an important population of the Grey-headed Flying-fox.
Fragment an existing important population into two or more populations
The proposal will not affect a breeding camp of diurnal roost site of the important population of the Grey-headed Flying-fox, and will not fragment the population in any way. The proposal will not form a barrier to the movement of the species between any local camps or roosts and foraging habitat in the locality. The proposal would therefore not fragment an existing important population of the Grey-headed Flying-fox into two or more populations.

Adversely affect habitat critical to the survival of a species
Grey-headed Flying-foxes require a continuous temporal sequence of productive foraging habitats, linked by migration corridors or stopover habitats, and suitable roosting habitat within nightly commuting distance of foraging areas. All foraging habitat has the potential to be productive during general food shortages and therefore provide a critical resource (DEE 2017). There would be no direct impact to the Wolli Creek camp. Large eucalypts would be retained at the site, which would continue to provide foraging habitat for the species. As such, the proposal is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population
There would be no direct impact to the Wolli Creek camp. Large eucalypts would be retained at the site, which would continue to provide foraging habitat for the species. The proposal will not form a barrier to the movement of Grey-headed Flying-foxes between any local camps and foraging habitat throughout the locality. Impacts would be restricted to a minor increase in diurnal noise and vibration which would be temporary during the remediation works. Given the distance to the camp, this is unlikely to impact roosting individuals. The proposal is therefore not likely to disrupt the breeding cycle of the local population of this highly mobile species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
There would be no direct impact to the Wolli Creek camp. Large eucalypts would be retained at the site, which would continue to provide foraging habitat for the species. The proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat for the Grey-headed Flying-fox to the extent that the species is like to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
The proposal is unlikely to introduce new feral animals to the area or encourage the spread of feral animals. The proposal is unlikely to cause the spread of any weed or invasive species in any areas of native vegetation that may provide habitat critical to the Grey-headed Flying-fox in the locality.
Introduce disease that may cause the species to decline
There are no known diseases affecting this species that are of relevance to the proposal. The proposal would be unlikely to increase the potential for significant disease vectors to affect this species.
Interfere substantially with the recovery of the species

The proposal would not remove habitat critical to the survival of the species. The proposal would not directly impact the Wolli Creek Camp and no impacts on the breeding success of the local population are likely. The draft recovery plan for the Grey-headed Flying-fox (DEE 2017) identifies the protection of foraging resources as a key recovery objective. The proposal will retain large eucalypts that are foraging habitat for this species. As such, the proposal is not likely to interfere with the recovery of the species.
Conclusion
The proposal is unlikely to have a significant impact on the Grey-headed Flying-fox as: ▪ The Wolli Creek camp would not be directly or indirectly impacted ▪ Removal of native vegetation on the site would be limited, with remnant eucalypts that provide potential foraging habitat for this species being retained ▪ Increases in noise and vibration during rehabilitation works would be negligible given the distance of the proposal from the camp. There is unlikely to be any disturbance of foraging activities. ▪ The proposal would not fragment habitat for the species. Planting of Grey-headed flying-fox trees is recommended following remediation.

rms.nsw.gov.au/

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Customer feedback

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