CHATSWOOD TO SYDENHAM

ENVIRONMENTAL IMPACT STATEMENT

MAY 2016

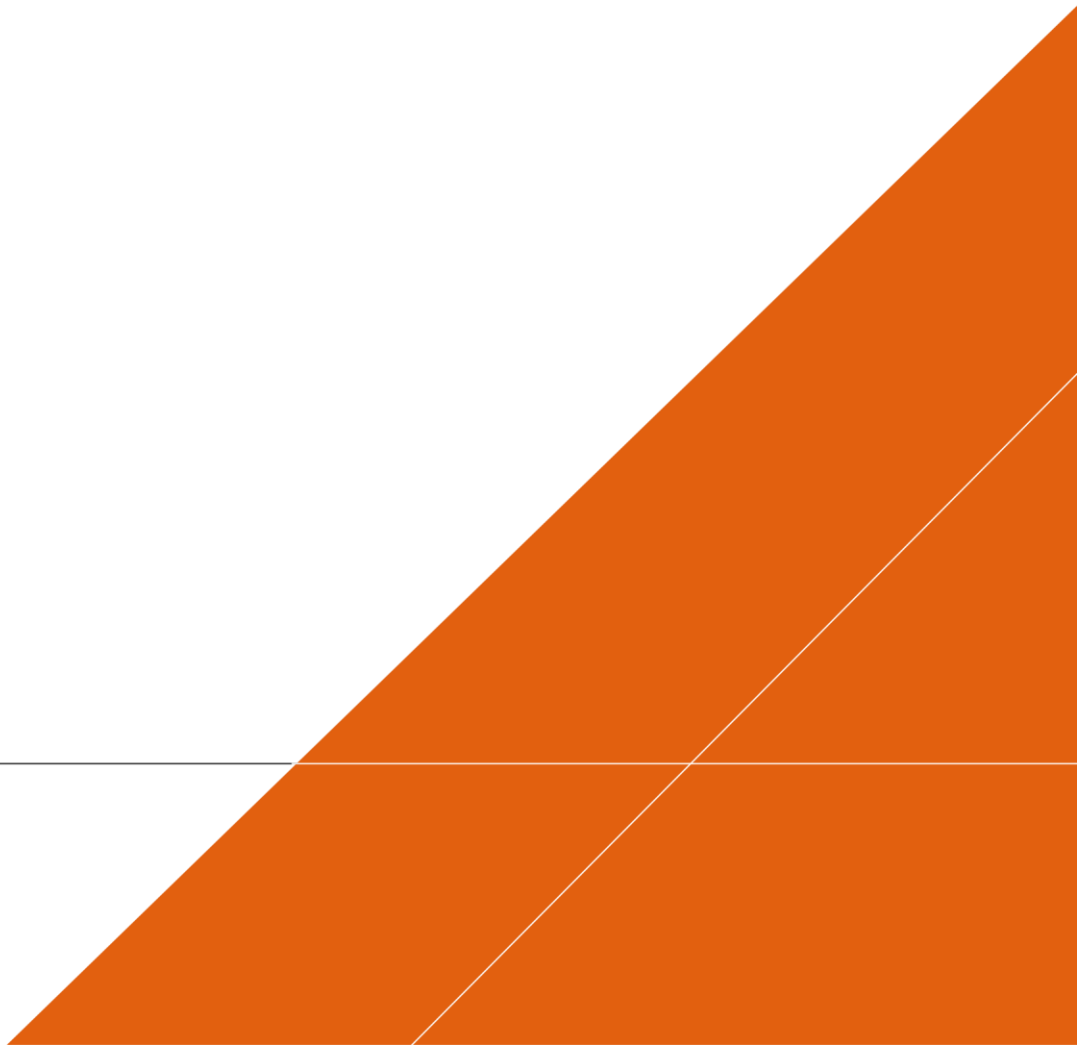
TECHNICAL PAPER 9: BIODIVERSITY ASSESSMENT

ARCADIS Design & Consultancy for natural and built assets

SYDNEY METRO CHATSWOOD TO SYDENHAM

Technical Paper 9: Biodiversity Assessment

MAY 2016



Incorporating Hyder

CONTENTS

APPENDICES

Acknowledgements

Report sections addressing aquatic habitats and potential aquatic impacts contain extracts from advice prepared by Mirella Verhoeven, Senior Environmental Scientist, Jacobs.

SUMMARY

Project overview

Sydney Metro is a new standalone rail network identified in Sydney's Rail Future. The Sydney Metro network consists of Sydney Metro City & Southwest and Sydney Metro Northwest.

The proposed Sydney Metro City & Southwest comprises two core components:

- The Chatswood to Sydenham project (the project), the subject of this technical paper, would involve construction and operation of an underground rail line between Chatswood and Sydenham
- The Sydenham to Bankstown upgrade would involve the conversion of the 13.5 kilometre Bankstown line to metro standards and upgrade of existing stations between Sydenham and Bankstown.

The Sydenham to Bankstown upgrade will be subject to a separate environmental impact assessment.

Investigations have started on the possible extension of Sydney Metro from Bankstown to Liverpool. The potential extension would support growth in Sydney's south west by connecting communities, businesses, jobs and services as well as improving access between the south west and Sydney's CBD. It would also reduce growth pressure on road infrastructure and the rail network, including the potential to relieve crowding on the T1 Western Line, T2 South Line and T2 Airport Line.

The Sydney Metro Chatswood to Sydenham project (the project) involves the construction and operation of a metro rail line. The project would be mainly located underground in twin tunnels extending from Chatswood on Sydney's north shore, crossing under Sydney Harbour, and continue to Sydenham.

The key components of the project would include:

- About 15.5 kilometres of twin rail tunnels (that is, two tunnels located side-by-side) between Mowbray Road, Chatswood and north of Sydenham Station (near Bedwin Road, Marrickville)
- Realignment of the existing T1 North Shore Line surface track within the existing rail corridor between Chatswood Station and in the vicinity of Brand Street, Artarmon, including a new bridge for a section of the 'down' (northbound) track to pass over the proposed northern dive structure
- About 250 metres of aboveground metro tracks between Chatswood Station and the Chatswood dive structure
- A dive structure (about 400 metres long) and tunnel portal south of Chatswood Station and north of Mowbray Road, Chatswood (the Chatswood dive structure)
- A substation (for traction power supply) at Artarmon
- Metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo; and new underground platforms at Central Station.
- A dive structure (about 400 metres long) and tunnel portal between Sydenham Station and Bedwin Road, Marrickville (the Marrickville dive structure)
- A services facility (for traction power supply and an operational water treatment plant) adjacent to the Marrickville dive structure.

The project would also include a number of ancillary components, including new overhead wiring and alterations to existing overhead wiring, signalling, access tracks / paths, rail corridor fencing, noise walls, fresh air ventilation equipment, temporary and permanent alterations to the road network, facilities for pedestrians, and other construction related works.

Approach to biodiversity assessment

This technical paper is based on a desktop review of database searches, regional biodiversity mapping and any relevant existing site-specific reports, as well as site inspection and detailed targeted field surveys, as necessary. This biodiversity assessment:

- Identifies and describes the flora and fauna species, habitat, populations and ecological communities (including groundwater dependent ecosystems) that occur or are considered likely to occur
- Assesses the direct and indirect impacts of the project on terrestrial and aquatic flora and fauna species, populations, ecological communities and their habitats, and groundwater dependent ecosystems
- Assesses the significance of the impacts of the project on species, ecological communities and populations, and groundwater dependent ecosystems listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act),the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the NSW *Fisheries Management Act 1994* (FM Act) that occur or are considered likely to occur
- Identifies and describes mitigation measures using the principles of 'avoid, minimise, mitigate', and
- Proposes offsets where residual impacts occur. The requirement for offsets is determined in accordance with the NSW *Biodiversity Offsets Policy for Major Projects* (Office and Environment and Heritage, 2014).

Overview of potential impacts

The project is located in a highly urbanised area and has a long history of modification and disturbance. Native vegetation is limited to planted trees and shrubs and occasional scattered regeneration of common native plant species. Planted trees and landscaped vegetation represent foraging habitat and shelter for fauna species.

No threatened species, populations or communities were identified in the study area during field surveys for the current study. The threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), listed as Vulnerable under the EPBC Act and TSC Act, was considered to have a high likelihood of occurrence in the Barangaroo Station and Chatswood Dive sites, which contain potential foraging habitat for the species. The Eastern Freetail-bat (*Mormopterus norfolkensis*) and Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), both listed as Vulnerable under the TSC Act, were considered to have a moderate likelihood of occurrence at the Waterloo, Chatswood, and Marrickville sites, where potential roosting habitat occurs in the form of bridges, buildings and hollow bearing trees. The Southern Right Whale (*Eubalaena australis*), listed as Endangered under the EPBC Act, was considered to have a moderate likelihood of occurrence in Sydney Harbour in the vicinity of the proposed ground improvement works.

The likely biodiversity impacts of the construction phase of the proposal include:

- Loss of native vegetation – there is minimal native vegetation to be impacted, with most occurring as planted trees and shrubs or scattered regrowth.
- Loss of fauna habitat – planted trees and landscaped vegetation would be removed which could impact foraging habitat and shelter for fauna species, and removal or modification of buildings and bridges have the potential to impact roosting and nesting fauna including microbats.
- Mortality of fauna species – could potentially occur during vegetation clearing activities, or from collisions with vehicles or plant.
- Impacts to threatened species – The removal of up to three hollow-bearing trees has the potential to impact Eastern Freetail-bat roosting habitat; removal of buildings and bridge removal/modification could also affect this species and the Eastern Bentwing-bat through the removal of potential roosting habitat; and Impacts to the Grey-headed Flying-fox could occur from the removal of potential foraging habitat for this species at Barangaroo and Chatswood. Impacts to the Southern Right Whale (*Eubalaena australis*) could occur due to water quality impacts/instream structures affecting navigation.

The likely biodiversity impacts of the operational phase of the proposal are limited to mortality of fauna species resulting from collisions with trains; it is unlikely that many fauna species would occur within the operational area, therefore impacts are expected to be minor.

An assessment of the proposal under the NSW Framework for Biodiversity Assessment (FBA) was carried out to determine whether biodiversity offsets would be required. It was concluded that the impacts of the project on native vegetation do not require an offset, given that they comprise planted or highly modified native vegetation.

Summary of mitigation response

Biodiversity mitigation measures that would be implemented include:

- An ecologist would be present during the removal of any hollow-bearing trees.
- Potential bat roosting locations at the Central Station, Waterloo Station and Marrickville dive sites would be checked by a qualified ecologist or wildlife handler prior to demolition. Any bats found would be relocated.
- The local WIRES group and / or veterinarian would be contacted if any fauna are injured on site or require capture and / or relocation.
- Procedures would be developed and implemented, in accordance with the National System for the Prevention and Management of Marine Pest Incursions, during Sydney Harbour ground improvement works to avoid transportation of marine pests from other locations, particularly the marine alga *Caulerpa taxifoli*.

GLOSSARY AND ACRONYMS

BoM	Bureau of Meteorology
dbh	Diameter at breast height (of tree trunks)
DoE	Commonwealth Department of the Environment
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning & Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FBA	Framework for Biodiversity Assessment
FM Act	*Fisheries Management Act 1994*
KTP	Key Threatening Process
LGA	Local Government Area
Matters of NES	Matters of National Environmental Significance
NPW Act	*National Parks and Wildlife Act 1974*
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SSI	State Significant Infrastructure
Study Area	All areas where biodiversity values are potentially affected by the project
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act 1995*
VIS	Vegetation Information System

1 INTRODUCTION

1.1 Project background

Sydney Metro is a new standalone rail network identified in Sydney's Rail Future. The Sydney Metro network consists of Sydney Metro City & Southwest and Sydney Metro Northwest.

The proposed Sydney Metro City & Southwest comprises two core components:

- The Chatswood to Sydenham project (the project), the subject of this technical paper, would involve construction and operation of an underground rail line between Chatswood and Sydenham
- The Sydenham to Bankstown upgrade would involve the conversion of the 13.5 kilometre Bankstown line to metro standards and upgrade of existing stations between Sydenham and Bankstown.

Both components are subject to assessment by the Department of Planning and Environment and approval by the Minister for Planning under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Sydenham to Bankstown upgrade will be subject to a separate environmental impact assessment.

Sydney Metro Northwest (formerly the North West Rail Link) is currently under construction, services will start in the first half of 2019. This includes a new metro rail line between Rouse Hill and Epping and conversion of the existing rail line between Epping and Chatswood to metro standards.

Investigations have started on the possible extension of Sydney Metro from Bankstown to Liverpool. The potential extension would support growth in Sydney's south west by connecting communities, businesses, jobs and services as well as improving access between the south west and Sydney's CBD. It would also reduce growth pressure on road infrastructure and the rail network, including the potential to relieve crowding on the T1 Western Line, T2 South Line and T2 Airport Line.

The Sydney Metro Delivery Office has been established as part of Transport for NSW to manage the planning, procurement and delivery of the Sydney Metro network.

The Sydney Metro rail network is shown in Figure 1.

1.2 The Sydney Metro network

The customer experience underpins how Sydney Metro is being planned and designed. The customer experience incorporates all aspects of travel associated with the transport network, service and project including:

- The decision on how to travel
- The travel information available
- The speed and comfort of the journey
- The range and quantity of services available at stations, interchanges and within station precincts.

A high quality 'door to door' transport product is critical to attract and retain customers and also to meet broader transport and land use objectives. This includes providing a system that is inherently safe for customers on trains, at stations and at the interface with the public domain; providing direct, comfortable, legible and safe routes for customers between transport modes; and provide a clean, pleasant and comfortable environment for customers at stations and on trains.

Key features of the metro product include:

- Comfortable carriages with space for customers to sit or stand
- A ‘turn-up-and-go’ service, with high frequency trains Reduced journey times with faster trains, and new underground routes through the Sydney CBD
- Increased capacity to safely and reliably carry more customers per hour due to the increased frequency of trains
- Reduced dwell times at stations as each carriage would be single-deck with three doors, allowing customers to board and alight more quickly than they can with double-deck carriages.

The Chatswood to Sydenham project would have the capacity to run up to 30 trains per hour through the Sydney CBD in each direction, which would provide the foundation for delivering a 60 per cent increase in the number of trains operating in peak periods, and cater for an extra 100,000 customers per hour.

Figure 1 The Sydney Metro network

1.3 Overview of the project

1.3.1 Location

The Sydney Metro Chatswood to Sydenham project (the project) involves the construction and operation of a metro rail line. The project would be mainly located underground in twin tunnels extending from Chatswood on Sydney’s north shore, crossing under Sydney Harbour, and continue to Sydenham.

1.3.2 Key features

The proposed alignment and key operational features of the project are shown in Figure 1 and would include:

- Realignment of T1 North Shore Line surface track within the existing rail corridor between Chatswood Station and Brand Street, Artarmon, including a new bridge for a section of the 'down' (northbound) track to pass over the proposed northern dive structure
- About 250 metres of aboveground metro tracks between Chatswood Station and the Chatswood dive structure
- A dive structure (about 400 metres long) and tunnel portal south of Chatswood Station and north of Mowbray Road, Chatswood (the Chatswood dive structure)
- About 15.5 kilometres of twin rail tunnels (that is, two tunnels located side-by-side) between Mowbray Road, Chatswood and Bedwin Road, Marrickville. The tunnel corridor would extend about 30 metres either side of each tunnel centre line and around all stations
- A substation (for traction power supply) in Artarmon, next to the Gore Hill Freeway, between the proposed Crows Nest Station and the Chatswood tunnel portal
- Metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo; and new underground platforms at Central Station
- A dive structure (about 400 metres long) and tunnel portal between Sydenham Station and Bedwin Road, Marrickville (the Marrickville dive structure)
- A services facility beside the Marrickville dive structure and tunnel portal, including a tunnel water treatment plant and a substation (for traction power supply).

The project would also include:

- Permanent closure of the road bridge at Nelson Street, Chatswood, and provision of an all vehicle right-turn movement from the Pacific Highway (southbound) into Mowbray Road (westbound)
- Changes to arrangements for maintenance access from Hopetoun Avenue and Albert Avenue, Chatswood as well as a new access point from Brand Street, Artarmon
- Underground pedestrian links at some stations and connections to other modes of transport (such as the existing suburban rail network) and surrounding land uses
- Alterations to pedestrian and traffic arrangements and public transport infrastructure (where required) around the new stations and surrounding Central Station
- Installation and modification of existing Sydney Trains rail systems including overhead wiring, signalling, rail corridor fencing and noise walls, within surface sections at the northern end of the project
- Noise barriers (where required) and other environmental protection measures.

The proposed construction activities for the project broadly include:

- Demolishing buildings and structures at the station sites and other construction sites
- Constructing tunnels, dive structures and tunnel portals
- Excavating, constructing and fitting out metro stations
- Fitting out tunnel rail systems and testing and commissioning of stations, tunnels, ancillary infrastructure, rail systems and trains
- Excavating shafts, carrying out structural work and fitting out ancillary infrastructure at Artarmon
- Excavating shafts, carrying out structural work and fitting out ancillary infrastructure at Marrickville.

A number of construction sites would be required to construct the project. These include locations for tunnel equipment and tunnel boring machine support at Chatswood, Barangaroo and Marrickville as well as at station sites; a casting yard and segment storage facility at Marrickville and a temporary tunnel boring machine retrieval site at Blues Point.

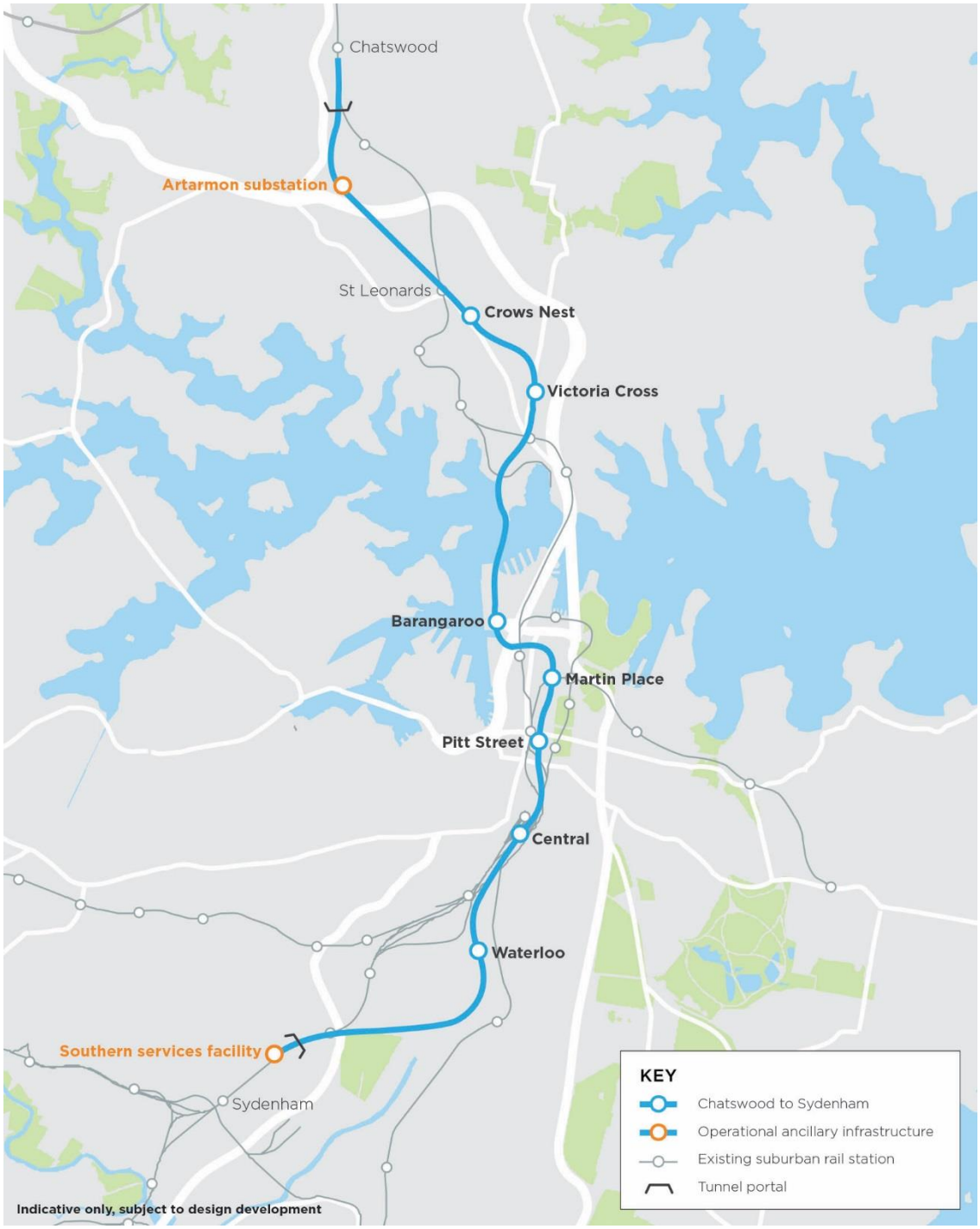


Figure 2 The project

1.4 Purpose and scope of this report

The project has been declared State significant infrastructure and critical State significant infrastructure and therefore is subject to assessment by the Department of Planning and Environment and approval by the Minister for Planning under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

This technical paper, *Technical Paper 9 Biodiversity Assessment* is one of a number of technical documents that forms part of the Environmental Impact Statement (EIS). The purpose of this technical paper is to identify and assess the biodiversity impacts of the project during both construction and operation. In doing so it responds directly to the Secretary's Environmental Assessment Requirements (SEARs) outlined in Section 1.5.

This technical paper is based on a desktop review of database searches, regional biodiversity mapping and any relevant existing site-specific reports, as well as site inspection and detailed targeted field surveys, as necessary. This biodiversity assessment will:

- Identify and describe the flora and fauna species, habitat, populations and ecological communities (including groundwater dependent ecosystems) that occur or are considered likely to occur
- Assess the direct and indirect impacts of the project on terrestrial and aquatic flora and fauna species, populations, ecological communities and their habitats, and groundwater dependent ecosystems
- Assess the significance of the impacts of the project on species, ecological communities and populations, and groundwater dependent ecosystems listed under the EPBC Act, the TSC Act and FM Act that occur or are considered likely to occur
- Identify and describe mitigation measures using the principles of 'avoid, minimise, mitigate', and
- Propose offsets where residual impacts occur. Offsets would be determined in accordance with the NSW *Biodiversity Offsets Policy for Major Projects* (Office and Environment and Heritage, 2014).

1.5 Secretary's environmental assessment requirements

The NSW Department of Planning and Environment issued Secretary's Environmental Assessment Requirements (SEARs) for the Proposal in December 2015 (SSI 15-7400). Input was also received from the NSW Office of Environment and Heritage (OEH).

The SEARs relating to biodiversity, and where these requirements are addressed in this technical paper, are outlined in Table 1.

Table 1 Secretary's environmental assessment requirements

Secretary's environmental assessment requirements	Where addressed
5. Biodiversity	
1. The Proponent must assess biodiversity impacts in accordance with the current guidelines including the Framework for Biodiversity Assessment (FBA).	Section 5
2. The Proponent must assess any impacts on biodiversity values not covered by the FBA as specified in s2.3. Footnote: OEH will provide specific assessment requirements for any such impacts during agency consultation on the SEARs.	Section 5
3. The Proponent must assess impacts on the following [EECs, threatened species and/or populations] and provide the information specified in s9.2 of the FBA. Footnote: OEH will provide this list of species during agency consultation on the SEARs.	Section 5

Secretary's environmental assessment requirements	Where addressed
4. The Proponent must identify whether the project as a whole, or any component of the project, would be classified as a Key Threatening Process (KTP) in accordance with the listings in the Threatened Species Conservation Act 1997 (TSC Act), Fisheries Management Act 1994 (FM Act) and Environmental Protection and Biodiversity Conservation Act 2000 (EPBC Act).	Section 4.3
17. Hydrology	
1. The Proponent must describe (and map) the existing hydrological regime for any surface and groundwater resource (including reliance by users and for ecological purposes) likely to be impacted by the project, including stream orders, as per the FBA.	Section 3.1.2
2. The Proponent must assess (and model if appropriate) the impact of the construction and operation of the project and any ancillary facilities (both built elements and discharges) on surface and groundwater hydrology in accordance with the current guidelines, including: (a) natural processes within rivers, wetlands, estuaries, marine waters and floodplains that affect the health of the fluvial, riparian, estuarine or marine system and landscape health (such as modified discharge volumes, durations and velocities), aquatic connectivity and access to habitat for spawning and refuge; (b) impacts from any permanent and temporary interruption of groundwater flow, including the extent of drawdown, barriers to flows, implications for groundwater dependent surface flows, ecosystems and species, groundwater users and the potential for settlement;	Section 4.1.1 Groundwater dependent ecosystems are discussed in Section 3.5 and Section 4.1.1.

1.6 Study area

The study area for this assessment includes all areas where biodiversity values are potentially affected by the project. A desktop review of mapping for all sites within the project was undertaken to determine areas potentially containing native vegetation and/or habitat for native flora and fauna. It was concluded that the sites at Crows Nest, Victoria Cross, Martin Place and Pitt Street did not have native biodiversity values that could be subject to impacts from the project, due to the lack of any vegetated areas or other native habitat features.

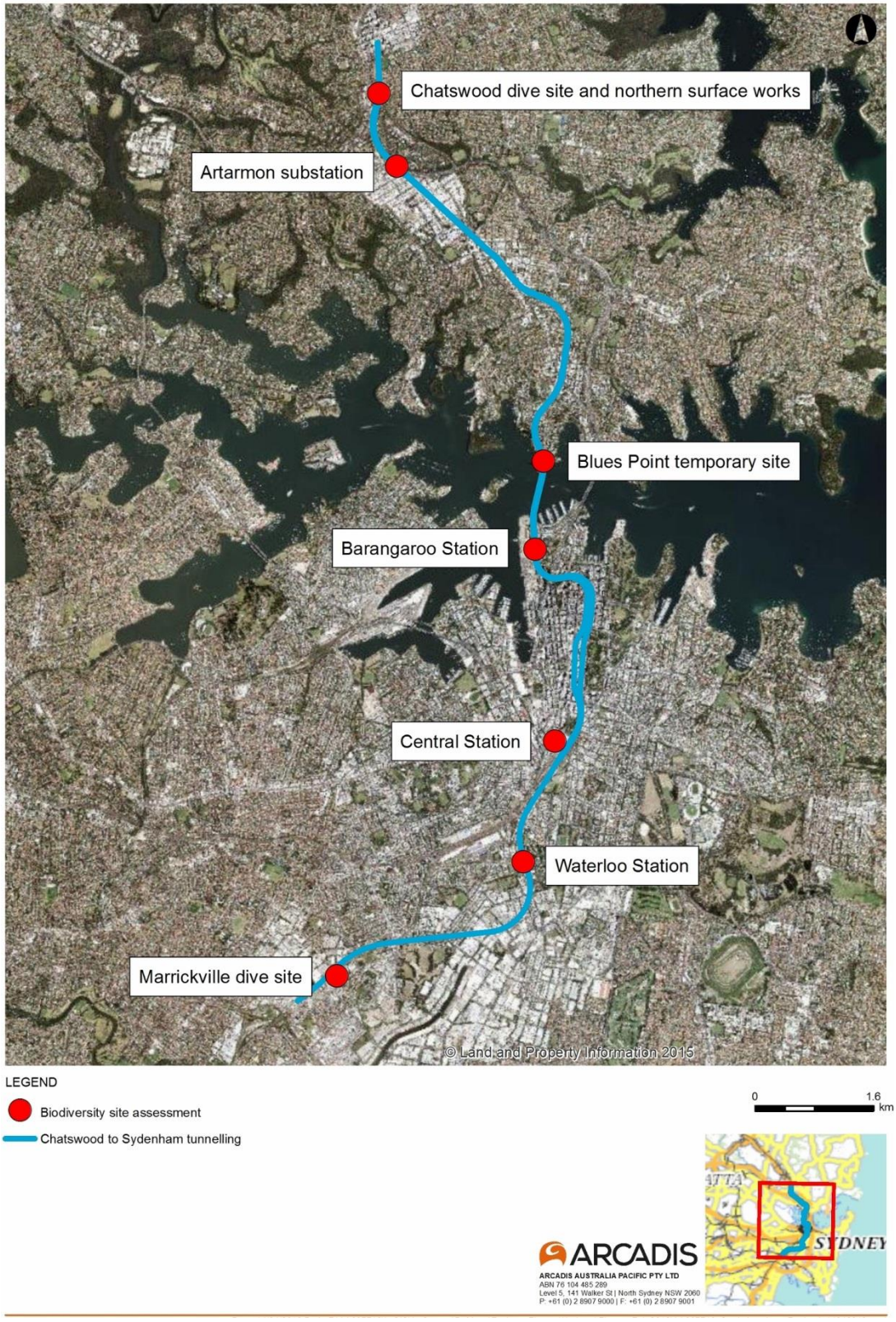
The project would have potential biodiversity impacts at seven sites (Table 2, Figure 3).

The study area is located in the Willoughby, North Sydney, Sydney and Marrickville Local Government Areas. Table 2 includes detailed descriptions and boundaries of study sites.

Table 2 Sites assessed in this report

Site	Location/description
Chatswood dive site and northern surface works	Includes section of rail corridor between Albert Avenue in the north and Brand Street in the south, associated road overbridges and the Ausgrid depot site immediately west of the rail corridor, between Mowbray Road and Nelson Street.
Artarmon substation	Cleared triangle of land adjoining the northern side of the M2 Motorway, south-west of residential apartment blocks on Barton Road.
Blues Point temporary site	Cleared grassland south of Henry Lawson Avenue and east of Blues Point Road, adjoining Sydney Harbour.
Barangaroo Station	Planted trees along road edge adjoining the large cleared development site to the west.
Central Station	Platform, concourse areas and trees and buildings between suburban and country rail tracks, to south of platform areas.
Waterloo Station	Industrial and commercial buildings on the block bounded by Botany Road, Raglan Street, Cope Street and Buckland Street.
Marrickville dive site	Industrial lands on northern side of the rail line north-east of Sydenham station.

Figure 3 Study locations



1.7 Legislation and policy

1.7.1 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance identified in the Act include:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Nationally threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, actions that have, or are likely to have, a significant impact on Matters of National Environmental Significance require approval from the Australian Government Minister for the Environment (the Minister). The Minister holds responsibility for deciding whether assessment and approval is required under the EPBC Act.

1.7.2 NSW *Environmental Planning and Assessment Act 1979*

The *Environmental Planning and Assessment Act 1979* (EP&A Act) provides the framework for assessing developments in NSW. Under the EP&A Act, a project is classified as State Significant Infrastructure (SSI), pursuant to Part 5.1 Section 115U, if it is declared as SSI by a State Environmental Planning Policy (SEPP) or declared SSI by an order of the Minister published on the NSW legislation website. The Minister is the consent authority for SSI in accordance with Part 5.1 of the EP&A Act.

1.7.3 NSW *Biodiversity Offsets Policy for Major Projects*

The NSW Biodiversity Offsets Policy for Major Projects was released in October 2014 and is applicable to projects that are State Significant Development (SSD) or State Significant Infrastructure (SSI) under the EP&A Act. The NSW Biodiversity Offsets Policy for Major Projects requires proponents to apply the Framework for Biodiversity Assessment (FBA) to assess impacts on biodiversity. The FBA also guides the identification of reasonable measures and strategies that can be taken to avoid and minimise impacts on biodiversity associated with a proposal.

1.7.4 NSW *Threatened Species Conservation Act 1995*

The NSW *Threatened Species Conservation Act 1995* (TSC Act) provides for the protection and management of threatened species, populations and ecological communities listed under schedules 1, 1A and 2 of the Act. The purpose of the TSC Act is to:

- Conserve biological diversity and promote ecologically sustainable development.
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities.
- Protect the critical habitat of those species, populations and ecological communities that are endangered.
- Eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities.
- Ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed.
- Encourage the conservation of threatened species, populations and ecological communities through co-operative management.

1.7.5 NSW *Fisheries Management Act 1994*

The Fisheries Management Act 1994 (FM Act) provides for the identification, conservation and recovery of threatened fish, aquatic invertebrates and marine vegetation. The Act also covers the identification and management of key threatening processes which affect threatened species or could cause other species to become threatened.

If a planned development or activity is likely to have any impact on a threatened species listed under the FM Act, an Assessment of Significance must be undertaken. If the impacts are likely to be significant, or if critical habitat is affected, a species impact statement must be prepared in accordance with Part 7A of the FM Act.

The FM Act requires permits for the harming of aquatic vegetation, blockage of fish passage and dredging and reclamation. Clause 115ZG of the EP&A Act provides an exemption for these permits for approved SSI under Part 5.1, Division 4 of the EP&A Act.

1.7.6 NSW *Noxious Weeds Act 1993*

The NSW *Noxious Weeds Act 1993* provides for the identification and classification for noxious weeds in each New South Wales Local Government Area (LGA). The Act imposes obligations on occupiers of land to control noxious weeds declared for their LGA.

2 METHODOLOGY

2.1 Nomenclature

The plant taxonomy used in this report follows the system and nomenclature presented in the most recent edition of Flora of New South Wales (Harden 1990-1993, 2002) and was supplemented by subsequent advice from The Royal Botanic Gardens and Domain Trust (2015). In this report plant species are referred to by both their scientific and common names (if applicable) when first mentioned. Subsequent references to these species cite the scientific name only.

The names of vertebrate fauna follow the Census of Australian Vertebrates database maintained by Department of the Environment (DoE 2015) and as used by OEH in the Atlas of NSW Wildlife (OEH 2015). In this report fauna species are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

2.2 Desktop research

2.2.1 Database interrogation

Two database searches were undertaken (dated 23 September 2015) to identify threatened entities listed under the TSC Act and EPBC Act (Commonwealth Matters of National Environmental Significance) known or likely to occur within 10 kilometres of the project. Databases interrogated for this purpose were:

- The NSW Bionet Wildlife Atlas, managed by the NSW Office of Environment and Heritage (OEH). A coordinate search was undertaken to determine threatened species records listed under the TSC Act to within 10 kilometres of the project.
- The Protected Matters Search Tool, managed by the Commonwealth Department of the Environment (DoE). A coordinate search was undertaken to determine threatened species, threatened ecological communities and migratory species listed under the EPBC Act known or likely to occur to within 10 kilometres of the project.

Database search results are presented in Appendix B and discussed in Section 3.2.3.

2.2.2 Literature review

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring in the study area and wider region. Reports, vegetation maps, topographic maps, aerial photography and literature reviewed included, but were not limited to, the following:

- Soil Landscapes of the Sydney 1:100 000 Sheet (Chapman and Murphy 1989)
- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (DECCW 2009).
- Marrickville Biodiversity Strategy 2011-2021 (Australian Museum Business Services 2011)
- Urban Ecology Strategic Action Plan (City of Sydney 2012)
- Urban Bushland Plan of Management Volume 1, Policy and Management Issues, 2014-2019 (Willoughby City Council 2014)

2.3 Field survey

Terrestrial flora and fauna inspections of seven sites within the study area were conducted by Jane Rodd, Kate Carroll on 25 May 2015, by Jane Rodd, Kate Carroll and Adam Costenoble on 7 to 8 October 2015 and by Jane Rodd and Laura Hoffman on 17 February 2016 (Table 3).

Table 3 Sites subject to biodiversity survey

Survey date	Site	Survey methods
25 May 2015	Barangaroo Station, part of Marrickville dive site	Diurnal site inspection
7 October 2015	Chatswood dive site, Artarmon substation, Waterloo Station,	Diurnal site inspection, dusk/evening active Anabat survey (Chatswood dive site only)
8 October 2015	Waterloo Station	Dusk/evening active Anabat survey
17 February 2016	Blues Point temporary site, Marrickville dive site	Diurnal site inspection, dusk/evening active Anabat survey (Marrickville dive site only)

The weather conditions at the time of survey ranged from mild and sunny to overcast and windy. The weather records from the Sydney Observatory Hill weather station (station 066062) (BOM 2015-2016) for the survey dates are shown in Table 4.

Table 4 Weather records from Sydney Observatory Hill weather station for the survey dates

Survey date	Temperature (°C)		Rain (mm)	Maximum wind gust	
	Min	Max		Direction	Speed (km/h)
25 May 2015	9.4	19.5	0	W	26
7 October 2015	19.7	21.5	0	SSW	67
8 October 2015	17	21.1	0	ENE	35
17 February 2016	19.5	26	0	SSE	39

The site inspection involved:

- Detection and identification of native plant and animal species;
- Detection and identification of environmental weeds and noxious weeds declared under the NSW Noxious Weeds Act 1993 for the Willoughby, Sydney and Marrickville LGAs;
- Assessment of fauna habitat values;
- Searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and digging); and
- Assessment of potential habitat for threatened flora and fauna species previously recorded within the locality.

In addition to the diurnal site inspection, active ultrasonic bat call detection (Anabat) surveys were conducted at the Chatswood dive site, Waterloo Station and Marrickville dive site where potential microbat habitat occurs. Active Anabat surveys comprised active recording on foot at dusk for one hour, with a handheld spotlight used to view potential roosting locations when the light was low. Bat calls were analysed by Dr Anna McConville of Echo Ecology.

2.4 FBA Assessment

The impacts of the proposal on biodiversity were assessed using the methodology in the Framework for Biodiversity Assessment (FBA)(OEH 2014). All applicable sections of the FBA were addressed. Given that no Plant Community Types (PCTs) listed in the NSW Vegetation Information System (VIS) Database are located within the study sites, it was not possible to undertake an assessment using the FBA credit calculator.

2.5 Limitations

The flora and fauna survey for this assessment was carried out over four half days in late autumn and spring 2015 and late summer 2016. This assessment is based on the condition of the study area at the time of field investigation and the information available at the date of publication of this document.

The duration and timing of the investigation mean that the full spectrum of flora and fauna species likely to occur in the study area cannot be fully quantified or described in this report. Some plant species that occur in the local area, such as cryptic species, are annuals and are present only in the seed bank for much of the year. Other plant species are perennial but are inconspicuous or difficult to identify unless flowering.

Similarly, some fauna species that have been recorded in the local area occur on a seasonal or migratory basis, and may be absent from the locality for much for the year. Fauna behaviours may have also affected detectability; species that are easily disturbed or cryptic may not have been detected during surveys. It is possible that a number of species occurring in the study area were not detected during the current survey due to the above factors.

Access to some areas was not possible during the surveys including vegetated areas within the rail corridor at Chatswood and Central and within buildings at Chatswood, Central, Waterloo and Marrickville. The proposed substation site at Artarmon was a construction site on the day of assessment and could only be viewed from the property boundary.

These limitations have been partly addressed by identifying potential habitats for flora and fauna species and assessing the potential for targeted species to occur on the site based on previous records, the type and condition of habitats present, the land use throughout the study area and surrounds, and the landscape context.

2.6 Likelihood of occurrence assessment criteria

The database searches identified threatened flora and fauna species that have been recorded or that are likely to occur within 10 kilometres of the study area. The probability that each threatened species occurs within the study area was determined as being either low, moderate, high or known, based on the criteria in Table 5.

Table 5 Likelihood of occurrence criteria for threatened species

Likelihood of occurrence	Criteria - one or more of the following conditions applies for threatened flora species	Criteria - one or more of the following conditions applies for threatened fauna species
Low	The species has not been recorded previously within 10km of the study area. The species has historically (>20 years ago) been recorded within 10km of the study area, and suitable habitat is no longer present. The study area is beyond the current known geographic range of the species. The species has specific habitat requirements that are not present in the study area or are present in a poor or modified condition. The species is considered extinct.	The species has not been recorded previously within 10km of the study area. The species has historically (>20 years ago) been recorded within 10km of the study area, and suitable habitat is no longer present. The study area is beyond the current known geographic range. The species has specific habitat requirements that are not present in the study area or are present in a poor or modified condition. The species is considered extinct. Targeted surveys for the species were undertaken and the species was not detected.
Moderate	The species has historically (>20 years ago) been recorded in the study area or nearby and the species has specific habitat requirements that are present in the study area. The species has been recorded more recently (<20 years ago) within 10km of the study area and the species has specific habitat requirements that are present in the study area.	The species has historically (>20 years ago) been recorded in the study area or nearby and the species has specific habitat requirements that are present in the study area. The species has been recorded more recently (<20 years ago) within 10km of the study area and the species has specific habitat requirements that are present in the study area. The species is unlikely to maintain a resident population in the study area, however may occasionally utilise resources within the study area. Targeted surveys for the species were undertaken and the species was not detected, however, the species is difficult to detect or prone to high fluctuations in population size and extent.

Likelihood of occurrence	Criteria - one or more of the following conditions applies for threatened flora species	Criteria - one or more of the following conditions applies for threatened fauna species
High	The species has recently (within the last 20 years) been recorded in the study area or nearby, and has specific habitat requirements that are present in the study area and are in moderate to good condition. A known population of the species is located in similar habitat in proximity to the study area.	The species has recently (within the last 20 years) been recorded in the study area or nearby and the species has specific habitat requirements that are present in the study area in a moderate to good condition. The species is known or likely to maintain resident populations in proximity to the study area and could utilise resources within the study area. The species is known or likely to regularly utilise resources in the study area.
Known	The species was recorded in the study area during the current survey.	The species was recorded on or in proximity to the study area during the current survey.

3 RESULTS

3.1 Environmental context

3.1.1 Geology and soils

The geology of the Sydney 1:100 000 sheet was mapped by Clark and Jones (1991), and the soil landscapes of the Sydney 1:100 000 sheet were mapped by Chapman and Murphy (1989). A number of different geological and soil landscape map units are mapped underlying the sites within the study area, as presented in Table 6.

Table 6 Geology and soil landscape mapping of the study area

Site	Geology mapping	Soil landscape mapping
Chatswood dive site and northern surface works	Ashfield Shale	Blacktown soil landscape
Artarmon substation	Ashfield Shale	Gymea soil landscape
Blues Point temporary site	Hawkesbury Sandstone	Hawkesbury soil landscape
Barangaroo Station	Hawkesbury Sandstone	Most of site is mapped as Disturbed Terrain, with small areas of Gymea soil landscape in the north-east and east.
Central Station	Ashfield Shale	Blacktown soil landscape
Waterloo Station	Quaternary sand deposits	Tuggerah soil landscape
Marrickville dive site	Quaternary sand deposits across most of site; Ashfield Shale in north-east of site.	Birrong soil landscape across most of site; Blacktown soil landscape in southern part of vegetated area.

3.1.2 Hydrology

The project intersects the estuary of Sydney Harbour, a drowned river valley formed during sea level rise approximately 10,000 years ago. The estuary opens up from the entrance to form Port Jackson, and then divides into three main branches, Middle Harbour to the north and the Parramatta and Lane Cove Rivers extending south, then westward away from the heads. The estuary is approximately 30 kilometres long, with a total catchment of 500 square kilometres (Sydney Institute of Marine Science 2016). The project area lies to the east of the confluence of the Parramatta and Lane Cove Rivers.

The bathymetry of Sydney Harbour is complex, and comprises dredged channels for shipping and a number of deep holes of about 28 to 45 metres, separated by shoals with depths of 3 to 5 metres (Sydney Institute of Marine Science 2016). There is a 45 metre deep hole immediately to the east of the project area.

The project lies within a highly urbanised catchment, and all natural watercourses have been historically replaced with constructed drainage systems. The only mapped watercourse within the study area is the Eastern Channel, which runs through the Marrickville dive site. The Eastern Channel is a concrete canal, built in the late 1890s (Sydney Water 2014), which drains to the Sydenham Pit to the west of the Marrickville dive site. The proposed tunnel between Marrickville dive site and Waterloo Stations runs beneath Sheas Creek, another concrete canal which forms the north-eastern extent of Alexandra Canal.

3.1.3 Land use

The study area is highly urbanised and is characterised by intensive residential, commercial and industrial land uses. Open space is largely dedicated to recreational use, rather than conservation. A comparison of the 1943 aerial photograph and the most recent aerial photograph available on the SIX maps website (Land and Property Information 2015) was carried out to review the changes in vegetation and development patterns in the study area (Table 7).

Table 7 Aerial photograph review

Site	1943 aerial photograph	Current aerial photograph
Chatswood dive site and northern surface works	The rail corridor appears to be entirely cleared, with no tree crowns visible; low shrub and grass vegetation may be present. The Ausgrid depot site consists of cleared parkland across most of the east of the site, with a row of planted trees along the eastern boundary of the site. The western and southern parts of the Ausgrid sites are occupied by residential houses.	Dense vegetation including tree crowns along the rail corridor south of Nelson Street; appears largely cleared north of Nelson Street. The Ausgrid depot site is mostly cleared and modified with industrial buildings and carparks. There are scattered tree crowns on the site, and rows of trees along the southern and eastern boundaries.
Artarmon substation	Residential houses and gardens occupy the site.	The most recent aerial photograph shows cleared grassland with trees bordering the north-western and north-eastern boundaries.
Blues Point temporary site	There appears to be disturbed low vegetation in the north-west of the site and cleared land with small buildings/structures in the south of the site. A small wharf extends southwards from the shoreline.	Cleared grassland across the entire site.
Barangaroo Station	Entirely cleared industrial port lands and water.	Planted trees along road edge adjoining the large cleared development site to the west.
Central Station	The buildings currently located between the suburban and country rail lines are visible, but there are no trees around them.	The site is largely cleared and developed, with a stand of trees located around buildings in the central area between the suburban and country rail lines.
Waterloo Station	The site appears to support a combination of small and large buildings; no trees or other vegetation are clearly visible.	Site supports mostly industrial buildings; no trees or other vegetation present.
Marrickville dive site	The site is entirely cleared with exposed soil visible. No vegetation is visible.	Mostly cleared industrial land; there is one patch of tree/shrub vegetation

Site	1943 aerial photograph	Current aerial photograph
		adjoining the northern edge of the rail corridor.

3.2 Desktop studies

3.2.1 Literature review

Urban Ecology Strategic Action Plan (City of Sydney 2012)

The *Urban Ecology Strategic Action Plan* outlines the City of Sydney's approach to biodiversity management over a ten-year timeframe. Baseline biodiversity surveys were conducted across the Sydney LGA in 2010 as part of the Plan.

Almost all of the original vegetation and other natural features of the City have been removed or modified, and biodiversity values within the LGA have been greatly reduced since European colonisation in 1788. Some small areas of naturally occurring vegetation, including possible remnants, were identified in the LGA during the surveys. Vegetation representative of five recognisable vegetation communities was identified and mapped:

- Sydney Turpentine Ironbark Forest
- Coastal Saltmarsh
- Coastal Swamp/Alluvial Forest
- Mangrove Forest
- Coastal Sandstone Outcrop Forest.

These vegetation communities are all considered to be of conservation significance at a local level, and three (Sydney Turpentine Ironbark Forest, Coastal Saltmarsh and Coastal Swamp/Alluvial Forest) are representative of endangered ecological communities. No naturally occurring vegetation communities were mapped in or near the survey sites. The vegetation in the south and east of Prince Alfred Park is mapped as "Indigenous/mostly indigenous plantings".

Approximately 365 indigenous flora species were recorded in the LGA and individuals of around 20% of the total were considered likely to be naturally occurring. No threatened plant species were recorded. A total of 81 exotic species were recorded, including four weeds of national significance, 13 noxious weeds and 20 environmental weeds.

A total of 99 fauna species were confirmed in the LGA comprising 87 native species (with an additional two unconfirmed) and 12 introduced species. This included:

- 70 bird species, including seven introduced species;
- 13 mammal species (with an additional two unconfirmed microchiropteran bats), including five introduced species;
- 11 reptile species; and
- Five frog species.

The following threatened species were identified:

- Green and Golden Bell Frog (*Litoria aurea*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Powerful Owl (*Ninox strenua*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Long-nosed Bandicoot (*Perameles nasuta*)

There were also possible records of the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) during surveys. None of the threatened species were identified at any of the

project sites, however, it is noted that the Grey-headed Flying-fox forages over a large and broad area at night.

The Long-nosed Bandicoot, while not a threatened species, was identified as likely to be part of the Endangered Population in Inner Western Sydney. The species was recorded in Alexandria and at the University of Sydney campus. This population is known to include Marrickville and Canada Bay LGAs with the likelihood that it also includes Canterbury, Ashfield and Leichhardt LGAs. The listing may be extended to the City of Sydney LGA given that the individuals present in the area are likely to be part of the wider inner west population.

Marrickville Biodiversity Strategy 2011-2021 (Australian Museum Business Services)

The Marrickville Biodiversity Strategy contains information on the biodiversity within the Marrickville LGA, including threatened species, populations and ecological communities.

The strategy lists the following threatened fauna as being known to occur in the Marrickville LGA:

- Long-nosed Bandicoot population in inner western Sydney (Endangered Population)
- Green and Golden Bell Frog
- Grey-headed Flying-fox
- Powerful Owl

There have also been potential recordings of the Eastern Bentwing-bat and Eastern Freetail-bat in the Marrickville LGA.

3.2.2 Vegetation mapping

DECCW (2009) mapped the vegetation of the Sydney Metropolitan Catchment Management Authority (CMA) Area. The Sydney CMA Area encompasses the eastern portions of the Sydney Metropolis, extending from the coastline to the catchments that flow to the Parramatta, Georges and Hacking River. The study area is within the Sydney Metropolitan CMA Area.

No remnant native vegetation communities were mapped in the study area. There is some mapped vegetation within and adjacent to the survey sites; all of this is classified under the map unit Urban Exotic/Native. The closest mapped native vegetation community to the study area is an area of Blue Gum High Forest mapped approximately 250 metres west of the Chatswood dive site (Figure 4a to 4c).

Figure 4a Vegetation mapping of the study area (DECCW 2009)(north)

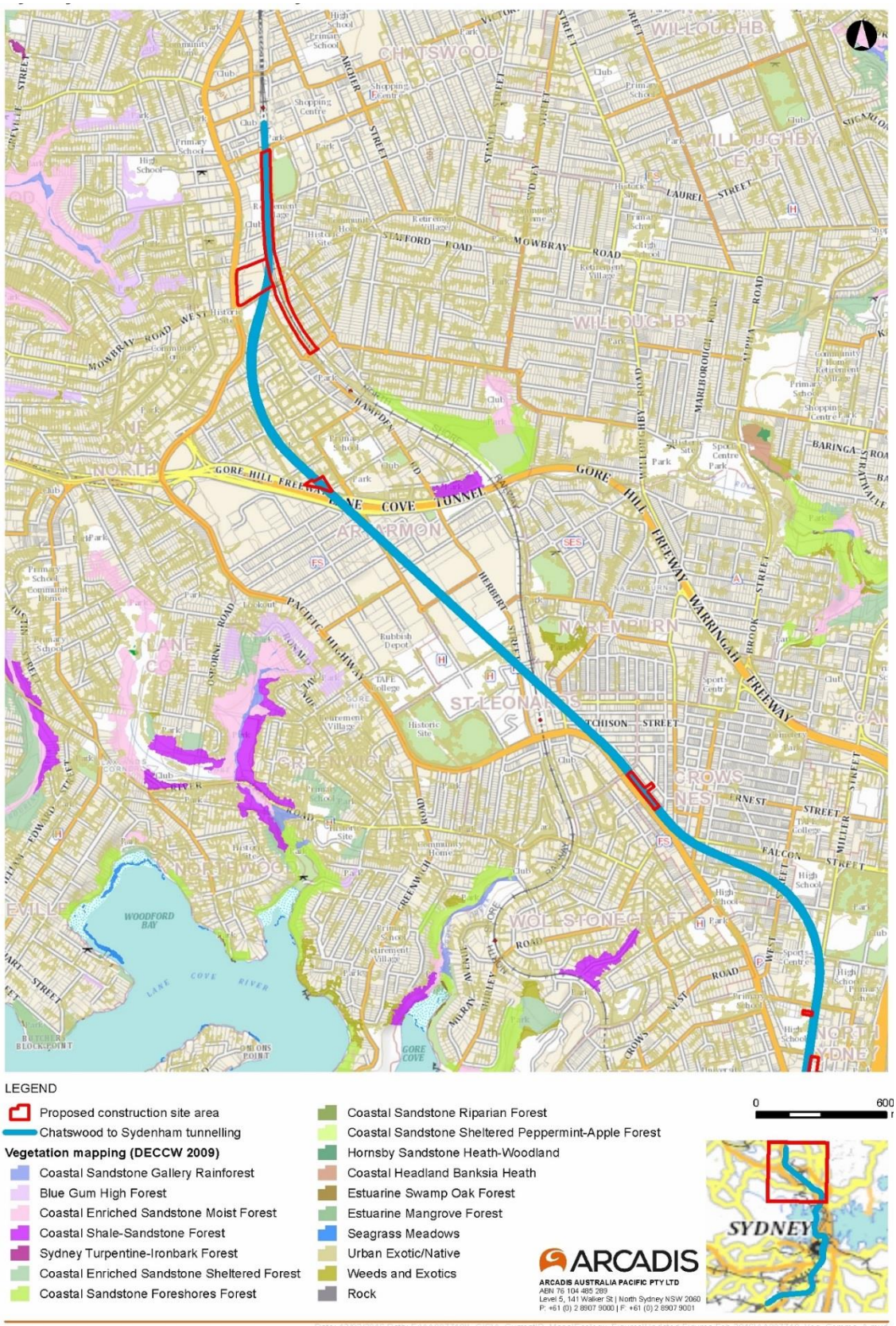


Figure 4b Vegetation mapping of the study area (DECCW 2009)(centre)

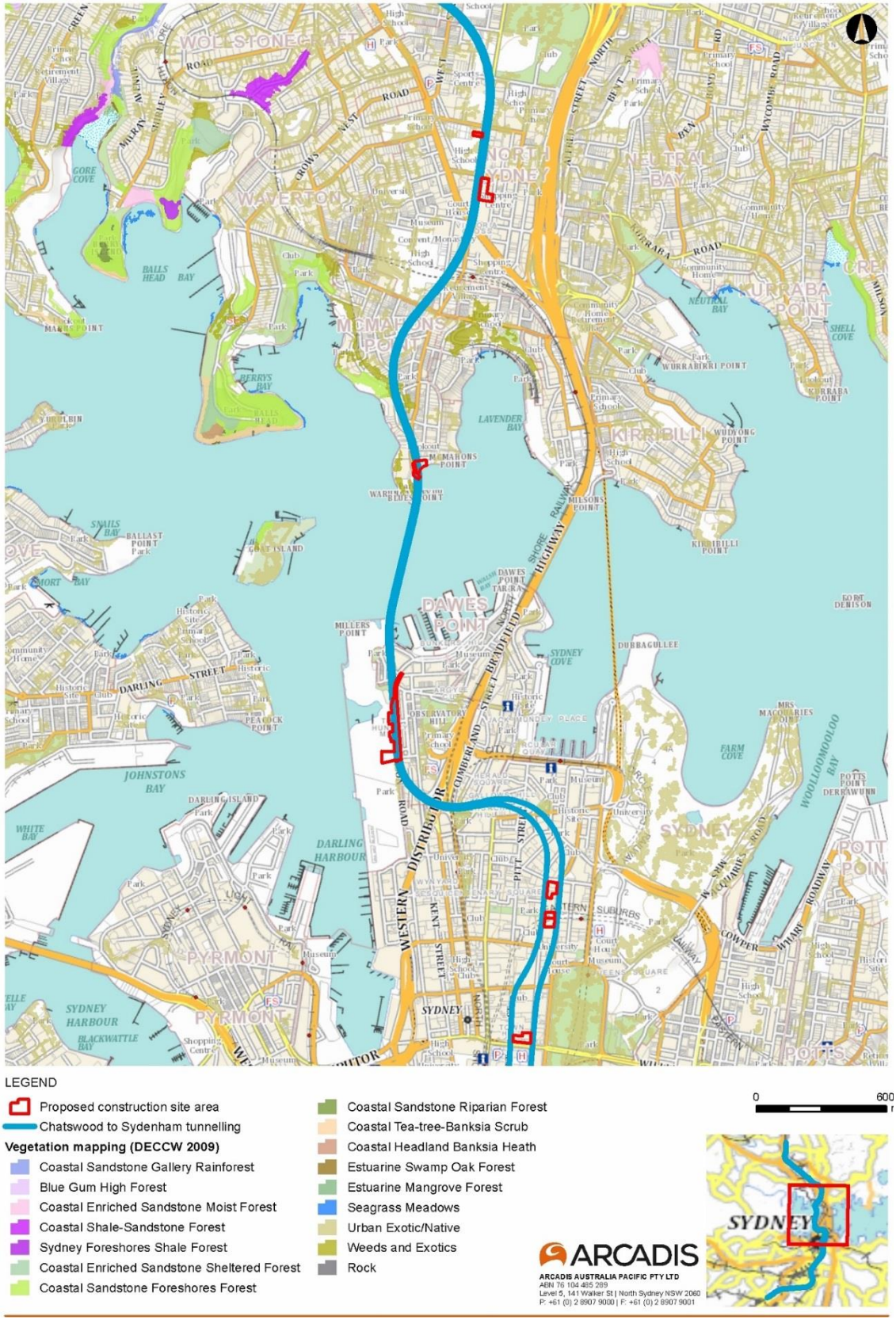
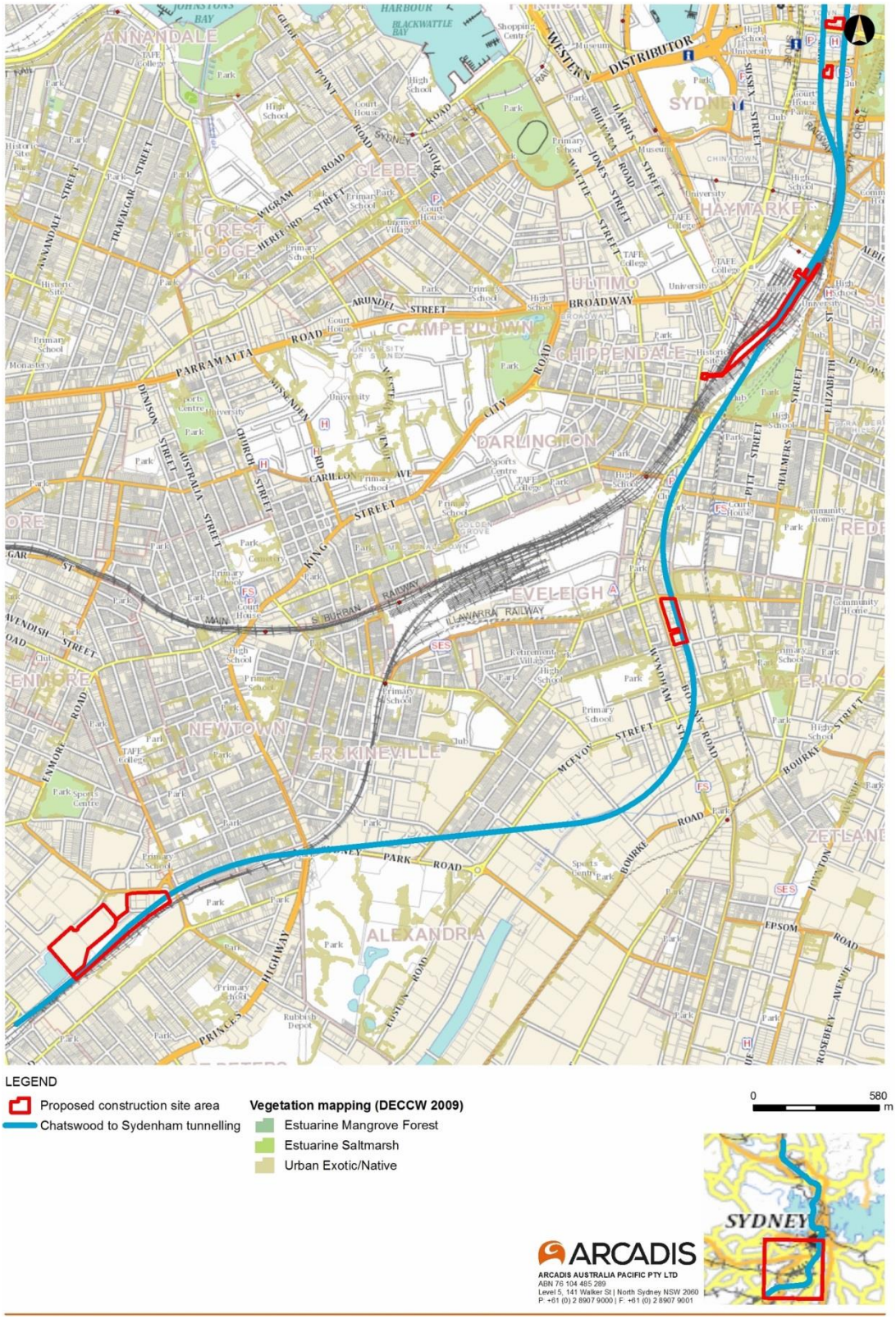


Figure 4c Vegetation mapping of the study area (DECCW 2009)(south)



3.2.4 Database searches

A search of the DoE Protected Matters Search Tool identified thirteen threatened ecological communities (TECs) listed under the EPBC Act that are known or likely to occur within 10 kilometres of the study area:

- Blue Gum High Forest of the Sydney Basin Bioregion Critically - Endangered
- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion - Endangered
- Coastal Upland Swamps in the Sydney Basin Bioregion - Endangered
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion - Critically Endangered
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest - Critically Endangered
- Eastern Suburbs Banksia Scrub of the Sydney Region - Endangered
- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia - Critically Endangered
- *Posidonia australis* seagrass meadows of the Manning-Hawkesbury ecoregion - Endangered
- Shale Sandstone Transition Forest of the Sydney Basin Bioregion - Critically Endangered
- Subtropical and Temperate Coastal Saltmarsh - Vulnerable
- Turpentine-Ironbark Forest in the Sydney Basin Bioregion - Critically Endangered
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion - Endangered
- Western Sydney Dry Rainforest and Moist Woodland on Shale - Critically Endangered

It is considered unlikely that any of the identified TECs occur within the study area; all vegetation mapped within the study sites by DECCW (2009) is classified as Urban Exotic/Native, and the closest area of mapped TEC is Blue Gum High Forest located approximately 250 metres west of the Chatswood dive site.

The Protected Matters Search also identified 42 threatened flora species, 59 threatened fauna species and 78 migratory fauna species listed under the EPBC Act that are known or likely to occur within 10 kilometres of the study area. The likelihood of each threatened species occurring in the study area was assessed (Appendix B).

A search of the NSW Wildlife Atlas found records of 51 threatened flora species and 86 threatened fauna species within 10 kilometres of the study area. The likelihood of each threatened species to occur in the study area was assessed (Appendix B). Species restricted to pelagic marine environments were excluded from the assessment in Appendix B due to the absence of these habitats from potential impact areas. Species occurring in coastal and estuarine environments are included and assessed.

No threatened plant species are considered likely to occur within the study area, with the possible exception of planted specimens (Appendix B).

The Grey-headed Flying-fox (*Pteropus poliocephalus*), a Vulnerable species under the TSC Act and EPBC Act, was considered to have a high likelihood of occurrence at Chatswood and Barangaroo and a moderate likelihood of occurrence at Central Station. Four fauna species were found to have a moderate likelihood of occurrence. This included two Vulnerable species listed under the TSC Act, Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and Eastern Freeetail-bat (*Mormopterus norfolkensis*), the Southern Right Whale (*Eubalaena australis*), listed as Endangered under the TSC Act and EPBC Act.

The habitats of each of these species on the relevant site(s) are discussed in section 3.4.

3.3 Field survey

All seven of the assessed sites are located in highly developed and disturbed urban areas, with limited native flora and fauna habitat values and low habitat connectivity. A summary of the biodiversity features at each of the assessed sites within the study area is provided below.

Chatswood dive site (northern) and northern surface works

Figure 5 Chatswood dive site (northern) and northern surface works boundary

Figure 6 Chatswood dive site (northern) and northern surface works

Flora

The Chatswood dive site and northern surface works comprises the section of the rail corridor between Albert Avenue in the north and Brand Street in the south, associated road overbridges and the Ausgrid depot site immediately west of the rail corridor, between Mowbray Road and Nelson Street.

The section of the rail corridor north of Nelson Street was almost entirely cleared of vegetation at the time of site inspection, and the western slope face had been shotcreted. The only remaining vegetation visible was scattered (*Ageratina adenophora* (Crofton Weed) at the rail track edge, a single *Pittosporum undulatum* (Sweet Pittosporum) at the base of the western slope near the Nelson Street overbridge, and a large tree of *Eucalyptus saligna x botryoides* (Sydney Blue Gum) at the top of the western slope just north of Nelson Street.

Between Nelson Street and Mowbray Road, there appeared to be planted native vegetation in the rail corridor, mixed with invasive exotic species. The western slope was characterised by planted native trees and shrubs, mostly *Acacia binervia* (Coast Myall) and *Acacia decurrens* (Black Wattle), with a dense midlayer dominated by the noxious weed *Genista linifolia* (Flax-leaved Broom) with scattered occurrence of other native and exotic shrub species. On the eastern slope, the vegetation consisted of an overgrown strip at the top of a tall retaining wall, with planted native shrub and groundcover species mixed with *Genista linifolia* and other weedy exotic species.

Between Mowbray Road and Brand Street, the vegetation ranged from dense native and exotic tree and shrub cover to weedy grass cover. The vegetation on the western side of the rail line in this section could not be inspected due to access restrictions but appeared from the eastern side to support large stands of native and exotic shrubs and trees. The vegetation on the eastern side of the rail line included dense stands of trees including the native species *Pittosporum undulatum* (Sweet Pittosporum) and a single *Syncarpia glomulifera* (Turpentine), the non-local native species *Lophostemon confertus* (Brush Box), thickets of the exotic tree *Acer negundo* (Box-elder Maple), and a huge tree of *Ficus elastica* (Rubber Tree) near the southern end. Exotic vines were observed to be abundant in this area, particularly *Anredera cordifolia* (Madeira Vine), *Cardiospermum grandiflorum* (Balloon Vine) and *Ipomoea indica* (Blue Morning Glory).

The Ausgrid depot site was not accessed during the current site inspections, but viewed from adjoining streets; this site was characterised by planted native and exotic trees.

Earlier fieldwork for the project undertaken by GHD in late 2014 and mid 2015 identified two vegetation types within the rail corridor section of the Chatswood dive site: ‘Exotic forest or scrub’ and ‘Planted native vegetation’. Blue Gum High Forest was identified in Artarmon Reserve, approximately 370 metres south-east of the Chatswood dive site.

Fauna

The Chatswood dive site and northern surface works has limited fauna habitat values due to lack of native vegetation, urban development and high levels of disturbance from road and rail traffic. Common urban birds were observed at this site including Noisy Miner (*Manorina melanocephela*), Sulphur-crested Cockatoo (*Cacatua galerita*) and Eastern Koel (*Eudynamys orientalis*).

The depot was not accessible at the time of survey, though parts of the depot could be viewed from adjacent land. Scattered trees are present within the depot and around the southern boundary. A potential hollow-bearing tree was located in the middle of the depot. A nest box and a hollow-bearing tree were observed on the southern boundary of the depot. The remainder of the depot contains buildings and hardstand. Most buildings did not appear suitable for microbats. No microbats were recorded during Anabat surveys of this site.

The rail corridor comprises narrow sections of vegetated slopes between the rail line and adjacent houses. Mature trees and shrubs are present, including fruiting and flowering shrubs that would provide foraging habitat for urban birds and arboreal mammals. The groundcover is densely grassed where tree cover was low and sparse in sections of high tree cover.

Two concrete road overbridges are present in this site. Crevices in the bridge deck could provide roosting habitat for microbats. The bridges are subject to high levels of road and rail traffic and as such, suboptimal for microbats. None were observed during targeted surveys.

Earlier fieldwork for the project undertaken by GHD in late 2014 and mid 2015 did not identify any threatened fauna species within the Chatswood dive site. Calls potentially attributable to the threatened microbat species Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) was recorded in Artarmon Reserve, approximately 370 metres south-east of the Chatswood dive site, amongst a cluster of hollow-bearing trees.

Artarmon substation

Figure 7 Artarmon substation site boundary

Flora

The vegetation of the Artarmon site comprised cleared grassland lined by trees and shrubs. At the time of inspection the construction of a temporary extension of Artarmon Public School was occurring. The site was inspected from the western boundary and south-east corner. Trees adjoining the site to the east appeared to be mostly *Eucalyptus saligna* (Sydney Blue Gum).

Fauna

The Artarmon site would provide some foraging and nesting habitat for common urban fauna. It otherwise has limited habitat value for fauna due to the disturbed nature of the site including urban development and roads.

Blues Point temporary site

Figure 8 Blues Point temporary site boundary

Figure 9 Blues Point temporary site

The Blues Point temporary site comprises cleared mown grassland adjacent to the foreshore of Sydney Harbour. The dominant species across the site is the cosmopolitan native grass *Cynodon dactylon* (Couch). The foreshore has been modified with a brick retaining wall and concrete boat ramp. The site has limited fauna habitat value, though shorebirds could occur as vagrants on the shoreline or in grassland behind it. The boat ramp was not inspected from the water, and as such, the presence of microbat habitat in the underside of the boat ramp cannot be ruled out.

Barangaroo Station

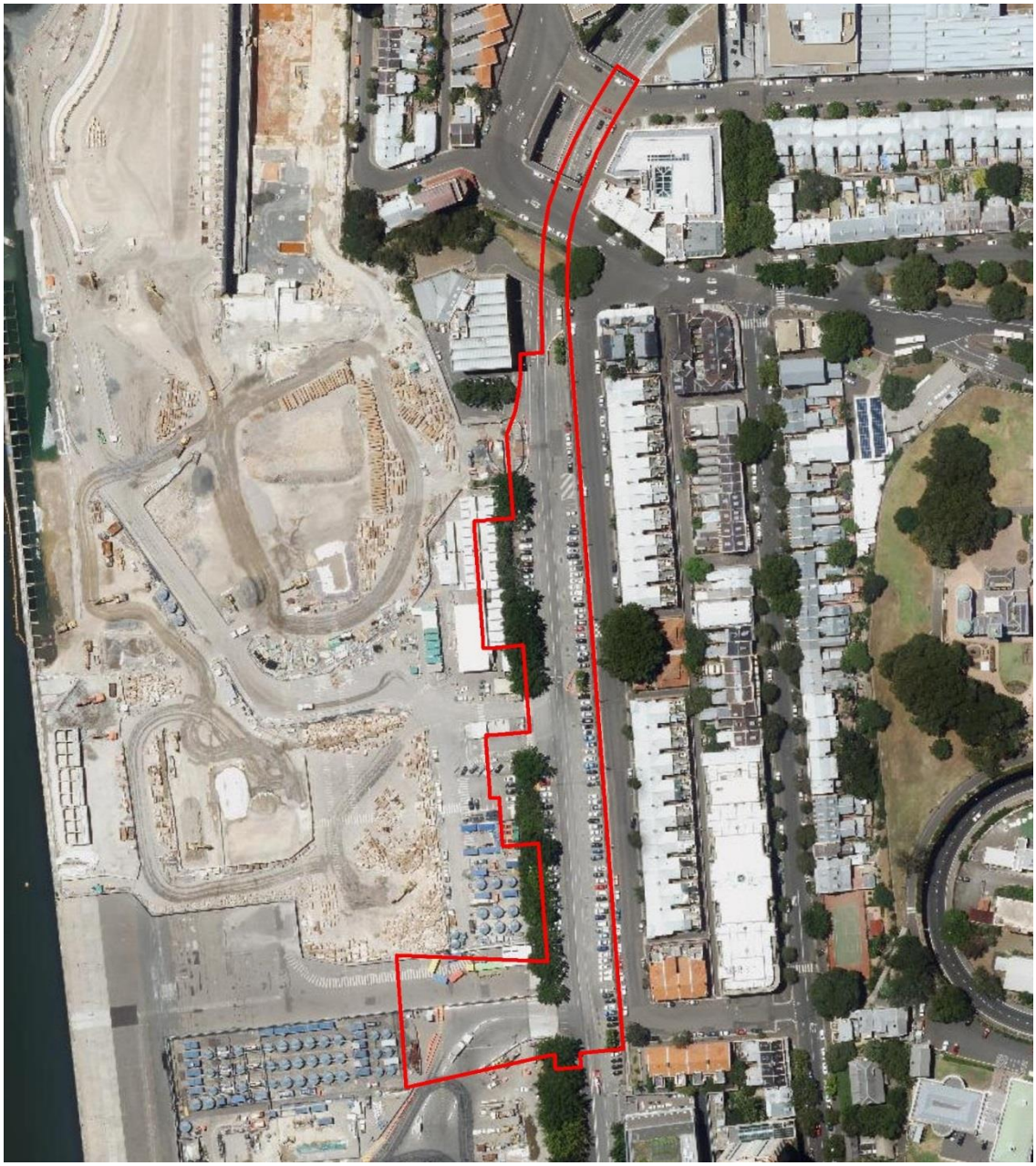


Figure 10 Barangaroo site boundary

Flora

The area inspected comprised the stretch of Hickson Road between the southern extent of High Street and the Munn Street tunnel to the north. The vegetation of this site consists of planted street trees within a highly modified urban context. On the western side of Hickson Road is a row of planted *Ficus microcarpa* var. *hillii* (Hills Weeping Fig). The only other vegetation in the street comprises occasional exotic landscape plantings.

Fauna

Fauna habitats at the Barangaroo site were restricted to scattered planted street trees (*Ficus microcarpa* var. *hillii*) and a small patch of landscaped vegetation with palm trees, succulents and grasses. Street trees would provide foraging habitat and shelter for common fauna adapted to urban environments. Common native and exotic birds were observed during the field survey including Common Myna (*Sturnus tristis*), Rock Dove (*Columba livia*) and Rainbow Lorikeet (*Trichoglossus haematodus*). Just south of the site, a White-plumed Honeyeater (*Lichenostomus penicillatus*) was observed foraging in roadside shrubs. Fig trees at this site could provide foraging habitat for the Grey-headed Flying-fox when fruiting.

Central Station

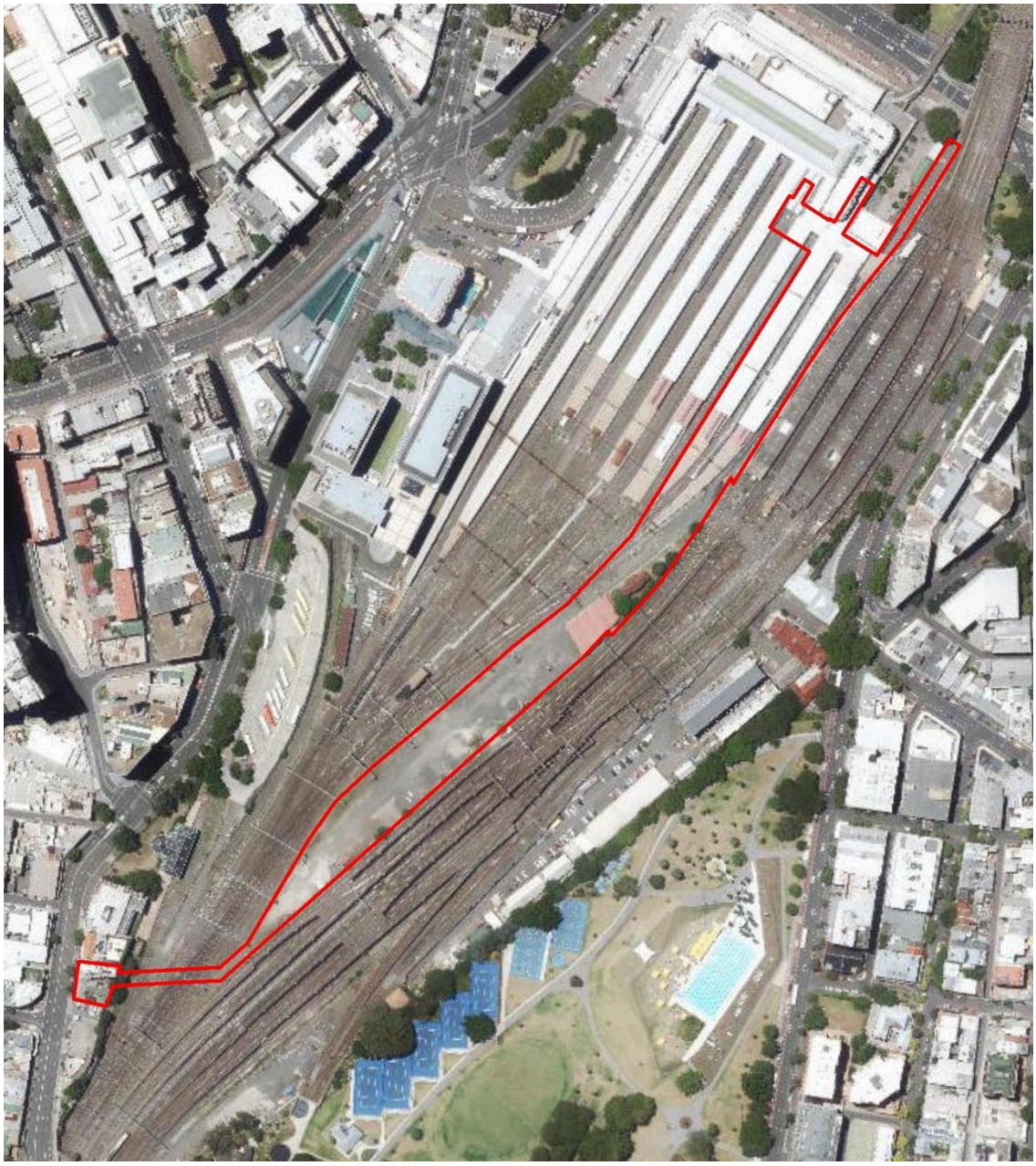


Figure 11 Central station site boundary

Figure 12 Central Station site

Flora

The Central Station site is a major railway hub within the centre of Sydney. The site consists of the strip between the suburban and country railway lines and is mostly hardstand with a railway platform, a few planted/regenerating trees and buildings in the middle section. This area was not inspected on foot, but was observed from passing trains to support native and exotic trees and shrubs including *Celtis* sp., *Jacaranda mimosifolia, Morus* sp. and *Cyathea cooperi.*

Fauna

The site has limited fauna habitat value due to the highly disturbed and developed nature of the site. The trees and buildings were viewed from a distance. It is possible that buildings could provide roosting habitat for microbats, though unlikely due to their location within the middle of a busy railway station.

The trees and in the middle of the site would provide limited shelter and foraging habitat for fauna that inhabit disturbed environments. Similarly, the eaves of the train platform could provide shelter and nesting habitat for fauna that inhabit disturbed environments such as Rock Dove.

Waterloo Station

Figure 13 Waterloo site boundary

Figure 14 Waterloo site

Flora

The Waterloo site was comprised entirely of buildings and there was no vegetation observed on the site.

Fauna

The buildings at the Waterloo study site were inspected from the outside at street level. Based on this inspection, the buildings did not appear suitable for microbats due to the high levels of activity within, lack of suitable insulation and lack of entry/exit points. No microbats were observed or recorded during Anabat surveys of this site.

Marrickville dive site (southern)

Figure 15 Marrickville dive site (southern) boundary

Figure 16 Trees adjoining rail corridor at Marrickville dive site (southern)

Flora

Vegetation in the Marrickville dive site was limited to planted and regrowth native and exotic species, mainly along the south-eastern boundary of the site. The site was inspected from the adjoining section of rail corridor, as access to the site was restricted.

Tree species observed include local native species such as *Eucalyptus crebra* (Narrow-leaf Ironbark), *Eucalyptus robusta* (Swamp Mahogany), *Casuarina glauca* (Swamp oak), *Allocasuarina littoralis* (Black She-oak) and *Cupaniopsis anacardioides* (Tuckeroo), as well as exotic trees and shrubs including *Schinus areira* (Peppercorn), *Celtis sinensis* (Chinese Hackberry), *Plumeria rubra* (Frangipani) and *Nerium oleander* (Oleander). Trees appeared to have been planted along the fenceline in landscaping areas and most eucalypts were about 0.2 to 0.3 metres in diameter at breast height.

The ground layer was highly modified, with areas of fill and mounds of uncontained soil observed; groundlayer species were mainly weedy exotic grasses and herbs, with *Megathyrsus maximus* (Guinea Grass), *Paspalum dilatatum* (Pasapalum), *Ehrharta erecta* (Panic Veldtgrass), *Pennisteum setaceum* (Fountain Grass), *Bidens pilosa* (Cobblers Pegs), *Ageratina adenophora* (Crofton Weed), *Cestrum parqui* (Green Cestrum), *Araujia sericifera* (Mothvine) and *Parietaria judaica* (Asthma Weed) all commonly observed.

Vegetation in the remainder of the Marrickville dive site was confined to planted trees and shrubs in nature strips and landscape areas associated with the industrial buildings. There were some trees of *Eucalyptus robusta* and *Melaleuca linariifolia* (Flax-leaved Paperbark) growing immediately to the west of the canal where it adjoined Sydney Steel Road.

Fauna

A total of 15 vertebrate fauna species were recorded within or in proximity to Marrickville dive site, including 3 mammal species and 12 bird species.

One threatened fauna species was recorded on the site: Grey-headed flying fox (*Pteropus poliocephalus).* Grey-headed flying fox is listed as a Vulnerable species under both the EPBC Act and TSC Act. A large number of Grey-headed flying foxes were observed flying over the site, likely flying out from the permanent camp at Wolli Creek, located four kilometres south-west of the dive site. This camp is estimated to support up to 20,000 Grey-headed flying foxes and is listed as a Nationally Important camp for the species (DoE 2014). No Grey-headed flying foxes were observed foraging within the site, however several were observed visiting eucalypt trees in proximity to the dam, adjoining the site to the west. The study area offers a small area of marginal foraging habitat for the species, due to the presences of known feed trees such as *Eucalyptus robusta* (Swamp Mahogany) and *Pittosporum undulatum* (Sweet Pittosporum) (Eby and Law 2008). These trees occur in low abundances in an isolated patch of trees located on the rail corridor boundary.

All other native fauna species recorded are considered common and abundant throughout their ranges, such as Rainbow Lorikeet, Noisy Miner (*Manorina melanocephala*), Australian Raven (*Corvus coronoides)* and Magpie Lark *(Grallina cyanoleuca).* Exotic species identified included Starling (*Sturnus vulgaris),* Common Myna (*Acridotheres tristis)* and Cat *(Felis catus).* Calls of one microbat species, Gould's Wattled Bat (*Chalinolobus gouldii*) were recorded in proximity to the Sydenham Pit, located immediately west of the site.

Fauna habitat complexity is low across the site, given the highly urbanised nature of the site and surrounding locality, which is characterised by industrial and residential development, arterial roads and the rail corridor. Scattered trees and shrubs along the rail corridor boundary (Figure 18) and street trees offer potential foraging, sheltering and roosting habitat to birds. Patches of dense groundlayer vegetation (dominated by exotic grasses and herbs), stockpiled timber rail sleepers and ground timber offers potential sheltering and foraging habitat to small mammals and reptiles. The sparse vegetation of the site offers a small and marginal area of potential foraging habitat to microbats. Notable habitat features such as hollow-bearing trees, intact native vegetation, hydrological features, logs and rocky features are absent.

Figure 17 Limited fauna habitat features of the rail corridor

Figure 18 Scattered trees along the rail corridor boundary

Figure 19 Gaps beneath the roof of warehouses on Sydney Steel road could allow microbats to access potential roosting habitat

Potential microbat roosting habitat was identified in Bedwin Road overbridge, located 30 metres to the east of the site. Warehouses and industrial buildings adjoining the rail corridor to the north did not appear to support potential microbat roosting habitat, however, microbats could possibly roost within two large warehouses on Sydney Steel Road. Microbats could gain access to these warehouses via visible gaps below the roof (Figure 19). Existing culverts beneath the site could offer additional microbat roosting habitat.

3.4 Threatened species, populations and communities

The study area is highly modified and has been historically cleared of native vegetation. No naturally occurring vegetation communities were observed during site inspections, and none of the vegetation in the study area meets the criteria for any threatened ecological community listed under the EPBC Act or the TSC Act. The closest area of TEC mapped by DECCW (2009) is some fragmented patches of Blue Gum High Forest located approximately 250 metres west of the Chatswood dive site.

No threatened flora species were recorded, and given the low native flora habitat values of the study area, there is a low likelihood of any occurring, with the exception of planted non-local native specimens.

As discussed in Section 3.2.3, the following four fauna species listed under the EPBC Act and/or TSC Act, were considered to have a high or moderate likelihood of occurrence at one or more of the sites:

- Grey-headed Flying-fox – Vulnerable under TSC Act and EPBC Act
- Eastern Freetail-bat – Vulnerable under TSC Act
- Eastern Bentwing-bat – Vulnerable under TSC Act
- Southern Right Whale – Endangered under TSC Act and EPBC Act

The Grey-headed Flying-fox has been recorded frequently in the Sydney area with 461 records of the species within 10 kilometres of the study area.

The DoE National Flying-fox monitoring viewer (DoE 2015) visually presents camp census data collected via the National Flying-fox Monitoring Program. The viewer identifies three Nationally Important Flying-fox camps within 10 kilometres of the project: at Gordon, approximately 5 kilometres north of the study area; at Wolli Creek, approximately 3.5 kilometres south-west of the study area; and at Centennial Park, approximately 3.3 kilometres east of the study area. Three other camps which are not considered Nationally Important are also identified within 10 kilometres of the study area: at the Royal Botanic Gardens, Gladesville and Balgowlah.

It is noted that a relocation program of the Grey-headed Flying-fox colony formerly present in the Royal Botanic Gardens (approximately 0.5 kilometres east of the study area) was carried out in 2012 (REF) The monitoring data for the Royal Botanic Gardens camp available on the National Flying-fox monitoring viewer states that between November 2012 and February 2015 the camp was monitored, but no Flying-foxes were found.

The Grey-headed Flying-fox is found in urban gardens and feeds on the fruit of rainforest trees and vines. Fig trees are present at Chatswood and in the Barangaroo road reserve which would provide a foraging resource for this species. As such, it has a high likelihood of occurrence at these two sites. The species was recorded flying over the Marrickville dive site and was observed visiting trees immediately to the south-west of the site. It is unlikely to occur at the remaining sites.

There are 82 records of the Eastern Bentwing-bat within 10 kilometres of the study sites and 10 records of the Eastern Freetail-bat. The Eastern Freetail-bat roosts in hollow-bearing trees which are present at the Chatswood dive site and northern surface works. The Eastern Freetail-bat also roosts in buildings, as does the Eastern Bentwing-bat. Microbats are attracted to roosts that have a large thermal mass and remain warm at night (Keeley and Tuttle 1999). Buildings at the Waterloo Station, Chatswood dive site and northern surface works, Central Station, and Marrickville dive site generally did not appear suitable for these microbat species, however, internal inspections were not undertaken and many of the buildings were not accessible for survey. Based on external visual inspections and aerial photographs, most buildings appeared to be unsuitable for microbat roosts as they would be unlikely to maintain warm or stable temperatures. The buildings at the Marrickville dive, Chatswood dive, and Waterloo Station sites generally comprise factories/stores with high corrugated iron rooves. One brick building in the Ausgrid depot at the Chatswood dive site had eaves and potential flyways, however, no microbats were recorded during the survey at this site. Buildings at Central Station had well-sealed tiled rooves with brick walls.

Further, two rail bridges at the Chatswood dive site could provide habitat for both species. The bridges are constructed of concrete and contain crevices that could provide roosting habitat, however, close inspection of the underside of the bridges was not possible. No microbats were detected in either bridge during targeted surveys. One common microbat species, Gould's Wattled Bat, was recorded in the vicinity of the Sydenham Pit near the Marrickville dive site, however this would not be impacted by the proposed works.

However, given microbats avoid foraging in noisy environments (Shaub *et al.* 2008) the sites would be suboptimal for both microbat species due to their locations within highly developed and disturbed environments close to rail and road corridors. Both species are considered to have a moderate likelihood of occurrence at the Waterloo Station, Chatswood dive site and northern surface works, Central Station and Marrickville dive site.

There are eight records of the Southern Right Whale within 10 kilometres of the study sites. Southern Right Whales visit southern Australia during the winter months, and they are increasingly found in NSW waters. The whales are often seen in very shallow water, including estuaries and bays. The species is not known to regularly occur in Sydney Harbour, however, it has been recorded close to Blues Point, likely as a vagrant.

3.5 Groundwater dependent ecosystems

A search of the National Atlas of Groundwater Dependent Ecosystems (BOM 2015) did not identify any Groundwater Dependent Ecosystems within the study area.

The section of the study area between Central and Sydenham (ie Central Station, Waterloo Station and Marrickville dive site) is located within land that forms part of the Botany Sands Groundwater Source, subject to the provisions of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011. The Botany Sands Groundwater Source extends to the Botany Wetlands, which includes a high priority groundwater dependent ecosystem listed on Schedule 4 of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011.

3.6 Noxious weeds

Seventeen exotic species recorded in the study area are declared noxious under the NSW Noxious Weeds Act 1993 for either the Willoughby, North Sydney, Sydney and/or Marrickville LGAs (Table 8).

Table 8 Plant species recorded in the study area listed under the NSW Noxious Weeds Act 1993 for Willoughby, Sydney, North Sydney and/or Marrickville LGAs.

Scientific name	Common name	Control class	Listed control area (LGA)	Location in study area
Anredera cordifolia	Madeira Vine	4	Willoughby	Chatswood dive site and northern surface works
Arundo donax	Giant Reed	4	All	Chatswood dive site and northern surface works
Asparagus aethiopicus	Asparagus Fern	4	All	Chatswood dive site and northern surface works, Marrickville dive site
Cardiospermum grandiflorum	Balloon Vine	4	Willoughby	Chatswood dive site and northern surface works

Scientific name	Common name	Control class	Listed control area (LGA)	Location in study area
Celtis sinensis	Chinese Hackberry	4	All	Central station, Marrickville dive site
Cestrum parqui	Green Cestrum	3	All	Marrickville dive site
Chrysanthemoides monilifera subsp. monilifera	Boneseed	1	All	Chatswood dive site and northern surface works
Cinnamomum camphora	Camphor-laurel	4	Willoughby	Chatswood dive site and northern surface works, Marrickville dive site
Genista linifolia	Broom	4	All	Chatswood dive site and northern surface works
Genista monspessulana	Montpelier Broom	3	Marrickville, Willloughby	Chatswood dive site and northern surface works
Ipomoea indica	Blue Morning Glory	4	Willoughby	Chatswood dive site and northern surface works, Marrickville dive site
Lantana camara	Lantana	4	All	Chatswood dive site and northern surface works, Marrickville dive site
Ligustrum lucidum	Broad-leaved Privet	4	All	Chatswood dive site and northern surface works, Marrickville dive site
Ligustrum sinense	Small-Leaved Privet	4	All	Chatswood dive site and northern surface works
Ochna serrulata	Mickey Mouse Plant	4	Willoughby	Chatswood dive site and northern surface works
Olea europaea subsp. cuspidata	African Olive	4	Willoughby	Chatswood dive site and northern surface works
Ricinus communis	Castor Oil Plant	4	All	Marrickville dive site

The *NSW Noxious Weeds Act 1993* imposes obligations on occupiers of land to control noxious weeds declared for their area. The control requirements for the classes of noxious weeds recorded in the study area are presented in Table 9.

Table 9 Weed control classes and requirements

Control Class	Weed type	Control requirements
Class 1 State Prohibited Weed	Plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.	The plant must be eradicated from the land and that land must be kept free of the plant
Class 3 Regionally Controlled Weed	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.	The plant must be fully and continuously suppressed and destroyed.
Class 4 Locally Controlled Weed	Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

3.7 Aquatic Habitats

3.7.1 Aquatic Vegetation

Aquatic vegetation is protected under the *Fisheries Management Act* 1994 (e.g. saltmarsh, seagrasses, and mangroves) and a permit is required for any works which are likely to harm aquatic vegetation. Expansive seagrass meadows are not known to occur between Walsh Bay and Lavender Bay within the Project area, however small isolated and fragmented patches of *Zostera capricorni* have been identified on the western and northern parts of Lavender Bay (DPI 2005). Other fragmented patches of *Z.capricorni* are also located to the north-west in Berrys Bay. Seagrasses are unlikely to be located away from the intertidal or shallow subtidal zones in the Harbour due to the deep and turbid waters which limit light available for photosynthesis. Only in the clearest waters can seagrasses grow to a depth of 12m (DPI 2007). Other aquatic macrophytes (saltmarsh, mangroves) are not known to occur within or near the project area. Kelp (*Ecklonia radiata*) and other algae are commonly found in the shallow subtidal areas within the Harbour, including Berrys Bay, Lavender Bay and Walsh Bay.

The population of the seagrass *Posidonia australis* in Sydney Harbour is listed as an endangered population under the FM Act, and forms part of an endangered ecological community listed under the EPBC Act. *P.australis* is not known to occur in the project area, with the closest recorded observations to the east near Darling Point.

The listed pest algal species, *Caulerpa taxifolia*, is not known to occur in the project area or in nearby Berrys Bay and at the Barangaroo development (DPI 2005; Worley Parsons, 2010; Haskonig Australia Pty Ltd 2015).

Lavender Bay near the southernmost tip of McMahons Point is designated as a Wetlands Protection Area in the *Sydney Harbour Regional Environmental Plan (Sydney Harbour Catchment) 2005*.

3.7.2 Benthic Fauna and Habitat

The harbour sediments at the nearby Barangaroo development in the south are dominated by silts, clays and sand, making up at least 95% of the sediment composition. The remainder is made up of gravel and cobbles (Worley Parsons, 2010; Haskonig Australia Pty Ltd 2015). Sediment composition in Berrys Bay contains the same particle size classes but is slightly coarser, with a smaller contribution of clay but a greater contribution of silt, sand and gravel (Worley Parsons 2010). Contamination is the harbour is widely reported and is typically associated with finer sediments.

As part of the environmental impact assessment, sediment samples from Sydney Harbour within the two grout zones were analysed for potential contaminants. Sediments here were a little coarser, consisting of muddy, sandy gravels and muddy, gravelly sands and containing a lot of shell fragments. Elevated levels of mercury, lead, polychlorinated PCDD/Fs, DDD, total PAHs and TBT were detected.

The sediments within this region provide habitat for benthic infauna and epifauna. Those occupying nearby areas of Berrys Bay and Barangaroo include sponges, ascidians, polychaete worms, amphipods, crustaceans, cnidarians, brittle stars, bivalves and gastropods (Worley Parsons 2010; Marine Pollution Research 2014). No seagrasses or other vegetation have been identified at these locations in previous video tows.

Threatened benthic infauna or epifauna are not known to occur in the area.

3.7.3 Mobile Fauna

Fish species in Sydney Harbour include the common recreational fish species such as yellowfin bream (*Acanthopagrus australis*), tarwhine (*Rhabdosargus sarba*), snapper (*Chrsophrys auratus*), mullet (Family: Mugilidae), dusky flathead (*Platycephalus fuscus*), sand whiting (*Sillago ciliate*), leatherjackets (Family: Monocanthidae), luderick (*Girella tricuspidata*) and large tooth flounder (*Pseudorhombus arsius*).

The Black Rockcod is listed as a vulnerable species under the FM Act. The Black Rockcod is a reef dwelling species found along the NSW coastline. They inhabit caves, gutters, beneath bommies in near shore environments to depths of 50m (DPI 2012). Large juveniles can be found around rocky shores in estuaries. The proposed works is not expected to directly impact suitable habitat for the Black Rockcod, however the nearshore environments could provide suitable habitat and there is a notable, 45 metre deep hole immediately to the east of the project area (Figure 20).

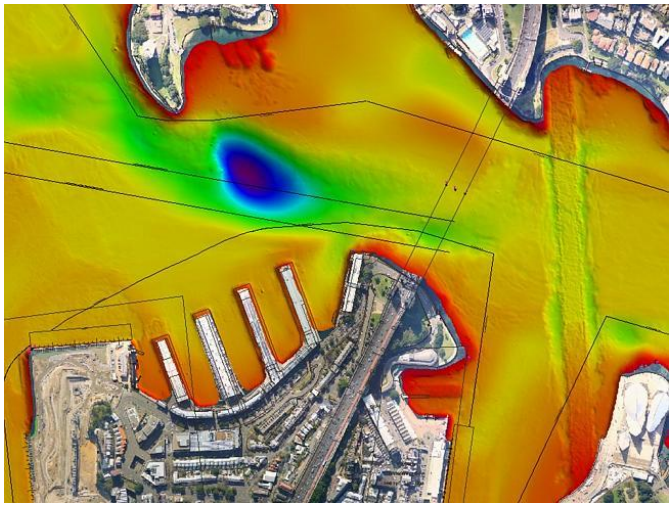


Figure 20 45m deep hole located to the east of the Project area (Sydney Ports n.d).

Sharks and marine birds and mammals are also known to occur in the area, including Bull Sharks, Little Penguins and dolphins. The Little Penguin population in the Manly Point area is listed as an Endangered Population under the TSC Act. Little Penguins are often observed feeding throughout the Harbour.

Pipefish and seahorses (*Syngnathids*) are protected under the FM Act and most species are listed Marine species under the EPBC Act. Along coasts, Syngnathids are commonly found near algae, weed or seagrass habitats or around man-made structures (e.g. jetties). Suitable habitat is not known to occur in the project area.

Due to the contamination which has been detected in sediments in Sydney Harbour, DPI Fisheries has advised that fish or crustaceans captured west of the Sydney Harbour Bridge should not be consumed.

4 IMPACT ASSESSMENT

4.1 Construction phase

4.1.1 Likely impacts

Loss of Native Vegetation

There is minimal native vegetation in the area to be impacted. Native vegetation is limited to planted trees and shrubs and occasional scattered regeneration of common native plant species.

Loss of Fauna Habitat

Clearing of vegetation at the project sites would result in the removal of fauna habitat. Planted trees and landscaped vegetation would be removed which could impact foraging habitat and shelter for fauna species, though impacts would be to a very small amount of vegetation and would therefore be minor and generally restricted to common fauna species that inhabit urban environments. Potential removal of fig trees at the Barangaroo Station, and Chatswood dive site and northern surface works could impact foraging habitat for the threatened Grey-headed Flying-fox. Up to two hollow-bearing trees and a nest box could be removed at Chatswood dive site and northern surface works which would impact roosting habitat/shelter for fauna, including Eastern Freetail-bat.

Removal of buildings and the Nelson Street bridge at the Chatswood dive site and northern surface works site as well as removal of buildings at Central Station, Waterloo Station and Marrickville dive site have the potential to impact roosting and nesting fauna including microbats. No microbats were observed within these sites during targeted surveys, but one call was recorded in the vicinity of the Sydenham Pit to the west of the Marrickville dive site. As such, there is a moderate likelihood of microbats occurring in the study area.

Mortality of Fauna Species

Fauna injury or mortality is most likely to occur during vegetation clearing activities, but also may result from collisions with vehicles or plant. The majority of fauna species recorded within the study area were highly mobile bird species. These species are likely to be able to move away from vegetation clearing activities quite readily. Any fauna inhabiting the hollows in hollow-bearing trees may be injured during tree-felling. This could potentially include hollow-dependent birds and mammals. Those animals that are unable to disperse away from areas under active clearing are also particularly susceptible to injury or death. This includes amphibians and reptiles.

Impacts to Threatened Species

The project has the potential to impact five threatened fauna species listed under the TSC Act, two of which are also listed under the EPBC Act. This includes the following species:

- Eastern Bentwing-bat – Vulnerable TSC Act
- Eastern Freetail-bat – Vulnerable TSC Act
- Grey-headed Flying-fox – Vulnerable TSC Act & EPBC Act
- Southern Right Whale – Endangered TSC Act & EPBC Act

The removal of up to two hollow-bearing trees at the Chatswood dive site and northern surface works has the potential to impact Eastern Freetail-bat roosting habitat. Removal of buildings and bridge removal/modification at Chatswood, Central, Waterloo and Marrickville could also affect this species and the Eastern Bentwing-bat through the removal of potential roosting habitat.

Impacts to the Grey-headed Flying-fox could occur from the removal of potential foraging habitat for this species at Barangaroo and Chatswood. An Assessment of Significance under the EPBC Act has been undertaken in Appendix A. Impacts to this species are not likely to be significant due to the small amount of potential habitat to be removed.

Impacts to Southern Right Whale could occur as a result of temporary disturbance for ground improvement works in Sydney Harbour. An Assessments of Significance under the EPBC Act has been undertaken in Appendix A. Impacts to this species are not likely to be significant due to the low likelihood of the species being injured or disturbed as a result of the proposed works.

Impacts to Aquatic Habitats

The potential impacts to aquatic habitats in Sydney Harbour from the proposed ground improvement works include:

- Direct physical disturbance to benthic habitat. The proposed grouting of unconsolidated sediments and potential anchoring of the barges will have a direct impact to the benthic infauna and epifauna. However these are shortlived, abundant taxa which are widespread throughout the Harbour. Displaced taxa can readily colonise neighbouring areas due to the abundance of similar habitat. The proposed activities would not significantly impact any species, populations or communities. No threatened benthic taxa are known to occur in the project area.
- Noise and vibration disturbances to mobile aquatic fauna. Noise and vibration are expected over the duration of the works. Sydney Harbour is a busy, highly used waterway with many boating and development activities. Mobile fauna have the ability to relocate during the works. The impact from the presence of barges and construction works is likely to be negligible.
- Water quality impacts from the resuspension of sediments (increased turbidity) and spills from plant and machinery. With the appropriate mitigation measures in place, sediment plumes are likely to be shortlived and will readily dissipate with the volume of Harbour traffic and tidal influence.
- Mobilisation and release of sediment contaminants. The mobilisation of contaminants can potentially increase contaminant concentrations in filter feeders and benthic foragers. Activities resulting in sediment resuspension in contaminated environments in NSW Harbours have been shown to increase metal accumulation in the Sydney Rock Oyster (*Saccostrea glomerata*) by increasing water column contaminants (Hedge *et al,* 2009). The Department of Primary Industries (Fisheries) currently advises that no fish or crustaceans should be consumed if captured west of the Sydney Harbour Bridge due to elevated levels of dioxins.

  Analysis of sediments collected from within the two proposed grout zones found elevated concentrations of organic contaminants and trace metals in the sampled sediments. Bioavailability tests found that almost all the lead present within sediments is readily bioavailable, but only about 10% to 30% of total mercury present is bioavailable. The majority of mercury in sediment is not present as methyl-mercury, the most toxic form of the element. Laboratory elutriation tests simulating resuspension of sediments sampled from the proposed grout zones in ambient seawater demonstrated that trace metals and all organic contaminants are likely to remain bound to sediment particles and would not be released into the water column.
- Spills from plant and machinery. Provided mitigation measures, including spill response and containment measures are in place to contain potential spills and leakages, the impact of spills should be controlled and any impacts minimised.
- Spread of marine pests (*Caulerpa taxifolia*) from the transportation of aquatic plant and machinery (e.g. barges). *C. taxifolia* is not known to occur in the Project area. If the appropriate care and mitigation measures are in place to avoid transportation of marine pests from other locations during transportation, no impact is expected.

- Temporary shading of marine vegetation from barge placement. Protected aquatic vegetation is not known to occur in the Project area (mangroves, saltmarsh, seagrasses). Macroalgae (e.g. *Ecklonia radiata*) is unlikely to occur at the depths of the proposed works, is abundant through the Harbour and utilises the available habitat (including artificial habitat such as rock walls, piles and other instream structures.

Impacts to Groundwater Dependent Ecosystems

A search of the National Atlas of Groundwater Dependent Ecosystems (BOM 2015) did not identify any Groundwater Dependent Ecosystems within the study area.

The section of the study area between Central and Sydenham (ie the Central Station, Waterloo Station and Marrickville dive site) is located within land that forms part of the Botany Sands Groundwater Source. The Botany Sands Groundwater Source extends to the Botany Wetlands, which includes a high priority groundwater dependent ecosystem.

At Waterloo Station, there is around four metres of sand near ground surface. The sand layer forms part of the Botany Sands Groundwater Source. Waterloo Station would be tanked and, as such, the sand layer would be hydraulically isolated (via permanent lining) from the station shaft, by design. As such, there would be no hydraulic connection between the project and the Botany Sands Groundwater Source and thereby no impact to the Botany Wetlands groundwater dependent ecosystem.

4.2 Operational phase

Fauna injury or mortality could result from collisions with trains. Impacts would be within urban areas or underground where it is unlikely many fauna species would occur.

4.3 Key threatening processes

The project may result in the operation of key threatening processes or the exacerbation of a key threatening process currently in operation in the study area. Key threatening processes are listed under the TSC Act and EPBC Act, and are generally defined as processes that adversely affect threatened species, populations or ecological communities, or could cause species, populations or ecological communities that are not threatened to become threatened.

The following Key Threatening Processes have been considered with regard to the project (Table 10):

Table 10 Key threatening processes

Act	Key Threatening Process	Applicability to Proposal
TSC Act	Loss of hollow-bearing trees.	Up to two hollow-bearing trees could be removed for the project.
TSC Act	Invasion and establishment of exotic vines and scramblers	Numerous exotic vines were recorded in the study area, particularly in the rail corridor within the Chatswood dive site. Species recorded within this area that are listed under the key threatening process include *Anredera cordifolia* (Madeira Vine), *Asparagus aethiopicus* (Ground Asparagus), *Cardiospermum grandiflorum* (Balloon Vine), *Delairea odorata* (Cape Ivy), *Hedera helix* (English Ivy), *Ipomoea indica* (Morning Glory), *Lonicera japonica* (Honeysuckle), *Tradescantia fluminensis* (Wandering Jew) and *Vinca major* (Periwinkle). There is a potential for disturbance during works to result in further spread of these species.

5 FBA ASSESSMENT

5.1 Landscape features

The FBA requires the assessment of landscape features to help describe the biodiversity values of the study area and assess the impacts of the project. Landscape features relevant to the FBA calculations are shown on Figure 21 and summarised in Table 11.

The project is a linear shaped development; as such, the landscape value has been assessed in accordance with the methodology in Appendix 5 of the FBA (OEH 2014).

Table 11 Landscape features

Landscape feature	Study area
IBRA bioregions and subregions	The study area is located within the Sydney Basin Bioregion and the Cumberland and Pittwater Subregions classified under IBRA (Interim Biogeographic Regionalisation for Australia).
Mitchell landscapes	The study area intersects the Pennant Hills Ridges, Port Jackson Basin, Ashfield Plains and Sydney - Newcastle Barriers and Beaches Mitchell Landscapes.
Rivers, streams and estuaries	The study area intersects the estuary of Sydney Harbour, however the project impacts will largely be beneath the harbour bed. The only mapped waterway in the study area is the canal that runs through the Marrickville dive site.
Wetlands	The project site does not contain any important wetlands as defined in the FBA. Lavender Bay near the southernmost tip of McMahons Point is designated as a Wetlands Protection Area in the Sydney Harbour Regional Environmental Plan (Sydney Harbour Catchment) 2005.
Native vegetation extent in landscape buffer	A landscape buffer of 550 m was applied to the centre line of the study area, in accordance with the methodology for assessing landscape value for linear shaped developments of multiple fragmentation impacts in Appendix 5 of the FBA. The landscape buffer of 550 m results in a buffer area of approximately 1985 ha. The current percent native vegetation cover in the 550 m landscape buffer is approximately 10% (192.24 ha out of the 1985 ha buffer). Of this 192.24 ha, only 7.82 ha has been defined as a natural vegetation community in the DECCW (2009) mapping, with the remaining 184.42 ha mapped as “Urban Exotic/Native”. This estimate of native vegetation extent includes planted and/or exotic vegetation cover and is different to the definition of native vegetation applied in offset calculations.
Score for percent current extent of native vegetation cover	The score for 6-10% native vegetation in the landscape buffer is 1.25.

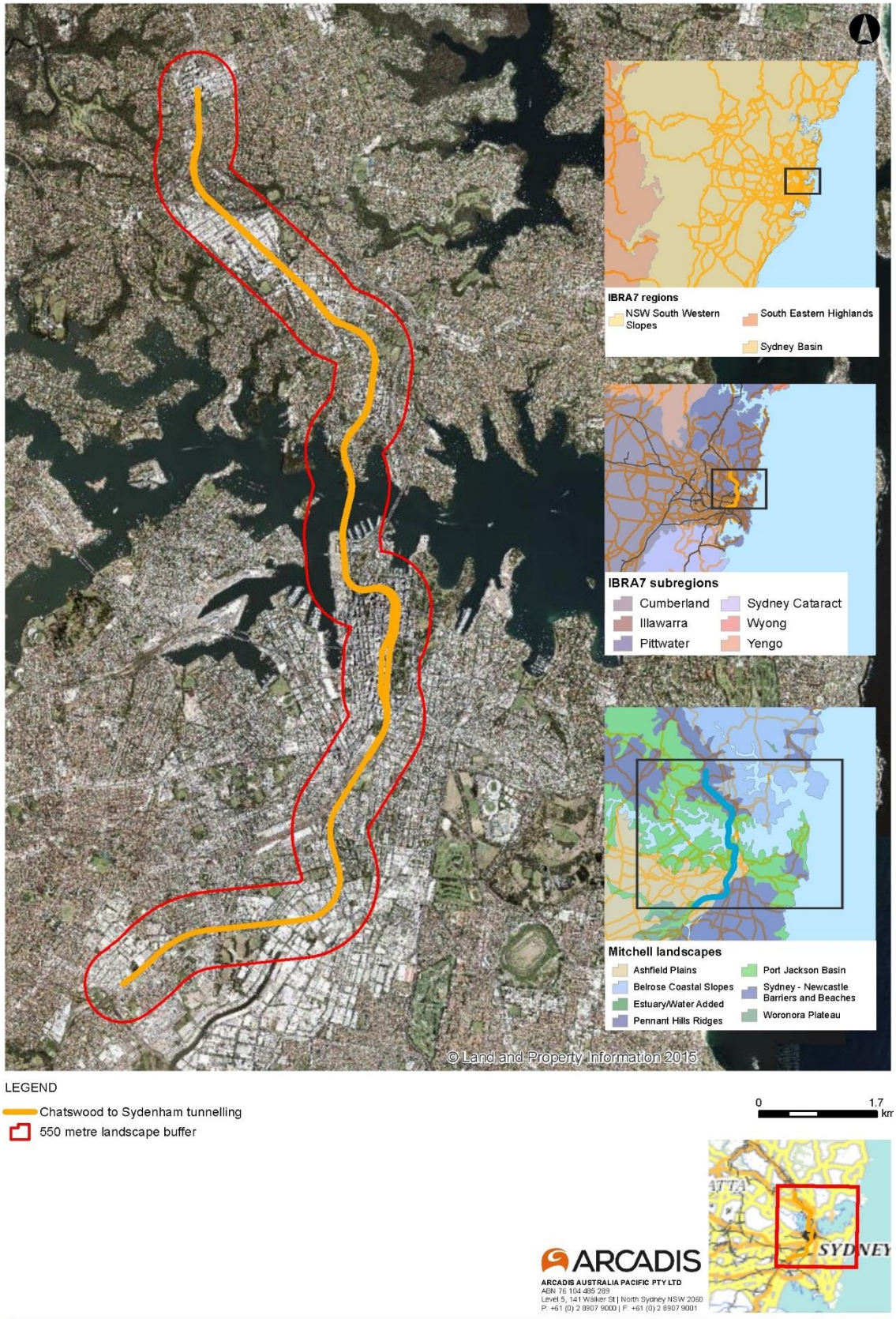
Landscape feature	Study area
Future native vegetation extent in the landscape buffer	The project would impact on up to 1.63 ha of mapped Urban Exotic/Native vegetation. This would result in a negligible reduction in the percent native vegetation cover in the landscape buffer, which would remain at approximately 10%.
Score for percent current extent of native vegetation cover	The score for future native vegetation in the landscape buffer would remain at 1.25.
Connectivity value	A connecting link is identified where native vegetation on the site adjoins native vegetation surrounding the site and the native vegetation is in moderate to good condition, has a patch size >1 ha, is separated by distance of <100 m (or <30 m for non-woody ecosystems) and is not separated by a hostile barrier such as a large water body or dual carriageway. Based on the above definition, there are no connecting links within or adjoining the study area. The vegetation adjoining the rail corridor on the Chatswood dive site does not meet the criteria as it is planted native and exotic vegetation with an exotic dominated understorey, and is not in moderate/good condition. It is noted that the definition of a state significant biodiversity link includes a riparian buffer 50 m around an important wetland or an estuarine area. The project crosses Sydney Harbour and there would be minor impacts within the harbour and in adjacent cleared land at Blues Point. However these impacts are not within a vegetated riparian buffer and are not considered to impact on connectivity in areas adjoining the harbour.
Patch size	N/A – as discussed, there is no native vegetation in moderate/good condition to be impacted by the project.
Area to perimeter ratio	N/A – no patches of native vegetation would be impacted by the project.
Landscape value score	The landscape value score for the site is 1.25.

5.2 Native vegetation

All vegetation identified within the study area is mapped as Urban – Exotic/Native by DECCW (2009) and field assessment has confirmed that most vegetation is planted or exotic regrowth.

None of the vegetation identified in the study area falls within the description for any Plant Community Types (PCTs) listed in the NSW Vegetation Information System database.

Figure 21 Landscape features



5.3 Threatened species

5.3.1 Ecosystem credit species

As there are no Plant Community Types within the project, no vegetation zones could be entered into the credit calculator and therefore a list of candidate ecosystem species for the project could not be generated. The threatened species identified in database searches were reviewed in the Threatened Species Profile Database and the credit class applicable to each species was determined (Appendix B).

Of the 82 threatened fauna species identified, 32 are associated with ecosystem credits in the Threatened Species Profile Database and six were identified as both ecosystem and species credit species in the TSPD. Species credits apply to breeding habitat and ecosystem credits apply to foraging habitat for these species.

Two species associated with ecosystem credits were considered to have a moderate or high likelihood of occurrence in some parts of the study area: Grey-headed Flying-fox (*Pteropus poliocephalus*) and Eastern Freetail-bat (*Mormopterus norfolkensis*). These species are discussed in sections 3.4 and impacts from the project are considered in section 4.

5.3.2 Species credit species

31 threatened fauna species identified in database searches are associated with species credits in the Threatened Species Profile Database. All threatened flora species are associated with species credits.

No threatened species associated with species credits, or their habitats, were identified in the study area.

OEH identified two threatened flora species requiring further consideration and provision of the information specified in s9.2 of the FBA:

- *Hibbertia* sp. Turramurra (Julian's Hibbertia)
- *Genoplesium baueri* (Bauer's Midge Orchid)

These species are discussed below in section 5.4.1.

5.4 Project impacts

5.4.1 Impacts on biodiversity that require further consideration

Section 9.2 of the FBA addresses biodiversity impacts that require further consideration. These are impacts that are considered to be complicated or severe, and require further consideration by the consent authority.

Under section 9.2.5 of the FBA, further consideration of the effects of a development on a threatened species or population that is specifically nominated in the SEARs as a species or population that is likely to become extinct or have its viability significantly reduced in the IBRA subregion if it is impacted on by the development. OEH nominated two threatened species in the SEARs as requiring further consideration under section 9.2: *Hibbertia* sp. Turramurra and *Genoplesium baueri.*

***Hibbertia* sp. Turramurra (Julian's Hibbertia)**

Hibbertia sp. Turramurra (syn. *Hibbertia spanantha*) is a decumbent shrublet up to 30cm high with linear leaves approximately 6mm long and bright yellow flowers approximately 20 mm wide. *Hibbertia* sp. Turramurra is listed as critically endangered under the TSC Act. The species was discovered in 2007 and is currently known from three locations in the northern Sydney suburbs of Turramurra, North Ryde and Cheltenham. In total, there are fewer than 20 plants occurring in the three known locations (NSW Scientific Committee 2015).

Due to the sensitive nature of the species, the exact locations of known records cannot be identified. However the three suburbs named are not in the vicinity of the project area, with the closest being North Ryde, approximately 2.5 kilometres west of the Chatswood dive site. It is therefore assumed that there are no known records of the species within or adjacent to the areas to be impacted by the project.

Habitat for the species is native forest with canopy species including *Eucalyptus pilularis, E. resinifera, Corymbia gummifera* and *Angophora costata*. The understorey is open with species of Poaceae, Orchidaceae, Fabaceae and Liliaceae. The known locations of *Hibbertia* sp. Turramurra are in close proximity to urban areas (NSW Scientific Committee 2015).

The vegetation recorded in the study area is fragmented and highly modified, and consists of planted native and exotic species or mostly exotic regrowth. No areas of suitable potential habitat for *Hibbertia* sp. Turramurra were identified.

***Genoplesium baueri* (Bauer's Midge Orchid)**

Genoplesium baueri is a terrestrial orchid 6-15 cm high, fleshy, brittle, yellowish green or reddish, with a sparse inflorescence of 1 to 3 cm in length, bearing 1 to 6 flowers. *Genoplesium baueri* is listed as Endangered under the TSC Act and EPBC Act. The species generally occurs in coastal areas, and its range extends from Ulladulla to Port Stephens. There are a number of older records of the *Genopesium baueri* from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga; no collections have been made from these locations in recent years.

There are 11 records of *Genoplesium baueri* in the NSW Bionet Wildlife Atlas within 10 kilometres of the study area; 10 of the records are dated between 1881 and 1918. There is one record dated from 2011, located approximately 7.5 km to the west of the Chatswood dive site.

Habitat for *Genoplesium baueri* is variously described as dry sclerophyll forest and moss gardens over sandstone (OEH 2016, NSW Flora Online) and heathland to shrubby woodland on sands or sandy loams or open forest, shrubby forest and heathy forest on well-drained sandy and gravelly soils (NSW Scientific Committee 2012). Plants do not regularly appear above ground every year, and individual plants may remain dormant in the soil. Flowering is between December and April and it has been suggested that flowering is enhanced by summer fires (NSW Scientific Committee 2014).

The vegetation recorded in the study area is fragmented and highly modified, and consists of planted native and exotic species or mostly exotic regrowth. No areas of suitable potential habitat for *Genoplesium baueri* were identified.

Neither *Hibbertia* sp. Turramurra nor *Genoplesium baueri* was recorded in the study area, and no potential habitat for the species was identified during surveys. Given the poor native flora habitat values and lack of nearby records of the species nominated for further consideration, it is considered unlikely that these species or their habitat would occur in the study area or adjacent areas, and therefore they will not be impacted by the project.

5.4.2 Impacts not requiring assessment or offset determination

An assessor is not required to assess areas of land on a development site without native vegetation, unless the SEARs issued for the project specifically require it.

The project area contains fragmented and highly modified vegetation that does not comprise native vegetation within the meaning of the FBA. Where vegetation does occur, there is no or very little native canopy or midstorey vegetation and the ground layer is generally dominated by exotic species. Most vegetation occurs on cuttings or fill associated with unnatural landforms.

The project site also includes buildings, hardstand areas and other infrastructure with occasional planted vegetation that do not comprise native vegetation within the meaning of the FBA and do not require further assessment.

5.5 Environmental values not assessed under the FBA

Biodiversity values not considered under the FBA include:

- Marine mammals
- Wandering sea birds
- Biodiversity that is endemic to Lord Howe Island.

There is potential for marine mammals to occur within Sydney Harbour, in the vicinity of the proposed ground improvement works.

Marine mammals recorded in Sydney Harbour include Southern Right Whale and Humpback Whale, Dwarf Minke Whale, Common Dolphin, Bottlenose Dolphin, Spotted Dolphin, New Zealand Fur-seal, Australian Fur-seal, Australian Sea-lion, Leopard Seal and Southern Elephant Seal. Of these species, only Southern Right Whale, Common Dolphin, Bottlenose Dolphin, New Zealand Fur-seal, Australian Fur-seal and Leopard Seal have been recorded in the vicinity of the proposed works; all other records are closer to the heads in the outer harbour.

The ground improvement works will be conducted from barges located to the west of Sydney Harbour Bridge. Pipes will extend underwater from the barges to the harbour bottom. Potential impacts to marine mammals from the proposed works could include increased collision risk, stress or disturbance to navigation from noise impacts, and water quality impacts. Given the low frequency and density at which marine mammals occur in Sydney Harbour, and the existing harbour traffic, it is considered unlikely that any marine mammals will be adversely affected as a result of the proposed works.

In addition, the FBA does not assess the direct impacts of a project that are not associated with clearing of vegetation. Examples of such impacts referenced in the FBA that may be relevant to the current project include:

- Vehicle strike.
- Downstream impacts on hydrology and environmental flows on surface vegetation and groundwater dependent ecosystems.

These types of impacts are assessed in Section 4 of this document.

6 ASSESSMENTS OF SIGNIFICANCE

Assessments of Significance were undertaken for relevant threatened species, listed under the EPBC Act that have a moderate or high likelihood of occurrence at at least one of the sites. The assessments of significance are provided in Appendix A.

Two threatened species are considered to have a high to moderate likelihood of occurrence in the study area: Grey-headed Flying Fox (*Pteropus poliocephalus*) and Southern Right Whale (*Eubalaena australis*).

The findings of the EPBC Act significant impact assessments are summarised in Table 12.

Table 12 Summary of EPBC Act Assessments

Threatened species or communities	Important population[1]	Likely significant impact?
Grey-headed Flying Fox (*Pteropus poliocephalus*)	No	No
Southern Right Whale (*Eubalaena australis*)	No	No

1) Important Population as determined by the Environment Protection and Biodiversity Conservation Act 1999, is one that for a vulnerable species:

   a) is likely to be key source populations either for breeding or dispersal

   b) is likely to be necessary for maintaining genetic diversity

   c) is at or near the limit of the species range.

7 MITIGATION MEASURES

Proposed biodiversity mitigation measures are listed in Table 13.

Table 13 Mitigation measures

ID	Mitigation measure	Applicable location(s)[1]
B1	An ecologist would be present during the removal of any hollow-bearing trees	CDS
B2	Potential bat roosting locations at Central Station, Waterloo Station and Marrickville dive site would be checked by a qualified ecologist or wildlife carer for presence of bats prior to demolition. Any bats found would be relocated.	CS, WS, MDS
B3	The local WIRES group and / or veterinarian would be contacted if any fauna are injured on site or require capture and / or relocation.	All except metro rail tunnels
B4	Procedures would be developed and implemented, in accordance with the National System for the Prevention and Management of Marine Pest Incursions, during Sydney Harbour ground improvement works to avoid transportation of marine pests from other locations, particularly the marine alga *Caulerpa taxifoli.*	GI

1 STW: Surface track works; CDS: Chatswood dive site; AS: Artarmon substation; CN: Crows Nest Station; VC: Victoria Cross Station; BP: Blues Point temporary site; GI: Ground improvement works; BN: Barangaroo Station; MP: Martin Place Station; PS: Pitt Street Station; CS: Central Station; WS: Waterloo Station; MDS: Marrickville dive site; Metro rail tunnels: Metro rail tunnels not related to other sites (eg TBM works); PSR: Power supply routes.

REFERENCES

Australian Museum Business Services (2011) *Marrickville Biodiversity Strategy 2011-2021.* Prepared by Australian Museum Business Services in association with Marrickville Council. Final report October 2011.

Bureau of Meteorology (BOM) (2015) Sydney - Observatory Hill (station 066062) Daily Weather Observations. Bureau of Meteorology Climate Data Online website: www.bom.gov.au/climate/data/ Accessed October 2015.

Chapman and Murphy (1989) *Soil Landscapes of the Sydney 1:100 000 Sheet* (Soil Conservation Service NSW, Sydney)

Churchill, S. (1998) *Australian Bats*. New Holland, Frenchs Forest.

City of Sydney (2012) *Urban Ecology Strategic Action Plan.*

DECCW (2009) *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area.* Department of Environment, Climate Change and Water NSW, Hurstville.

DoE (2014). *Draft EPBC Act Policy Statement: Camp management guidelines for the Grey-headed and Spectacled flying-fox.* Department of Environment, Canberra.

DoE (2015) *Census of Australian Vertebrates (CAVS) database*. Department of the Environment, Canberra

DoE (2015) National Flying-fox m*onitoring viewer.* http://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf accessed 14 October 2015.

(DPI 2005) *Mapping the Estuarine Habitats of – Port Jackson (map 1)*. Available from http://www.dpi.nsw.gov.au/research/areas/aquatic-ecosystems/estuarine-habitats-maps. Accessed 17 December 2015.

DPI (2007). *Primefact 629: Seagrasses.* Available from http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0019/203149/seagrasses-primefact-629.pdf. Accessed 17 December 2015.

DPI (2012). *Black Rockcod (*Epinephelus daemelii*) recovery plan.* Aquaculture, Conservation and Marine Parks Unit, Port Stephens Fisheries Institute.

Eby P. and Law B. (2008). *Ranking the feeding habitats of Grey-headed flying foxes for conservation management.* Report for The Department of Environment and Climate Change (NSW) & The Department of Environment, Water, Heritage and the Arts October 2008.

Geochemical Assessments (2016) *Sediment Quality Assessment: Sydney Metro Harbour Tunnel.* Report prepared for Jacobs. Dated 29 March 2016.

GHD (2015) *Sydney Rapid Transit: Northern Corridor Works Biodiversity Assessment Report.* Prepared for Transport for NSW. Dated October 2015.

Harden G. (1990-1993) *Flora of New South Wales Volumes 1-4.* University of New South Wales Press, Kensington.

Harden G. (2002) *Flora of New South Wales Volume 2 (Revised Edition).* University of New South Wales Press, Kensington.

Haskonig Australia Pty Ltd (2015). *Barangaroo Stage 1. Barangaroo Concept Plan Amendment (MP06_0162 MOD8). Marine Ecology, Water Quality and Contamination Sediment Impact Assessment.* Prepared for Lend Lease (Millers Point) Pty Ltd.

Hedge, L.H, Knott, N.A, and Johnston, E.L. (2009). Dredging related metal bioaccumulation in oysters. *Marine Pollution Bulletin* 832-840.

Keeley, B.W. & Tuttle, M.D. (1999) *Bats in American Bridges*. Bat Conservation International, Inc. Resource Publication No. 4.

Land and Property Information (2015) Spatial Information eXchange website: maps.six.nsw.gov.au accessed October 2015

Marine Pollution Research (2014). *Proposed Barangaroo Ferry Hub. Environmental Impact Statement – Aquatic Ecology Assessment.* Report prepared for RPS Australia East Pty Ltd.

OEH (2014) *Framework for Biodiversity Assessment.* Office of Environment and Heritage, September 2014

OEH (2015) *NSW Bionet: Atlas of NSW Wildlife.* http://www.bionet.nsw.gov.au

OEH (2015) *Long-nosed Bandicoot population in inner western Sydney – profile.* http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20107 accessed 28 May 2015.

Royal Botanic Gardens and Domain Trust (2015) PlantNET - The Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney, Australia (version 2.0). http://plantnet.rbgsyd.nsw.gov.au

Schaub, A., Otswald, J. & Siemers, B.M. (2008) *Foraging bats avoid noise*. The Journal of Experimental Biology 211: 3174-3180.

Sydney Water (2014) *Heritage Item: Sydenham Pit & Drainage Pumping Station No.001.* https://www.sydneywater.com.au/SW/water-the-environment/what-we-re-doing/Heritage-search/heritage-detail/index.htm?heritageid=4571743. Accessed 15 February 2016.

Willoughby City Council (2014) Urban Bushland Plan of Management Volume 1, Policy and Management Issues, 2014-2019

Worley Parsons (2010). *Barangaroo Stage 1. Barangaroo Concept Plan Amendment (MP06_0162 MOD4). Marine Ecology, Water Quality and Contamination Sediment Impact Assessment.* Prepared for Lend Lease (Millers Point) Pty Ltd.

APPENDIX A

Assessments of Significance

Assessments of significance have been undertaken for threatened species listed under the EPBC Act which are considered to have a high or moderate likelihood of occurrence at one or more of the study sites.

Assessments of significance have been prepared for the following threatened entities listed under the EPBC Act:

Threatened entity	EPBC Act Status	Likelihood of occurrence
Grey-headed Flying-fox (*Pteropus poliocephalus*)	Vulnerable	High
Southern Right Whale (*Eubalaena australis*)	Endangered	Moderate

Grey-headed Flying-fox (*Pteropus poliocephalus*)

Grey-headed Flying-fox is listed as Vulnerable under the EPBC Act. In NSW, the Grey-Headed Flying-Fox occurs along the east coast, eastern slopes of the Great Dividing Range and the tablelands. The species may be found in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps, while additional foraging is provided by urban gardens and cultivated fruit crops.

A large number of Grey-Headed Flying-Foxes were recorded flying over the Marrickville dive site during the field survey undertaken 17 February 2016, likely flying out from the permanent camp at Wolli Creek, located four kilometres south-west of the dive site. This camp is estimated to support up to 20,000 Grey-headed flying foxes and is listed as a Nationally Important camp for the species (DoE 2014). No Grey-headed flying foxes were observed foraging within the Marrickville dive site, however several were observed visiting eucalypts trees in proximity to dam, adjoining the dive site to the west. The study area offers a small area of marginal foraging habitat to the species, due to the presences of known feed trees such as *Eucalyptus robusta* (Swamp Mahogany) and *Pittosporum undulatum* (Sweet Pittosporum) (Eby and Law 2008). These trees occur in low abundances in an isolated patch of trees located on the rail corridor boundary.

Grey-headed Flying Fox was not recorded at any of the other sites during the current survey. Fig trees are present at Chatswood and in the Barangaroo road reserve and eucalypts at Chatswood would provide a potential foraging resource for this species. As such, it has a high likelihood of occurrence at these two sites. There are 461 records of the species within a 10 kilometre radius of the three sites.

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

Important populations are those that may be identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

The Grey-headed Flying-fox has no separate or distinct populations (DoE 2014b). The species constantly exchanges genetic information between camps throughout its geographic range. The project sites are not used for permanent roosting or as maternity camps. They are not at the limit of the species range. The removal of a small amount of potential foraging habitat for the species would not lead to a long-term decrease in the size of the population, including any local camps.

Reduce the area of occupancy of an important population

The project would results in the removal of a very small amount of potential foraging habitat for the Grey-headed Flying-fox in an urban and developed environment. This would not reduce the area of occupancy of the species.

Fragment an existing important population into two or more populations

The removal of potential foraging habitat for the project would not fragment the population of the Grey-Headed Flying-Fox into two or more populations.

Adversely affect habitat critical to the survival of a species

Habitat that is critical to the survival of the species as identified in the species' National Recovery Plan (DECCW 2009) is natural foraging habitat that meets at least one of the following criteria:

- Productive during winter and spring, when food bottlenecks have been identified
- Known to support populations of >30,000 individuals within a 50 kilometre radius (the maximum foraging distance of an adult)
- Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)
- Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions)
- Known to support a continuously occupied camp

The project sites are unlikely to be critical to the survival of the species.

Disrupt the breeding cycle of an important population
There is no known maternity roosting camp of Grey-headed Flying-foxes at the project sites, nor could they support one. The breeding cycle of this species would not be disrupted as a result of the project.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The project would involve the removal of a small number of feed trees of the Grey-headed Flying-fox. This foraging resource does not comprise a significant area of foraging habitat within the locality such that the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The action is unlikely to result in the establishment of an invasive species that is harmful to the Grey-Headed Flying-Fox.

Introduce disease that may cause the species to decline, or

The action is highly unlikely to introduce disease that may cause the Grey-Headed Flying-Fox to decline.

Interfere with the recovery of the species

There is currently no approved Recovery Plan in place for the Grey-Headed Flying-Fox. A Draft National Recovery Plan for the Grey-headed Flying-fox was prepared in July 2009 (DECCW 2009).The Draft National Recovery Plan lists 13 specific objectives for the five-year timeframe of the Plan. Of these, two could be considered relevant to the project:

- Objective 1: To identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes throughout their range.
- Objective 2: To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes.

The project is consistent with these two objectives of the Draft National Recovery Plan. The potential foraging habitat that would be removed as a result of the project is not likely to be key winter or spring foraging habitat nor is it likely to be critical to the survival of this species in the locality.

Conclusion

The project would require the removal of a small amount of potential foraging habitat for this species. The amount of potential foraging habitat to be cleared is not considered to be a significant area of habitat or of importance to the long-term survival of Grey-headed Flying-fox in the locality. As a result, it is considered unlikely that the project represents a significant impact to the vulnerable species Grey-headed Flying-fox. A Referral to the Minister is not required for this species.

Southern Right Whale (*Eubalaena australis*)

Southern Right Whale is listed as Endangered under the EPBC Act. The Southern Right Whale occurs in temperate and subpolar waters of the Southern Hemisphere. In Australian coastal waters, Southern Right Whales occur along the southern coastline including Tasmania, and generally as far north as Sydney on the east coast and Perth on the west coast. In coastal areas the species mostly occurs within two kilometres off shore and tend to be distinctly clumped in aggregation areas (DSEWPC 2012).

Southern Right Whale has previously been recorded in Sydney Harbour, but is not known to frequently occur in the locality. It is considered to have a moderate likelihood of occurrence in the study area, near the proposed ground improvement works.

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population

Southern Right Whales in Australian waters were until recently considered to be one population, however following genetic research it appears that south-east Australian right whales may be demographically separate from those in south-west Australia. The total Australian population is estimated to be about 3500 individuals; abundance in south-east Australia is currently very low in comparison with historical evidence.

The proposed ground improvement works in Sydney Harbour would not result in any decrease to the size of the Southern Right Whale population, as individuals would be highly unlikely to occur in the vicinity of the project area during works, and in the event an individual is present, the likelihood of injury or impacts from the proposed works is extremely low.

Reduce the area of occupancy of the species

The project would not result in the removal of any areas of occupancy for the species. Sydney Harbour is very rarely visited by Southern Right Whales, and the disturbance from ground improvement works will be temporary only.

Fragment an existing population into two or more populations

The proposed ground improvement works would not fragment the population of the Southern Right Whale into two or more populations.

Adversely affect habitat critical to the survival of a species

No critical habitat has been defined under the EPBC Act for the Southern Right Whale. Biologically important areas for the species, as identified in the Conservation Management Plan for the Southern Right Whale (DSEWPC 2012) are:

- Large established aggregation areas used for calving and nursing
- Small and potentially emerging aggregation areas used for calving and nursing
- Coastal connecting habitat
- Historic high use areas or suitable habitat in parts of the coastal range currently not used or under-used and potentially important to support full species recovery.

These areas are presented in maps in the Conservation Management Plan; all are located on the southern coasts of Western Australia, South Australia and Victoria, with a historically high use area on the far south coast of NSW. The project area is distant from any areas habitat critical to the survival of the species.

Disrupt the breeding cycle of a population

Southern Right Whales are highly mobile migratory species who travel thousands of kilometres between habitats. It is not known where conception occurs, although groups apparently involved in mating have been observed in Australian coastal waters. Calving grounds are located in mid to lower latitudes, and have been identified on the southern coasts of Western Australia, South Australia and Victoria (DSEWPC 2012).

The breeding cycle of this species would not be disrupted as a result of the project.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The project would involve the temporary disturbance of a small area of Sydney Harbour, where Southern Right Whales have very rarely been observed. The area does not comprise a significant area of habitat within the locality, and this temporary disturbance would not cause the species to decline.

Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat

No invasive species are known to be harmful to the Southern Right Whale.

Introduce disease that may cause the species to decline, or

The action is highly unlikely to introduce disease that may cause the Southern Right Whale to decline.

Interfere with the recovery of the species

A Conservation Management Plan for the Southern Right Whale in 2012 (DSEWPC 2012).The Conservation Management Plan lists 10 specific objectives for the ten-year timeframe of the Plan

- Maintain and improve existing legal and management protection
- Assessing and addressing anthropogenic noise (shipping, industrial and seismic)
- Reducing commercial fishing entanglements
- Impacts of climate variability and change
- Addressing vessel collisions
- Addressing infrastructure and coastal development impacts
- Measuring and monitoring population recovery
- Investigating the two-population model
- Understanding offshore distribution and migration
- Characterising behaviour and movements.

The project is consistent with the objectives of the Conservation Management Plan and would not interfere with the recovery of the species.

Conclusion

Southern Right Whale has previously been recorded in Sydney Harbour, but is not known to frequently occur in the locality. In coastal waters, the species is predominantly found along the southern coastline of Australia, where calving grounds are located. The project would require the temporary disturbance of a small area of Sydney Harbour for ground improvement works. Southern Right Whales would be highly unlikely to occur in the vicinity of the project area during works, and in the event an individual is present, the likelihood of injury or impacts from the proposed works is extremely low. As a result, it is considered unlikely that the project represents a significant impact to the endangered species Southern Right Whale. A Referral to the Minister is not required for this species.

APPENDIX B

Assessments of likelihood of occurrence

Following are tables that list the assessments of likelihood of occurrence for threatened species listed under the TSC Act and EPBC Act. The species are grouped into separate tables for threatened flora, threatened fauna and migratory fauna species.

Fauna: Likelihood of occurrence of State and Commonwealth threatened fauna species and populations identified in database searches

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Anseranas semipalmata	Magpie Goose	Vulnerable		Ecosystem	10	30/04/1988	Mainly found in shallow wetlands. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands. Most breeding now occurs in monsoonal areas; breeding is unlikely in south-eastern NSW.	Low Study area does not support preferred habitat.
Anthochaera phrygia	Regent Honeyeater	Critically Endangered	Critically Endangered	Species	11	17/06/1996	Occurs in temperate eucalypt woodlands, most commonly box-ironbark associations and wet lowland coastal forests. Nests usually constructed in eucalypts, casuarinas or mistletoes. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes	Low Study area does not support preferred habitat.
Arctocephalus forsteri	New Zealand Fur-seal	Vulnerable		N/A	4	19/05/1998	Occurs in Australia and New Zealand. Reports of non-breeding animals along southern NSW coast particularly on Montague Island, but also at other isolated locations to north of Sydney. Prefers rocky parts of islands with jumbled terrain and boulders.	Low Species prefers oceanic environments and rocky shores. Could occur in Sydney Harbour as a vagrant.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Arctocephalus pusillus doriferus	Australian Fur-seal	Vulnerable		N/A	13	2/03/2002	Reported to have bred at Seal Rocks, near Port Stephens and Montague Island in southern NSW. Haul outs are observed at isolated places along the NSW coast. Prefers rocky parts of islands with flat, open terrain.	Low Species prefers oceanic environments and rocky shores. Could occur in Sydney Harbour as a vagrant.
Botaurus poiciloptilus	Australasian Bittern	Endangered	Endangered	Species	5	16/11/2014	Widespread distribution but uncommon across south-eastern Australia. Favours permanent freshwater wetlands with tall, dense vegetation, where it forages at night for amphibians, invertebrates and crustaceans. Nests are built within densely vegetated wetlands on a platform of reeds.	Low Study area does not support preferred habitat.
Burhinus grallarius	Bush Stone-curlew	Endangered		Ecosystem	6	30/01/2011	Rare throughout south-eastern Australia where it inhabits open forests and woodlands. Forages nocturnally for insects and small vertebrates. Nests in a shallow scrape on the ground.	Low Study area does not support preferred habitat.
Calidris ferruginea	Curlew Sandpiper	Endangered	Critically Endangered	Ecosystem	454	26/08/2013	Distributed around most of the coastline of Australia. Occurs along the entire coast of NSW, particularly in the Hunter Estuary. Occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable		Ecosystem	92	3/06/2010	Found in the central NSW coast and Tableland areas, including Canberra and the Hawkesbury/Nepean and Sydney Metro region. However the Hornsby and Kuringai 'population' which is the last known breeding population in the Sydney metro region is endangered (estimated 18 - 40 pairs). Usually frequents forested areas with old growth attributes required for nesting and roosting purposes. Also utilises less heavily timbered woodlands and urban fringe areas to forage, but appears to favour well-timbered country.	Low Study area does not support preferred habitat.
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable		Ecosystem	9	22/06/2013	Occurs from the coast inland to the southern tablelands and central western plains of NSW. Inhabits forests and woodlands supporting Casuarina and Allocasuarina species. Requires large hollow-bearing eucalypts for nesting habitat.	Low Study area does not support preferred habitat.
Caretta caretta	Loggerhead Turtle	Endangered	Endangered	EEC/Marine	0	N/A	Found in tropical and temperate waters off the Australian coast. In NSW they are seen as far south as Jervis Bay. Loggerhead Turtles choose a wide variety of tidal and sub-tidal habitat as feeding areas and they nest on open, sandy beaches.	Low Species has not been recorded within 10km of the study area. Could occur in Sydney Harbour as a vagrant.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Cercartetus nanus	Eastern Pygmy-possum	Vulnerable		Species	58	25/09/2013	Occurs from the coast inland to the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. Inhabits woodlands and heath, occasionally rainforest where it forages for nectar and pollen of banksias, eucalypts and bottlebrushes. Shelters in tree hollows, rotten stumps, holes in the ground or abandoned bird-nests.	Low Study area does not support preferred habitat.
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable	Ecosystem/ Species	1	19/05/1992	Found mainly in areas with extensive cliffs and caves. It is generally rare with a very patchy distribution in NSW, with scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*). Forage in low to mid-elevation dry open forest and woodland and well-timbered areas containing gullies close to roosting habitat, for small, flying insects. Most likely hibernates through coolest months.	Low Study area does not support preferred habitat.
Chelonia mydas	Green Turtle	Vulnerable	Vulnerable	EEC/Marine	5	5/01/2003	Widely distributed in tropical and sub-tropical seas. Usually found in tropical waters around Australia but also occurs in coastal waters of NSW. They settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds.	Low Study area does not support preferred habitat. Could occur in Sydney Harbour as a vagrant.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Crinia tinnula	Wallum Froglet	Vulnerable		Species	1	8/07/1999	Occurs from the Queensland border south to Kurnell. The species is found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country.	Low Study area does not support preferred habitat.
Daphoenositta chrysoptera	Varied Sittella	Vulnerable		Ecosystem	5	15/12/2011	Widespread throughout mainland Australia, where it is found in eucalypt woodlands and forests, most commonly in areas of rough-barked eucalypts. Forages for insects in rough-bark eucalypts such as ironbark and stringybarks. Nests in a tree branch or fork.	Low Study area does not support preferred habitat.
Dasyornis brachypterus	Eastern Bristlebird	Endangered	Endangered	Species	1	31/12/1921	Distribution confined to three disjunct areas in NSW: the Queensland/NSW border, the Illawarra and the NSW/Victoria border. Species inhabits dense, low vegetation including heath and open woodland with a heathy understorey. Forages on the ground for insect, rarely flies. Nest constructed on the ground amongst dense vegetation.	Low Study area does not support preferred habitat.
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Endangered	Ecosystem	17	17/08/2009	Found along the escarpments, tablelands and coast of the eastern seaboard from the Bundaberg area in south-east Qld south through NSW to Victoria and Tasmania. Known from dry and moist eucalypt forests and rainforest. Species tends to move along drainage lines and make dens in fallen hollow logs or among large rocky outcrops.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Ephippiorhynchus asiaticus	Black-necked Stork	Endangered		Species	1	25/10/2004	Widespread in coastal and sub-coastal northern and eastern Australia; in NSW, the species becomes increasingly uncommon south of the Northern Rivers region. Rarely occurs south of Sydney. Found in association with wetlands, swamps, billabongs, estuaries and surrounding vegetation. Nests in a tall live tree, including paddock trees and paperbarks.	Low Study area does not support preferred habitat.
Epinephelus daemeli	Black Rockcod, Black Cod, Saddled Rockcod	Vulnerable	Vulnerable	N/A	0	N/A	Adult black cod are usually found in caves, gutters and beneath bomboras on rocky reefs. Small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores in estuaries. Recorded from the temperate and subtropical waters of the southwestern Pacific: Australia, Norfolk Island, Kermadec Islands and New Zealand.	Low Study area does not support preferred habitat.
Epthianura albifrons	White-fronted Chat	Vulnerable		Species	88	30/03/2010	In NSW, occurs in association with damp, open habitats below 1000m elevation along the coast (such as wetlands and saltmarsh), and in association with waterways in the west. Forage for insects on the ground. Nests in low vegetation elevated from the ground.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Esacus magnirostris	Beach Stone-curlew	Critically Endangered Species		Species	3	28/02/1985	In NSW, the species occurs regularly north of the Manning River, and the small population of north-eastern NSW is at the limit of the normal range of the species in Australia. Beach Stone-curlews are found exclusively along the coast, on a wide range of beaches, islands, reefs and in estuaries, and may often be seen at the edges of or near mangroves. Forage in the intertidal zone of beaches and estuaries and breed above the littoral zone, at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves.	Low Study area does not support preferred habitat.
Eubalaena australis	Southern Right Whale	Endangered	Endangered	N/A	8	8/08/2002	Occurs in temperate and sub-polar waters of the Southern Hemisphere. Migrate between summer feeding grounds in Antarctica and winter breeding grounds around the coasts of southern Australia, New Zealand, South Africa and South America. They feed in open ocean in summer and move inshore in winter for calving and mating. Calving females and females with young usually remain very close to the coast, particularly in the 5-10 m watermark.	Moderate Previously recorded in Sydney Harbour near Blues Point, most likely as a vagrant.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Eudyptula minor - endangered population	Little Penguin in the Manly Point Area (being the area on and near the shoreline from Cannae Point generally northward to the point near the intersection of Stuart Street and Oyama Cove Avenue, and extending 100 metres offshore from that shoreline)	Endangered Population		Species	4	3/09/2003	Occurs in Australia and NZ. They generally breed from south of Port Stephens in NSW along the coast through Victoria, South Australia, Tasmania and as far as Fremantle in Western Australia. 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. A range of nest sites are utilised by the penguins at Manly including under rocks on the foreshore, under seaside houses and structures, such as stairs, in wood piles and under overhanging vegetation including lantana and under coral tree roots.	Low Endangered Population is well outside study area.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable		Ecosystem	3	12/02/2014	Occurs along the east coast of NSW, where it inhabits tall moist forests. Roosts in hollows of eucalypts, occasionally under loose bark on trees or in buildings. Hunts for flying insects above or below the tree canopy.	Low Study area does not support preferred habitat.
Fregetta grallaria grallaria	White-bellied Storm-Petrel (Tasman Sea), Whitebellied Storm-Petrel (Australasian)	Vulnerable	Vulnerable	EEC/Marine	0	N/A	Wide oceanic distribution in the south Pacific and Atlantic Oceans, ranging into tropical waters from various breeding grounds. In Australia, breeds only on offshore islands in the Lord Howe Island group.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Glossopsitta pusilla	Little Lorikeet	Vulnerable		Ecosystem	10	7/06/2010	In NSW, the species occurs from the coast to the western slopes of the Great Dividing Range. Inhabits forests and woodlands, where it forages for nectar and pollen within the canopy stratum. Requires living, hollow-bearing eucalypts for nesting habitat.	Low Study area does not support preferred habitat.
Grantiella picta	Painted Honeyeater		Vulnerable	Ecosystem	0	N/A	A nomadic species that occurs at low densities throughout its range, most commonly found on the inland slopes of the Great Dividing Range in NSW. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests where it forages for the fruits of mistletoes growing on woodland eucalypts and acacias. Nests within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	Low Study area does not support preferred habitat.
Haematopus fuliginosus	Sooty Oystercatcher	Vulnerable		Species	8	12/06/2005	Sooty Oystercatchers are found around the entire Australian coast. The species inhabits rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Sooty Oystercatchers breed in spring and summer, predominately on offshore islands, occasionally on isolated promontories.	Low Study area does not support preferred habitat.
Haematopus longirostris	Pied Oystercatcher	Endangered		Species	64	23/12/2010	The Pied Oystercatcher is distributed around the entire Australian coastline and inhabits intertidal flats of inlets and bays, open beaches and sandbanks. The species nests mostly on coastal or estuarine beaches and occasionally in saltmarsh or grassy areas.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Heleioporus australiacus	Giant Burrowing Frog	Vulnerable	Vulnerable	Species	5	22/04/2013	Distribution largely restricted to sandstone geology of Sydney Basin, within heath, woodland and open dry sclerophyll forest. Moves to breeding habitat before or after heavy rain in autumn; typically soaks, pools in first or second order streams or hanging swamps. Outside of breeding period, inhabits burrows below soil surface or leaf litter, within 300m of breeding habitat. Generalist diet of invertebrates.	Low Study area does not support preferred habitat.
Hieraaetus morphnoides	Little Eagle	Vulnerable		Ecosystem	10	30/06/2001	Widespread throughout mainland Australia, often observed over woodland, forested land and open country. Appears to avoid rainforest and dense forest. Hunts for small terrestrial and arboreal mammals. Nests in a large living tree in open woodland or tree-lined watercourses.	Low Study area does not support preferred habitat.
Hoplocephalus bungaroides	Broad-headed Snake	Endangered	Vulnerable	Species			Distribution restricted to sandstone habitats within approximately 250km of Sydney. Requires rock crevices and flat sandstone rocks on exposed cliff edges for sheltering in cooler months, shelters in tree hollows near sandstone escarpments in summer. Forages for small reptiles, occasionally frogs and small mammals.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Endangered	Endangered	Species	104	20/09/2011	Occurs east of the Great Dividing Range, south from the Hawkesbury River, where it is found in heath or open forest with a heathy understorey on sandy or friable soils. Nests in a shallow depression in the ground covered by vegetation. Searches for insects or underground-fruiting fungi by digging conical holes in the soil.	Low Study area does not support preferred habitat.
Ixobrychus flavicollis	Black Bittern	Vulnerable		Species	7	6/08/2008	Scattered distribution throughout the NSW coast, although rarely recorded south of Sydney or inland. Inhabits areas of permanent water and dense vegetation. Forages for aquatic prey including invertebrates and small vertebrates. Roosts in trees or amongst dense reeds on the ground. Nest is constructed on a branch overhanging water.	Low Study area does not support preferred habitat.
Lathamus discolor	Swift Parrot	Endangered	Endangered	Ecosystem	18	8/07/2009	Migrates from breeding grounds in Tasmania to the Australian mainland in winter. Preferred over-winter habitat is woodlands and riparian vegetation where there are winter flowering eucalypts such as the Swamp Mahogany, Eucalyptus robusta in coastal areas.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Litoria aurea	Green and Golden Bell Frog	Endangered	Vulnerable	Species	259	27/01/2015	Isolated, scattered populations throughout coastal NSW, several within the Sydney metropolitan area, Shoalhaven and mid-north coast. Breeding habitat comprises natural and constructed waterbodies including wetlands, stormwater detention basins, marshes, dams and streams-side, preferably those that are unshaded but with fringing vegetation. Forage for invertebrates within grassy habitats near breeding habitat. May shelter under vegetation, rocks and building materials such as fibro, sheet iron or bricks.	Low Study area does not support preferred habitat.
Litoria littlejohni	Littlejohn's Tree Frog	Vulnerable	Vulnerable	Species			Distributed throughout the plateaus and eastern slopes of the Great Dividing Range south from Watagan State Forest. Breeds in the upper reaches of permanent streams and in perched swamps where it lays eggs on temporary or permanent slow flowing pools. Outside of the breeding season, inhabits forests and woodlands where it shelters under leaf litter and low vegetation and hunts for invertebrates.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Litoria raniformis	Southern Bell Frog	Endangered	Vulnerable	Species			Occurs in association with the Murray and Murrumbidgee River valleys and their tributaries. Inhabits emergent vegetation within or fringing still or slow-flowing waterbodies, including lagoons, ponds, swamps and dams. Basks on rocks or vegetation in summer and shelters in soil cracks, fallen timber, dense vegetation. Requires permanent, freshwater shallow lagoons for breeding.	Low Study area does not support preferred habitat.
Macronectes giganteus	Southern Giant Petrel	Endangered	Endangered	EEC/Marine	117	9/08/1986	Common visitor off the coast of NSW. Over summer, the species nests in small colonies amongst open vegetation on Antarctic and subantarctic islands.	Low Study area does not support preferred habitat.
Macronectes halli	Northern Giant-Petrel	Vulnerable	Vulnerable	EEC/Marine	4	25/07/1970	Common visitor in NSW waters, predominantly along the south-east coast during winter and autumn. Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer.	Low Study area does not support preferred habitat.
Megaptera novaeangliae	Humpback Whale	Vulnerable	Vulnerable	N/A	32	12/11/2009	Occurs in oceanic and coastal waters worldwide. The population of Australia's east coast migrates from summer cold-water feeding grounds in Subantarctic waters to warm-water winter breeding grounds in the central Great Barrier Reef.	Low Study area does not support preferred habitat. Could occur in Sydney Harbour as a vagrant.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Miniopterus australis	Little Bentwing-bat	Vulnerable		Ecosystem/ Species	9	17/04/2015	Distributed throughout the east coast and ranges of Australia, from Cape York in Queensland to Wollongong in NSW. Found in association with moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges. At night forages for small insects beneath the canopy of densely vegetated habitats.	Low Study area does not support preferred habitat.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable		Ecosystem/ Species	161	9/05/2015	Distributed throughout eastern and north-western Australia. In NSW, recorded from the coast to the western slopes of the Great Dividing Range. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300 km range of maternity caves. Hunt in forested areas, catching moths and other flying insects above the tree tops.	Moderate Some buildings and bridges in the study area may provide roosting habitat for the species outside the birthing period, though it is within highly modified environment subject to high levels of disturbance (e.g. noise) and therefore suboptimal for this species. Species not recorded during targeted surveys at Chatswood, Sydenham or Waterloo.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Mixophyes balbus	Stuttering Frog, Southern Barred Frog (in Victoria)	Endangered	Vulnerable	Species			In NSW, known only from three locations south of Sydney. Inhabits rainforest and wet, tall forest in the foothills and escarpment east of the Great Dividing Range. Requires streams with rock shelves or shallow riffles for breeding in summer. Outside of breeding period, species is found under deep leaf little and thick understory vegetation on forest floor.	Low Study area does not support preferred habitat.
Mormopterus norfolkensis	Eastern Freetail-bat	Vulnerable		Ecosystem	25	1/04/2014	Occurs along the east coast of NSW inland to the Great Dividing Range, where it is found in dry sclerophyll forest, woodland, swamp forest and mangrove forest. Roosts in trees hollows, occasionally under bark or in man-made structures. Forages for insects.	Moderate Species is found in wooded areas, though roost in hollows and man-made structures. Some buildings, bridges or hollow-bearing trees in the study area may provide roosting habitat for the species, though they are within a highly modified environment subject to high levels of disturbance (e.g. noise) and therefore suboptimal for this species. Species not recorded during targeted surveys at Chatswood, Sydenham or Waterloo.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Myotis macropus	Southern Myotis	Vulnerable		Ecosystem/ Species	474	9/05/2015	Distribution generally limited to within 100km of the coast. Forages over streams and pools for insects and small fish. Roosts communally in mine shafts, tree hollows, under bridges and storm water channels.	Low Species typically found by water. It is found in bridges and hollow-bearing trees, however, not recorded during targeted surveys.
Neophema chrysogaster	Orange-bellied Parrot	Critically Endangered Species	Critically Endangered	Ecosystem	1	21/08/2003	In NSW, the most recent records from Shellharbour and Maroubra are from May 2003. Typical winter habitat is saltmarsh and strandline/foredune vegetation communities either on coastlines or coastal lagoons. Spits and islands are favoured. The species can be found foraging in weedy areas or even in totally modified landscapes such as pastures, seed crops and golf courses.	Low Study area does not support preferred habitat.
Neophema pulchella	Turquoise Parrot	Vulnerable		Ecosystem	1	29/07/2005	In NSW, occurs from the coastal plains to the western slopes of the Great Diving Range. Found along the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Forages on the ground for seeds and grasses. Nests in a tree hollow, log or post.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Nettapus coromandelianus	Cotton Pygmy-Goose	Endangered		Species	4	30/11/1992	Although once found from north Queensland to the Hunter River in NSW, the Cotton Pygmy-Goose is now only a rare visitor to NSW. Uncommon in Queensland. Freshwater lakes, lagoons, swamps and dams, particularly those vegetated with waterlilies and other floating and submerged aquatic vegetation. The Cotton Pygmy-goose uses tall standing dead trees with hollows located close to water for roosting and breeding.	Low Study area does not support preferred habitat.
Ninox connivens	Barking Owl	Vulnerable		Ecosystem	9	28/09/2007	Scattered distribution throughout Australia, excluding central arid areas. In NSW, core populations are located on western slopes and plains. Inhabits woodland and open forest where it hunts for arboreal mammals, occasionally birds, invertebrates and small terrestrial mammals. Roosts in canopy or tall midstorey trees. Requires large, hollow-bearing eucalypts for nesting habitat.	Low Study area does not support preferred habitat.
Ninox strenua	Powerful Owl	Vulnerable		Ecosystem	532	18/08/2015	Widely distributed throughout NSW, from the coast inlands to the tablelands. Inhabits woodland, open forest, tall wet forest and rainforest, where it hunts for arboreal mammals, occasionally birds. Roosts in dense vegetation, requires old, large hollow-bearing eucalypts for nesting habitat.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Numenius madagascariensis	Eastern Curlew	Protected	Critically Endangered	Ecosystem	17	5/12/2006	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.	Low Study area does not support preferred habitat.
Onychoprion fuscata	Sooty Tern	Vulnerable		Species	4	23/01/2001	In NSW, most commonly found off the north coast; breeding colonies known from Lord Howe Island and Norfolk Island. Occasionally recorded as far south as Bermagui. A pelagic species only found onshore during the breeding season. Nests on coral cays, atolls, sandbanks and other offshore islets. Forages for fish taken from near the ocean surface.	Low Study area does not support preferred habitat.
Pandion cristatus	Eastern Osprey	Vulnerable		Species	5	31/12/2004	Found around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. Forage for fish over clear, open water. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Perameles nasuta	Long-nosed Bandicoot population in inner western Sydney	Endangered Population		Species	302	31/07/2015	The endangered population occurs in the local government areas (LGA) of Marrickville and Canada Bay, with the likelihood that it also includes Canterbury, Ashfield and Leichhardt LGAs. The species shelters mostly under older houses and buildings and forages in parkland and back-yards.	Low. Study area does not support preferred habitat.
Petaurus australis	Yellow-bellied Glider	Vulnerable		Ecosystem	1	20/01/1999	In NSW, distributed from the east coast to the western slopes of the Great Dividing Range. Occurs in association with tall mature eucalypt forest, generally in high rainfall areas and nutrient rich soils. Extract sap from favoured food trees, most commonly smooth-barked eucalypts. Dens in large tree hollows.	Low Study area does not support preferred habitat.
Petrogale penicillata	Brush-tailed Rock-wallaby	Endangered	Vulnerable	Species			Occurs along NSW coast, inland to the Warrumbungle Ranges. Occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Shelter in rock crevices and overhangs. Forages in and adjacent to rocky areas for grasses, foliage and fruits of shrubs and trees.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Petroica boodang	Scarlet Robin	Vulnerable		Ecosystem	6	12/11/2013	Distributed from the coast, inland to the western slopes of the Great Dividing Range. Inhabits open forests and woodlands, also found in grasslands in winter. Forages for insects on the ground. In NSW, the species breeds in tall moist eucalypt forests and woodlands in upland areas. In winter, moves to dry forests, open woodlands and grasslands of the inland slopes and plains. Forages amongst low branches for invertebrates. Nests near the ground in sheltered areas such as tree cavities or stumps.	Low Study area does not support preferred habitat.
Petroica phoenicea	Flame Robin	Vulnerable		Ecosystem	1	9/06/1969	In NSW, the species breeds in tall moist eucalypt forests and woodlands in upland areas. In winter, moves to dry forests, open woodlands and grasslands of the inland slopes and plains. Forages amongst low branches for invertebrates. Nests near the ground in sheltered areas such as tree cavities or stumps.	Low Study area does not support preferred habitat.
Pezoporus wallicus wallicus	Eastern Ground Parrot	Vulnerable		Species	2	22/05/2006	Occurs from southern Queensland through NSW to western Victoria. Found in small numbers on the NSW north coast including Broadwater, Bundjalung and Yuraygir national parks. Inhabits dense, low heathlands and sedgelands where it forages for seeds and nests in a shallow bowl of fine sticks and grass under dense vegetation.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable	Species	5	23/02/1997	Distribution of the species throughout Australia is highly fragmented. In NSW it mainly occurs on the central and north coasts with some populations in the western region inhabiting eucalypt woodlands and forests. The species feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Low Study area does not support preferred habitat.
Polytelis swainsonii	Superb Parrot	Vulnerable	Vulnerable	Ecosystem/ Species	1	30/06/1986	Occurs across Riverina area in summer, migrates along Macquarie and Namoi Rivers to northern NSW in winter. Inhabits timbered watercourses and nearby woodlands. Requires deep hollows or hollow limbs for nesting, typically in Red Gums. Forages mainly on the ground for seeds, fruit and insects.	Low Study area does not support preferred habitat.
Pommerhelix duralensis	Dural Land Snail		Endangered	Species			The species is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. Prefers forested habitats that have good native cover and woody debris, and favours sheltering under rocks or inside curled-up bark.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE mainland)	Vulnerable	Vulnerable	Ecosystem			Distribution in NSW restricted to coastal heaths and forests east of the Great Dividing Range. Also known from dry and wet sclerophyll forest. Requires dense understory and groundlayer vegetation for sheltering. Forages from fungi, roots tubers and insects in the soil.	Low Study area does not support preferred habitat.
Prototroctes maraena	Australian Grayling	Endangered	Vulnerable	N/A			Found in freshwater streams and rivers to the east of the Great Dividing Range, extending from Sydney southwards. Prefers habitats with a moderate flow over clear gravelly substrates in coastal streams, and estuarine areas.	Low Study area does not support preferred habitat.
Pseudomys novaehollandiae	New Holland Mouse	Protected	Vulnerable	Ecosystem	2	15/08/2001	Fragmented distribution across Tasmania, Victoria, NSW and Queensland where it inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. Forages for seeds, insects, leaves, flowers and fungi. Shelters and nests communally in burrows.	Low Study area does not support preferred habitat.
Pseudophryne australis	Red-crowned Toadlet	Vulnerable		Species	188	24/08/2015	Distribution restricted to the Sydney Basin, from Pokolbin south to Nowra, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, where it typically inhabits periodically wet drainage lines below sandstone ridges. Breeds in dense vegetation and debris beside ephemeral creeks and gutters. Outside of breeding season, is found under rocks and logs on sandstone ridges where it forages amongst leaf-litter.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Pterodroma leucoptera leucoptera	Gould's Petrel	Vulnerable	Endangered	EEC/Marine	1	19/12/1991	Breeds on both Cabbage Tree Island, 1.4 km offshore from Port Stephens and on nearby Boondelbah island. The range and feeding areas of non-breeding petrels are unknown.	Low Study area does not support preferred habitat.
Pterodroma neglecta neglecta	Kermadec Petrel (western)		Vulnerable	EEC/Marine			Ranges over subtropical and tropical waters of the South Pacific. Balls Pyramid (near Lord Howe Island) and Phillip Island (near Norfolk Island) are the only known breeding sites in Australian waters.	Low Study area does not support preferred habitat.
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable	Ecosystem/ Species	1566	13/03/2015	Found within 200km of the east coast of Australia. Roosting camps commonly found in gullies, close to water, in vegetation with a dense canopy. Camps typically located within 20km of a regular food source; nectar and pollen of native trees and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	High – Chatswood, Barangaroo and Marrickville dive site. Potential foraging habitat is present in Chatswood and Barangaroo. Small area of marginal foraging habitat present in Marrickville dive site. Intermittent foraging habitat present at these sites.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Ptilinopus superbus	Superb Fruit-Dove	Vulnerable		Ecosystem	25	11/06/1996	Occurs principally from north-eastern Queensland to north-eastern NSW; much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. At least some of the population, particularly young birds, moves south through Sydney, especially in autumn.	Low Study area does not support preferred habitat.
Rostratula australis	Australian Painted Snipe	Endangered	Endangered	Ecosystem	1	pre 1900	Occurs throughout Australia. Inhabits shallow freshwater wetlands, vegetated ephemeral and permanent lakes and swamps, and inundated grasslands.	Low Study area does not support preferred habitat.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Vulnerable		Ecosystem	4	21/03/2014	Occurs thoughout tropical and south-east of Australia, excluding Tasmania. Found in a variety of habitat types including wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grassland and desert. Forages for insects above the tree canopy. Roost in tree hollows, abandoned sugar glider nests or animals burrows.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable		Ecosystem	2	5/06/2014	Found mainly in the gullies and river systems that drain the Great Dividing Range. Distribution of the species in NSW is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. The species is known from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. The species forages along creek and river corridors. The species typically roosts in tree hollows but has also been found roosting in buildings. Maternity roosts usually comprise a suitable tree hollow.	Low Study area does not support preferred habitat.
Stagonopleura guttata	Diamond Firetail	Vulnerable		Ecosystem	4	28/03/2003	Widely distributed in NSW, known from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Not common in coastal districts. Found mainly in grassy eucalypt woodlands, occasionally open forest and riparian areas. Forages on the ground for seeds and insects. Roost and nest amongst shrubby understorey.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Sternula albifrons	Little Tern	Endangered		Species	375	24/05/2010	Migrates from eastern Asia to the north, east and south-east Australian coasts. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. Almost exclusively coastal, preferring sheltered environments. Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and island.	Low Study area does not support preferred habitat.
Sternula nereis nereis	Australian Fairy Tern		Vulnerable	Species			Occur in association with estuarine or lacustrine (lake) islands, wetlands, beaches and spits. Forages for small bait size fish, plant material, molluscs and crustaceans. Nests in small colonies on coral shingle on continental islands or coral cays, on sandy islands and beaches inside estuaries, and on open sandy beaches.	Low Study area does not support preferred habitat.
Stictonetta naevosa	Freckled Duck	Vulnerable		Ecosystem	1	5/06/2013	Found in association with large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers. Disperses during extensive inland droughts when it may be found along the east coast. Nests in dense vegetation at or near water level. Forages for aquatic vegetation.	Low Study area does not support preferred habitat.

Scientific Name	Common Name	TSC Act/ FM Act Status	EPBC Act Status	Credit class	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Tyto longimembris	Eastern Grass Owl	Vulnerable		Ecosystem	1	4/10/1982	In NSW the Eastern Grass Owl is more likely to be resident in the north-east. Their numbers can fluctuate greatly, increasing especially during rodent plagues. Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains.	Low Study area does not support preferred habitat.
Tyto novaehollandiae	Masked Owl	Vulnerable		Ecosystem	2	23/04/1985	Occurs from the eastern coast of NSW inland to the western plains. Found in eucalypt forests and woodlands from sea level to 1100 m. Roosts and nests in large tree hollows within moist eucalypt forested gullies.	Low Study area does not support preferred habitat.
Tyto tenebricosa	Sooty Owl	Vulnerable		Ecosystem	1	22/09/2009	Occurs on the coast, coastal escarpment and eastern tablelands. Inhabits rainforest and moist eucalypt forests, where it hunts for small arboreal and terrestrial mammals. Roosts in a large tree hollow or amongst thick vegetation. Nests in a large tree hollow.	Low Study area does not support preferred habitat.
Varanus rosenbergi	Rosenberg's Goanna	Vulnerable		Species	34	25/02/2014	Distributed from Wollemi National Parks south to the ACT region and near Cooma, usually in association with sandstone. Found in heath, open forest and woodland. Shelters in hollow logs, rock crevices and in burrows. Requires termite mounds for nesting habitat.	Low Study area does not support preferred habitat.

Migratory Species: Likelihood of occurrence of State and Commonwealth migratory fauna species and populations identified in database searches

GROUP	Scientific Name	Common Name	TSC Status	EPBCA Status	Habitat	Likelihood of occurrence
Marine fauna (excluding birds)	*Caperea marginata*	Pygmy Right Whale		Migratory	These species occupy the marine environment including, open ocean, coastal waters and, in some instances, estuarine habitats	Low – all species except Southern Right Whale. Study area does not support preferred habitat for these species, though they could occur in Sydney Harbour as vagrants. Moderate – Southern Right Whale. Previously recorded in Sydney Harbour near Blues Point, most likely as a vagrant.
	Dugong dugon	Dugong	Endangered	Migratory		
	Eubalaena australis	Southern Right Whale	Endangered	Endangered, Migratory		
	Lagenorhynchus obscurus	Dusky Dolphin		Migratory		
	Megaptera novaeangliae	Humpback Whale	Vulnerable	Vulnerable, Migratory		
	Orcinus orca	Killer Whale		Migratory		
	Sousa chinensis	Indo-Pacific Humpback Dolphin		Migratory		
	Caretta caretta	Loggerhead Turtle		Endangered, Migratory		
	Chelonia mydas	Green Turtle	Vulnerable	Vulnerable, Migratory		
	Manta birostris	Giant Manta Ray		Migratory		
Wading Birds (Sandpipers, Herons & Plovers)	*Ardea alba*	Great Egret		Migratory	These species occur in close proximity to either coastal habitats, estuarine shores or terrestrial wetlands and associated beaches, rock benches, mudflats or grassland.	Low Study area does not support preferred habitat.
	Ardea ibis	Cattle Egret		Migratory		
	Actitis hypoleucos	Common Sandpiper		Migratory		
	Arenaria interpres	Ruddy Turnstone		Migratory		
	Calidris acuminata	Sharp-tailed Sandpiper		Migratory		

GROUP	Scientific Name	Common Name	TSC Status	EPBCA Status	Habitat	Likelihood of occurrence
	Calidris alba	Sanderling	Vulnerable	Migratory		
	Calidris canutus	Red Knot, Knot		Migratory		
	Calidris ferruginea	Curlew Sandpiper	Endangered	Critically Endangered, Migratory		
	Calidris melanotos	Pectoral Sandpiper		Migratory		
	Calidris ruficollis	Red-necked Stint		Migratory		
	Calidris subminuta	Long-toed Stint		Migratory		
	Calidris tenuirostris	Great Knot	Vulnerable	Migratory		
	Charadrius bicinctus	Double-banded Plover		Migratory		
	Charadrius leschenaultii	Greater Sand-plover	Vulnerable	Migratory		
	Charadrius mongolus	Lesser Sand-plover	Vulnerable	Migratory		
	Charadrius veredus	Oriental Plover, Oriental Dotterel		Migratory		
	Gallinago hardwickii	Latham's Snipe, Japanese Snipe		Migratory		
	Gallinago megala	Swinhoe's Snipe		Migratory		
	Gallinago stenura	Pin-tailed Snipe		Migratory		
	Heteroscelus brevipes	Grey-tailed Tattler		Migratory		
	Heteroscelus incanus	Wandering Tattler		Migratory		
	Limicola falcinellus	Broad-billed Sandpiper	Vulnerable	Migratory		
	Limosa lapponica	Bar-tailed Godwit		Migratory		

GROUP	Scientific Name	Common Name	TSC Status	EPBCA Status	Habitat	Likelihood of occurrence
	Limosa limosa	Black-tailed Godwit	Vulnerable	Migratory		
	Numenius madagascariensis	Eastern Curlew	Protected	Critically Endangered, Migratory		
	Numenius minutus	Little Curlew, Little Whimbrel		Migratory		
	Numenius phaeopus	Whimbrel		Migratory		
	Philomachus pugnax	Ruff (Reeve)		Migratory		
	Pluvialis fulva	Pacific Golden Plover		Migratory		
	Pluvialis squatarola	Grey Plover		Migratory		
	Tringa stagnatilis	Marsh Sandpiper, Little Greenshank		Migratory		
	Xenus cinereus	Terek Sandpiper	Vulnerable	Migratory		
Other Birds	*Pandion haliaetus*	Osprey		Migratory	The Osprey's habitat includes mangroves, rivers, and estuaries, inshore seas and coastal islands. It is thinly distributed around the coast (more abundant in the north) and its nest consists of a bulky structure of sticks, roughly linked with grass and seaweed.	Low Study area does not support preferred habitat.
	Sterna albifrons	Little Tern		Migratory	The species is widespread in Australia from north-western Western Australia, around the north to south-eastern Australia. In Australia, Little Terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches.	Low Study area does not support preferred habitat.

GROUP	Scientific Name	Common Name	TSC Status	EPBCA Status	Habitat	Likelihood of occurrence
	Apus pacificus	Fork-tailed Swift		Migratory	The Fork-tailed Swift migrates from breeding sites to Australia for the summer. They are almost exclusively aerial. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They also occur over settled areas, including towns, urban areas and cities	Low Species almost exclusively aerial.
	Cuculus optatus	Oriental Cuckoo, Horsfield's Cuckoo		Migratory	Distributed across northern and eastern Australia. Solitary or congregates in feeding groups in mid and upper stage of forest and woodland.	Low Study area does not support preferred habitat.
	Hirundapus caudacutus	White-throated Needletail		Migratory	Migrates from northern Asia to eastern Australia for the summer. In NSW, occurs from the coast to the western slopes of the Great Dividing Range. Species is almost exclusively aerial, most commonly recorded above open forest and rainforest. They are less commonly recorded flying above woodland. They also commonly occur over heathland, but less often over treeless areas, such as grassland or swamps.	Low Species almost exclusively aerial.
	Monarcha melanopsis	Black-faced Monarch		Migratory	Migrates to south-eastern coast of Australia from the north-eastern coast. The Black-faced Monarch mainly occurs in rainforest ecosystems. The species also occurs in selectively logged and 20—30 years old regrowth rainforest. The Black-faced Monarch may sometimes be found in suburban parks and gardens.	Low Study area does not support preferred habitat.
	Motacilla flava	Yellow Wagtail		Migratory	Distributed widely across Australia. This insectivorous bird inhabits open country near water, such as wet meadows.	Low Study area does not support preferred habitat.

GROUP	Scientific Name	Common Name	TSC Status	EPBCA Status	Habitat	Likelihood of occurrence
	Rhipidura rufifrons	Rufous Fantail		Migratory	Occurs throughout east coast of Australia, migrates from eastern NSW to north-eastern Queensland and Papua New Guinea in winter. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts with a dense shrubby understorey often including ferns. They are also recorded from parks and gardens when on passage.	Low Study area does not support preferred habitat.

Flora: Likelihood of occurrence of State and Commonwealth threatened flora species and populations identified in database searches

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Acacia bynoeana	Bynoe's Wattle	Endangered	Vulnerable	20	4/03/2008	Semi-prostrate shrub to 1m high. Occurs from the coast to the Blue Mountains and Morisset in the north to the Southern Highlands in the south. Found in heath or dry sclerophyll forest on sandy soils, often in slightly disturbed areas, in association with Red Bloodwood, Scribbly Gum and Parramatta Red Gum.	Low No potential habitat for the species occurs in the study area.
Acacia gordonii		Endangered	Endangered	1	17/08/1966	Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops. Restricted to the north-west of Sydney with disjunct distributions in the lower Blue Mountains and the Maroota/Glenorie area.	Low No potential habitat for the species occurs in the study area.
Acacia prominens	Gosford Wattle, Hurstville and Kogarah Local Government Areas	Endangered Population		6	21/02/2007	Occurs at a few sites along the railway line at Penshurst, at Carss Bush Park, Carss Park and there is an unconfirmed siting at Oatley Park, Oatley. Grows in open situations on clayey or sandy soils. Flowers from July to September and pods are produced in September-October.	Low No potential habitat for the species occurs in the study area.
Acacia pubescens	Downy Wattle	Vulnerable	Vulnerable	438	13/06/2014	A spreading shrub distributed within Bankstown-Fairfield-Rookwood areas and the Pitt Town area. Known from Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland on alluviums, shales and at the intergrade between shales and sandstones.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Acacia terminalis subsp. terminalis	Sunshine Wattle	Endangered	Endangered	308	15/04/2015	Occurs in coastal scrub and dry sclerophyll woodland on sandy soils. Habitat is generally sparse and scattered and most areas of habitat or potential habitat are small and isolated. Most sites are highly modified or disturbed due to surrounding urban development. Flowers in autumn.	Low No potential habitat for the species occurs in the study area.
Allocasuarina glareicola		Endangered	Endangered	0	N/A	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil. Found in open woodland with *Eucalyptus parramattensis*, *Eucalyptus fibrosa*, *Angophora bakeri*, *Eucalyptus sclerophylla* and *Melaleuca decora*.	Low No potential habitat for the species occurs in the study area.
Allocasuarina portuensis	Nielsen Park She-oak	Endangered	Endangered	70	17/07/2007	The original known habitat of the Neilsen Park She-oak is at Nielsen Park, in Woollahra local government area. No plants left at the original site, however, it has been planted successfully at a number of locations at Nielsen Park and other locations in the local area. The original habitat is tall closed woodland. The original habitat occurs above a sandstone shelf approximately 20 m above the harbour. The shallow sandy soils are highly siliceous, coarsely textured and devoid of a soil profile.	Low No potential habitat for the species occurs in the study area.
Asterolasia buxifolia		Endangered		1	4/03/2008	Known from a single site at a granite outcrop in the riparian zone of the Lett River. Rediscovered in 2000, little is known about the species. Apparently restricted to dense riparian scrub along rocky watercourses with a granitic substrate.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Asterolasia elegans		Endangered	Endangered	0	N/A	Found in sheltered forests on mid- to lower slopes and valleys on Hawkesbury Sandstone. Known from only seven populations north of Sydney in the Baulkham Hills. Hawkesbury and Hornsby Local Government Areas.	Low No potential habitat for the species occurs in the study area.
Astrotricha crassifolia	Thick-leaf Star-hair	Vulnerable	Vulnerable	0	N/A	Grows on dry ridgetops to 300m altitude and is associated with very rich heath, or dry sclerophyll woodland. Vegetation associations include typical sandstone genera such as Hakea, Banksia and Xylomelum.	Low No potential habitat for the species occurs in the study area.
Caladenia tessellata	Thick Lip Spider Orchid	Endangered	Vulnerable	8	4/03/2008	Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Low No potential habitat for the species occurs in the study area.
Callistemon linearifolius	Netted Bottle Brush	Vulnerable		16	13/03/2015	Grows in dry sclerophyll forest on the coast and adjacent ranges, chiefly from Georges River to the Hawkesbury River.	Low No potential habitat for the species occurs in the study area.
Chamaesyce psammogeton	Sand Spurge	Endangered		3	10/10/2002	Found sparsely along the coast from south of Jervis Bay to Queensland. Grows on fore-dunes, pebbly strandlines and exposed headlands.	Low No potential habitat for the species occurs in the study area.
Cryptostylis hunteriana	Leafless Tongue-orchid	Vulnerable	Vulnerable	0	N/A	Orchid with an upright flower-stem to 45 cm tall. Sparse distribution along east coast. Known from a range of communities including swamp, heath and most typically woodland dominated by *Eucalyptus sclerophylla*, *E. sieberi*, *Corymbia gummifera* and *Allocasuarina littoralis*.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Darwinia biflora		Vulnerable	Vulnerable	172	1/12/2013	An erect to spreading shrub to 80cm high. Occurs on margin of weathered shale-capped ridges in north-western Sydney, where these intergrade with Hawkesbury Sandstone. Occurs in woodland or open forest in association with *Eucalyptus haemastoma*, *Corymbia gummifera* and/or *E. Squamosa*.	Low No potential habitat for the species occurs in the study area.
Deyeuxia appressa		Endangered	Endangered	3	4/03/2008	A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Was first collected in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown. Almost nothing is known of the species' habitat and ecology.	Low No potential habitat for the species occurs in the study area.
Diuris arenaria	Sand Doubletail	Endangered		1	21/09/2001	Known from the Tomaree Peninsula near Newcastle. Occurs in coastal heath and dry grassy eucalypt forest on sandy flats. Grows in gently undulating country in eucalypt forest with a grassy understorey on clay soil.	Low No potential habitat for the species occurs in the study area.
Epacris purpurascens var. purpurascens		Vulnerable		22	16/05/2010	Grows in sclerophyll forest, scrubs and swamps on sandstone from Gosford and Sydney districts. Found in a range of habitat types, most of which have a strong shale soil influence.	Low No potential habitat for the species occurs in the study area.
Eucalyptus camfieldii	Camfield's Stringybark	Vulnerable	Vulnerable	43	1/12/2006	Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges	Low No potential habitat for the species occurs in the study area.
Eucalyptus fracta	Broken Back Ironbark	Vulnerable		1	4/03/2008	Restricted to the northern Broken Back Range near Cessnock, NSW. Occurs in dry eucalypt woodland in shallow soils.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Eucalyptus nicholii	Narrow-leaved Black Peppermint	Vulnerable		15	15/04/2009	Natural distribution confined to the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield. Widely planted as an urban street tree and in gardens. Found largely on private property and roadsides, and occasionally conservation reserves. Typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock.	Moderate. May occur as planted street or garden tree. The study area is outside the natural range of this species, and the records in the locality are not of conservation significance.
Eucalyptus scoparia	Wallangarra White Gum	Endangered		3	4/06/2003	In NSW it is known from only three locations near Tenterfield, including Bald Rock National Park. Widely planted as an urban street tree and in gardens.	Moderate. May occur as planted street or garden tree. The study area is outside the natural range of this species, and the records in the locality are not of conservation significance.
Genoplesium baueri	Bauer's Midge Orchid	Endangered	Endangered	11	7/1/2011	Grows in sparse sclerophyll forest and moss gardens over sandstone. Recorded from locations between Ulladulla and Port Stephens; most older records are from northern Sydney suburbs. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Grevillea caleyi	Caley's Grevillea	Critically Endangered Species	Endangered	61	25/01/2013	Restricted to an 8 km square area around Terrey Hills, approximately 20 km north of Sydney. All sites occur on the ridgetop between elevations of 170 to 240m asl, in association with laterite soils and a vegetation community of open forest, generally dominated by *Eucalyptus sieberi* and *Corymbia gummifera*.	Low No potential habitat for the species occurs in the study area.
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	Vulnerable	Vulnerable	0	N/A	A low spreading to erect shrub occurring on sandy clay loam soils, often with lateritic ironstone gravels. Generally found on crests, upper slopes or flats. Distribution generally associated with Nepean and Georges Rivers. Small populations occur at Kemps Creek & Voyager Point. Occurs in a range of vegetation types from heath and shrubby woodland to open forest.	Low No potential habitat for the species occurs in the study area.
Grevillea shiressii		Vulnerable	Vulnerable	0	N/A	Grows along creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soil.	Low No potential habitat for the species occurs in the study area.
Haloragis exalata subsp. exalata	Wingless Raspwort, Square Raspwort	Vulnerable	Vulnerable	0	N/A	Occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. It appears to require protected and shaded damp situations in riparian habitats.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Haloragodendron lucasii		Endangered	Endangered	20	1/12/1992	Known locations of this species are confined to a very narrow distribution on the north shore of Sydney. Associated with dry sclerophyll forest; reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland.	Low No potential habitat for the species occurs in the study area.
Hibbertia puberula subsp. glabrescens (syn. *Hibbertia* sp. Bankstown)		Critically Endangered	Critically Endangered	0	N/A	Endemic to New South Wales and is currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs. The site is highly modified; soil is a sandy alluvium with a high silt content, and the habitat is consistent with an inferred pre-settlement cover of Castlereagh Ironbark Forest.	Low No potential habitat for the species occurs in the study area.
Hibbertia sp. Turramurra	Julian's Hibbertia	Critically Endangered		1	15/09/2014	Endemic to NSW where it is restricted to a single population located in the northern Sydney suburb of Turramurra. Grows in forest with canopy species including *Eucalyptus pilularis*, *E. resinifera*, *Corymbia gummifera* and *Angophora costata*. The understorey is open with species of Poaceae, Orchidaceae, Fabaceae and Liliaceae. The soil is identified as a light clay occurring on a shale sandstone soil transition.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Hibbertia superans		Endangered		1	16/01/2008	Occurs from Baulkham Hills to South Maroota in the northern outskirts of Sydney, where there are currently 16 known sites, and at one locality at Mount Boss, inland from Kempsey. No populations are known from a formal conservation reserve. Flowering time is July to December. The species occurs on sandstone ridgetops often near the shale/sandstone boundary. Occurs in both open woodland and heathland, and appears to prefer open disturbed areas, such as tracksides.	Low No potential habitat for the species occurs in the study area.
Kunzea rupestris		Vulnerable	Vulnerable	0	N/A	Restricted, with most locations in the Maroota - Sackville - Glenorie area and one outlier in Ku-ring-gai Chase National Park, all within the Central Coast botanical subdivision of NSW. Grows in shallow depressions on large flat sandstone rock outcrops. Characteristically found in short to tall shrubland or heathland.	Low No potential habitat for the species occurs in the study area.
Lasiopetalum joyceae		Vulnerable	Vulnerable	4	23/11/2005	Has a restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. It is currently known from 34 sites between Berrilee and Duffys Forest. Seventeen of these are reserved. Grows in heath on sandstone.	Low No potential habitat for the species occurs in the study area.
Leptospermum deanei		Vulnerable	Vulnerable	10	3/11/1989	Occurs in Hornsby, Warringah, Ku-ring-gai and Ryde LGAs. Woodland on lower hill slopes or near creeks. Sandy alluvial soil or sand over sandstone. Occurs in Riparian Scrub - e.g. *Tristaniopsis laurina*, *Baeckea myrtifolia*; Woodland - e.g. Eucalyptus haemastoma; and Open Forest - e.g. *Angophora costata*, *Leptospermum trinervium*, *Banksia ericifolia*. Flowers October-November.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Leucopogon exolasius	Woronora Beard-heath	Vulnerable	Vulnerable	0	N/A	Woronora Beard-heath is found along the upper Georges River area and in Heathcote National Park. The plant occurs in woodland on sandstone. Flowering occurs in August and September.	Low No potential habitat for the species occurs in the study area.
Maundia triglochinoides		Vulnerable		2	17/01/1903	Grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients.	Low No potential habitat for the species occurs in the study area.
Melaleuca biconvexa	Biconvex Paperbark	Vulnerable	Vulnerable	1	pre 1900	Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Low No potential habitat for the species occurs in the study area.
Melaleuca deanei	Deane's Paperbark	Vulnerable	Vulnerable	36	23/02/2011	A shrub that typically grows in wet heath on sandstone. Known from two areas in the north and south of Sydney (Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas) with isolated occurrences in the Blue Mountains, Nowra and Central Coast areas.	Low No potential habitat for the species occurs in the study area.
Micromyrtus blakelyi		Vulnerable	Vulnerable	0	N/A	Restricted to areas near the Hawkesbury River, north of Sydney. Distribution extends from north of Maroota in the north, to Cowan in the south. All known populations occur within the Baulkham Hills and Hornsby local government areas. Typically occurs within heathlands in shallow sandy soil in cracks and depressions of sandstone rock platforms.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Microtis angusii	Angus's Onion Orchid	Endangered	Endangered	1	1/01/2002	Currently known from only one site at Ingleside, north of Sydney. The Ingleside location is highly disturbed. The dominant species occurring on the site are introduced weeds *Hyparrhenia hirta* (Coolatai grass) and *Acacia saligna*. The Ingleside population occurs on soils that have been modified but were originally those of the restricted ridgetop lateritic soils in the Duffys Forest - Terrey Hills - Ingleside and Belrose areas.	Low No potential habitat for the species occurs in the study area.
Pelargonium sp. Striatellum (G.W.Carr 10345)	Omeo Stork's-bill	Endangered	Endangered	0	N/A	The NSW populations are in the Hawkesbury-Nepean, Murrumbidgee and Southern Rivers Natural Resource Management (NRM) regions and the South Eastern Highlands. Known to occur in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds.	Low No potential habitat for the species occurs in the study area.
Persoonia hirsuta	Hairy Geebung	Endangered	Endangered	36	4/03/2008	The Hairy Geebung has been recorded in the Sydney coastal area, the Blue Mountains area and the Southern Highlands. The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations.	Low No potential habitat for the species occurs in the study area.
Persoonia mollis subsp. maxima		Endangered	Endangered	0	N/A	Highly restricted, known from the Hornsby Heights-Mt Colah area north of Sydney in the Sydney Basin Bioregion. Occurs in sheltered aspects of deep gullies or on the steep upper hillsides of narrow gullies on Hawkesbury Sandstone. These habitats support relatively moist, tall forest vegetation communities, often with warm temperate rainforest influences.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Persoonia nutans	Nodding Geebung	Endangered	Endangered	1	31/12/1999	An erect to spreading shrub restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Low No potential habitat for the species occurs in the study area.
Pimelea curviflora var. curviflora		Vulnerable	Vulnerable	32	19/12/2012	A small shrub confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region. Distribution associated with shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	Low No potential habitat for the species occurs in the study area.
Pimelea spicata	Spiked Rice-flower	Endangered	Endangered	2	4/03/2008	A small spreading or erect shrub Cumberland Plain and coastal Illawarra. In western Sydney, occurs an undulating topography of substrates derived from Wianamatta Shale in associated with Cumberland Plain Woodland.	Low No potential habitat for the species occurs in the study area.
Prasophyllum fuscum	Slaty Leek Orchid	Critically Endangered Species	Vulnerable	1	4/03/2008	Confined to the Blue Mountains, Hawkesbury sandstone, and the Burrawang district, NSW. Grows in moist heath, often along seepage lines. The known population grows in moist sandy soil over sandstone amongst sedges and grasses in an area that appears to be regularly slashed.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Prostanthera densa	Villous Mintbush	Vulnerable	Vulnerable	0	N/A	This species has been recorded from the Currarong area in Jervis Bay, Royal National Park, Cronulla, Garie Beach and Port Stephens. The Sydney and Royal National Park populations were thought possibly extinct, but the species is now known to occur at Bass and Flinders Point in Cronulla. It generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea.	Low No potential habitat for the species occurs in the study area.
Prostanthera junonis	Somersby Mintbush	Endangered		3	4/03/2008	The species is restricted to the Somersby Plateau. It occurs on both the Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone within open forest/low woodland/open scrub. It occurs in both disturbed and undisturbed sites.	Low No potential habitat for the species occurs in the study area.
Prostanthera marifolia	Seaforth Mintbush	Critically Endangered Species	Critically Endangered	36	4/02/2010	Currently only known from a single population in the northern Sydney suburb of Seaforth. Occurs in localised patches in or in close proximity to the endangered Duffys Forest ecological community.	Low No potential habitat for the species occurs in the study area.
Pterostylis gibbosa	Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood	Endangered	Endangered	0	N/A	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Pterostylis saxicola	Sydney Plains Greenhood	Endangered	Endangered	0	N/A	A ground orchid known from few populations in western Sydney. Distribution restricted between Freemans Reach in the north and Picton in the south. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines.	Low No potential habitat for the species occurs in the study area.
Pterostylis sp. Botany Bay	Botany Bay Bearded Greenhood, Botany Bay Bearded Orchid	Endangered	Endangered	0	N/A	Restricted to the Sydney region where it is known from a small number of sites within Botany Bay National Park on the Kurnell Peninsula. First collected at Maroubra in 1908 but not recorded at Maroubra since that time. Occupies moist level sites on skeletal sandy soils derived from sandstone.	Low No potential habitat for the species occurs in the study area.
Pultenaea parviflora		Endangered		1	4/03/2008	A small erect branching shrub endemic to the Cumberland Plain from Windsor to Penrith and east to Dean Park. Outlier populations are recorded from Kemps Creek and Wilberforce. Associated with scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays.	Low No potential habitat for the species occurs in the study area.
Senecio spathulatus	Coast Groundsel	Endangered		1	25/08/2005	Occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park. Grows on frontal dunes.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Syzygium paniculatum	Magenta Lilly Pilly	Endangered	Vulnerable	50	5/05/2015	Natural occurrence is in littoral rainforest in scattered small populations along a narrow, linear coastal strip from Bulahdelah to Conjola State Forest. Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Moderate. May occur as planted street or garden tree. The majority of the study area is outside the natural range of this species, and most of the records in the locality, particularly closer to the project, are not of conservation significance.
Tetratheca glandulosa		Vulnerable		86	24/05/2013	A small, spreading shrub distributed from Ingleside in the east to East Kurrajong in the west, Sampons Pass on the north to West Pymble in the south. Strongly associated with areas of shale-sandstone transition. Where it occurs on ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches.	Low No potential habitat for the species occurs in the study area.
Tetratheca juncea	Black-eyed Susan	Vulnerable	Vulnerable	26	4/03/2008	Usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape.	Low No potential habitat for the species occurs in the study area.
Thelymitra kangaloonica	Kangaloon Sun Orchid	Critically Endangered	Critically Endangered	0	N/A	*Thelymitra kangaloonica* is only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is found in swamps in sedgelands over grey silty grey loam soils.	Low No potential habitat for the species occurs in the study area.

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	No of records within 10km	Date of last record	Habitat preference/ known distribution	Probability of occurrence in the study area
Thesium australe	Austral Toadflax	Vulnerable	Vulnerable	1	pre 1900	A small, straggling herb to 40 cm tall. Occurs in grassland or grassy woodland, commonly in association with *Themeda australis* in damp areas.	Low No potential habitat for the species occurs in the study area.
Triplarina imbricata	Creek Triplarina	Endangered	Endangered	1	4/03/2008	Found only in a few locations in the ranges south-west of Glenreagh and near Tabulam in north-east NSW. Occurs along watercourses in low open forest with Water Gum (*Tristaniopsis laurina*).	Low No potential habitat for the species occurs in the study area.
Wilsonia backhousei	Narrow-leafed Wilsonia	Vulnerable		12	27/05/2013	Grows in coastal saltmarshes; chiefly in the Sydney district, also common at Jervis Bay.	Low No potential habitat for the species occurs in the study area.

ARCADIS Design & Consultancy for natural and built assets