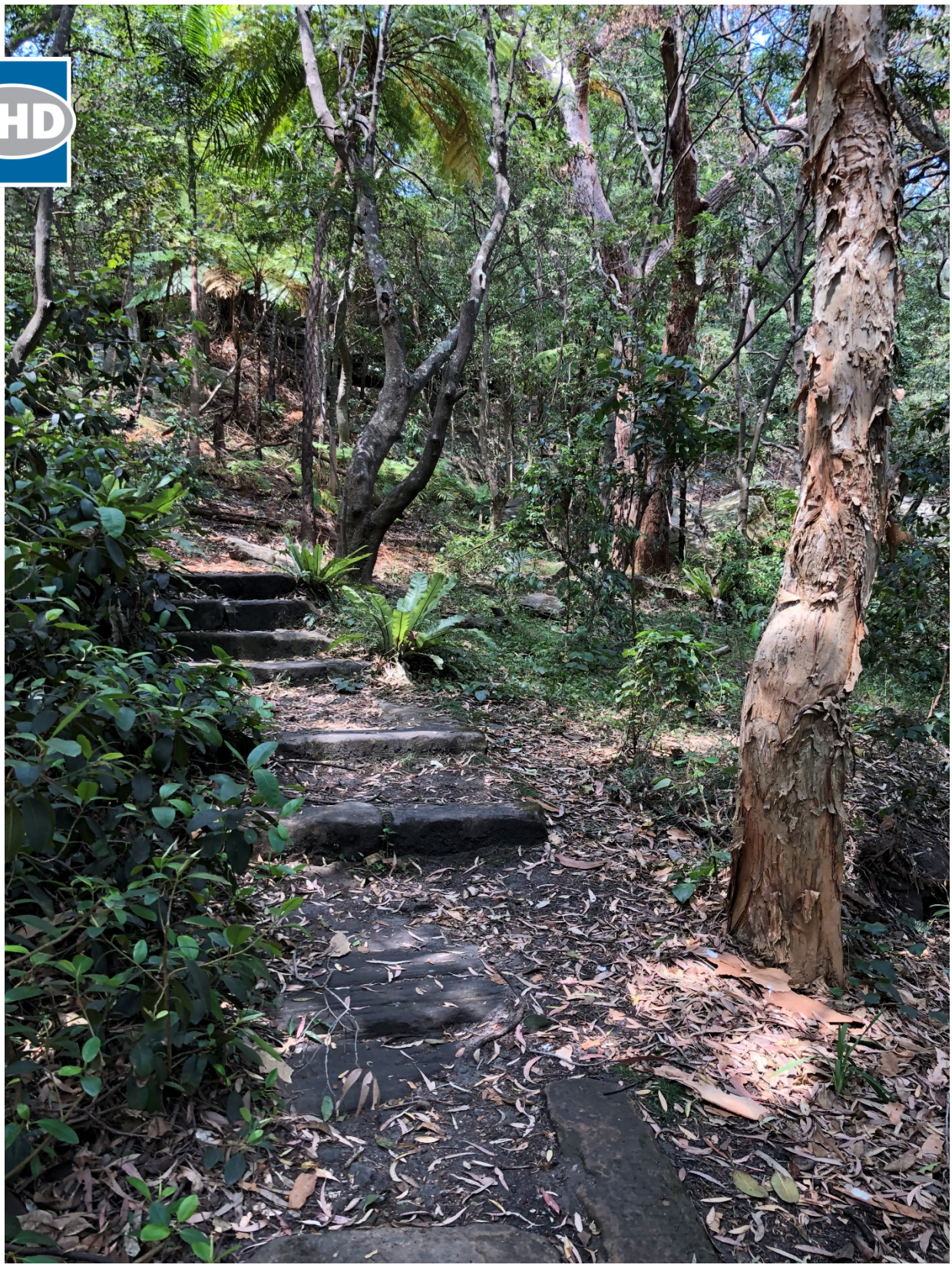

Sydney Water Corporation

Vaucluse Diamond Bay - Concept Design

Biodiversity Assessment

April 2020

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1. Introduction

1.1 Background

In November 2018, the NSW Government announced its commitment to address the flow of untreated wastewater from three ocean outfalls at Vaucluse and Diamond Bay. To address this issue, Sydney Water proposes to construct and operate sewerage infrastructure at Vaucluse and Diamond Bay (the project), which will redirect untreated wastewater through the wastewater network to the catchment of Bondi Wastewater Treatment Plant for treatment, mitigating the associated risks to water quality and public health. The location of the project and the existing outfalls is shown in Figure 1.

The project will include the construction and operation of the following key components:

- Sewage pumping station at Parsley Bay, Vaucluse (SP1216).
- Sewage pumping station at Eastern Avenue Reserve, Diamond Bay (SP1217).
- Wastewater mains connecting the pumping stations to the existing outfalls and network.

The two sewage pumping stations at Vaucluse and Diamond Bay would be constructed mainly below existing ground level. The wastewater mains would be constructed by a mix of open trenching and trenchless methods such as horizontal directional drilling or microtunnelling.

The key components of the project and indicative construction footprint, including Sections of wastewater mains that would be constructed by trenched or trenchless methods, are shown in Figure 2.

During normal operation, the project will redirect untreated wastewater through the wastewater network to the catchment of Bondi Wastewater Treatment Plant for treatment. During wet weather, when the catchment is at full capacity, wastewater may continue to flow through ocean outfalls.

1.2 Purpose of this report

The aim of this Biodiversity assessment report is to:

- Describe the existing environment within and adjoining the indicative construction footprint, including vegetation types, fauna habitats and flora and fauna species known or likely to occur
- Assess the value and conservation significance of native vegetation and habitats in the study area
- Compile a list of threatened biota or migratory species previously recorded or predicted to occur in the locality and assess their potential to occur at the site
- Assess the likely impacts on threatened biota from the proposed works
- Recommend mitigation measures to reduce impacts on biodiversity values
- Provide concluding statements regarding the likely significance of impact of the proposed works on threatened biota or migratory species and the requirement or otherwise for further assessment or approvals at the State or Federal level.

1.3 Disclaimer

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

GHD otherwise disclaim responsibility to any person other than Sydney Water Corporation arising in connection with this report. GHD also exclude implied warranties and conditions to the extent legally permissible.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report and will not account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions described herein. GHD disclaim liability to any person other than Sydney Water Corporation arising from any of the assumptions being incorrect.

GHD have relied on pre-existing information and information provided by third parties including Government authorities in the preparation of this report that has not been independently verified or checked. GHD do not accept any liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

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

Paper Size ISO A4

0 200 400

Metres

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

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Sydney Water
Vaucluse Diamond Bay Concept Design
Biodiversity Assessment

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Revision No. **-**
Date **02 Apr 2020**

Project location

FIGURE 1

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Paper Size ISO A4

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Metres

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

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Revision No. **-**
Date **02 Apr 2020**

Project layout

FIGURE 2a

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Data source: General Topo - NSW LPI DTDB 2018. Cadastre - NSW LPI DCDB 2018. Aerial Imagery - Sixmaps 2020 © Department of Finance, Services & Innovation 2017. Created by: jrprice

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Metres

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Map Projection: Transverse Mercator
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Biodiversity Assessment

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Date **02 Apr 2020**

Project layout

FIGURE 2b

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Data source: General Topo - NSW LPI DTDB 2018. Cadastre - NSW LPI DCDB 2018. Aerial Imagery - Sixmaps 2020 © Department of Finance, Services & Innovation 2017. Created by: jrprice

Paper Size ISO A4

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Metres

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

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Vaucluse Diamond Bay Concept Design
Biodiversity Assessment

Project layout

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Date **02 Apr 2020**

FIGURE 2c

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Data source: General Topo - NSW LPI DTDB 2018. Cadastre - NSW LPI DCDB 2018. Aerial Imagery - Sixmaps 2020 © Department of Finance, Services & Innovation 2017. Created by: jrprice

Paper Size ISO A4

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Metres

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

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Project layout

FIGURE 2d

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Data source: General Topo - NSW LPI DTDB 2018. Cadastre - NSW LPI DCDB 2018. Aerial Imagery - Sixmaps 2020 © Department of Finance, Services & Innovation 2017. Created by: jrprice

Paper Size ISO A4

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Metres

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

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Project layout

FIGURE 2e

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Data source: General Topo - NSW LPI DTDB 2018. Cadastre - NSW LPI DCDB 2018. Aerial Imagery - Sixmaps 2020 © Department of Finance, Services & Innovation 2017. Created by: jrprice

Paper Size ISO A4

0 40 80

Metres

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

N

Sydney Water
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Project layout

FIGURE 2f

N:\AU\Sydney\Projects\21\28225\GIS\Maps\Deliverables\Biodiversity\21_28225_Z002_Biodiversity_ProjectLayout.mxd

Data source: General Topo - NSW LPI DTDB 2018. Cadastre - NSW LPI DCDB 2018. Aerial Imagery - Sixmaps 2020 © Department of Finance, Services & Innovation 2017. Created by: jrprice

2. Legislative context

2.1 NSW State legislation and policy

2.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) forms the legal and policy platform for proposal assessment and approval in NSW and aims to, amongst other things, 'encourage the proper management, development and conservation of natural and artificial resources'. All development in NSW is assessed in accordance with the provisions of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000.*

Under Section 5.5 (1) of the EP&A Act, determining authorities must 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'. This report addresses the ecological components of the environment to assist Sydney Water to address the requirements of Section 5.5 (1) of the EP&A Act.

Section 1.7 of the EP&A Act states that the Act is subject to provisions of Part 7 of the BC Act and Part 7A of the FM Act. Part 7.3 of the BC Act and Section 220ZZ of the FM Act list factors that must be taken into account when determining the significance of potential impacts of a proposed activity on threatened species, populations or ecological communities (or their habitats) listed under the BC Act and the FM Act. The 'assessment of significance' is used to assist in the determination of whether a proposal is 'likely' to impose 'a significant effect' on threatened biota and thus whether a species impact statement (SIS) is required under the BC Act or FM Act. Under the BC Act, there is also the option to prepare a Biodiversity Development Assessment Report (BDAR) rather than an SIS.

2.1.2 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) came into effect on 25 August 2017 and repealed the TSC Act. Self-determining authorities can assess impacts of Part 5 developments on threatened biota listed under the BC Act via Part 7.3 of the BC Act and Section 5AA of the EP&A Act. This requires assessment of potential impacts on threatened biodiversity via the new five-part test of significance (replacing the old seven-part test), and if significant impacts are likely, a species impact statement (SIS) or assessment under the Biodiversity Assessment Methodology (BAM) would be required.

The BC Act has been addressed in this assessment through:

- Desktop review to determine the threatened species, populations or ecological communities that have been previously recorded within the locality and hence could occur subject to the habitats present.
- Field survey for listed threatened species, populations and ecological communities.
- Identification, assessment and mapping of listed threatened communities and threatened species (or their habitat).
- Assessment of potential impacts on listed threatened species, populations and ecological communities, including identification of key threatening processes relevant to the project.
- Assessment of the likely significance of impacts on threatened biota and the requirement or otherwise for the preparation of an SIS.
- Identification of measures to avoid or minimise impacts on listed threatened species.

2.1.3 Fisheries Management Act 1994

The objects of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. It provides for:

- The listing of threatened species, populations and ecological communities, with endangered species, populations and communities listed under Schedule 4, critically endangered species and communities listed under Schedule 4A, 'vulnerable' species and communities listed under Schedule 5.
- The listing of 'Key Threatening Processes' under Schedule 6.
- Diseases affecting fish and marine vegetation under Schedule 6B.
- Noxious fish and noxious marine vegetation under Schedule 6C.
- The preparation and implementation of Recovery Plans and Threat Abatement Plans.
- Requirements or otherwise for the preparation of a SIS.

One of the objectives of the FM Act is to 'conserve key fish habitats' which includes aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. To assist in the protection of key fish habitats, DPI has produced the *Policy and guidelines for fish habitat conservation and management* (2013 update).

The FM Act has been addressed in this assessment through undertaking:

- A desktop review to determine the threatened species, populations or ecological communities that have been previously recorded within the locality of the project and hence could occur subject to the habitats present.
- Survey of the study area to identify any potential freshwater aquatic habitats.

The potential impacts of the project on the marine environment has been assessed separately in the Vaucluse Diamond Bay - Concept Design Marine Environment Assessment (GHD 2019b).

2.1.4 Biosecurity Act 2015

The *NSW Biosecurity Act 2015* regulates pests, diseases and weeds in NSW. The primary object of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

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

Three priority weed species were recorded in the study area. Mitigation measures to minimise the potential for the introduction and/or spread of weeds as a result of the project are discussed in Section 4.2.4.

2.1 Commonwealth legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The purpose of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to ensure that actions likely to cause a significant impact on 'matters of national environmental significance' undergo an assessment and approval process. Under the EPBC Act, an action includes a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Minister for the Environment (the 'Minister').

The EPBC Act identifies matters of national environmental significance (MNES) as:

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

Potential impacts on MNES are subject to an assessment of significance pursuant to the EPBC Act Significant Impact Guidelines (DoEE 2013). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Minister.

The EPBC Act has been addressed in this assessment through:

- Desktop review to determine the listed biodiversity matters that are predicted to occur within the locality of the project and hence could occur, subject to the habitats present
- Targeted field surveys for listed threatened biota and migratory species
- Assessment of potential impacts on threatened biota and migratory species and the need or otherwise for a Referral
- Identification of suitable impact mitigation and environmental management measures for threatened biota, where required.

3. Methods

3.1 Terms and definitions

The following definitions have been used in this report:

- The 'project' refers to the proposed construction of wastewater infrastructure at Vaucluse and Diamond Bay that is outlined in Section 1.1 of this report (see Figure 1 and Figure 2). The project is described in detail in Section 2.1 of the REF.
- The 'indicative construction footprint' refers to the potential disturbance footprint of the project and comprises the subject site for this assessment. This report assumes a worst case scenario involving removal of all native vegetation within the construction corridor for the purposes of estimating the extent of vegetation that will be affected. However, clearing will be largely restricted to groundcover and understorey within the construction footprint and large, mature trees will be retained and protected.
- The 'study area' includes the indicative construction footprint and immediately adjoining areas that may be affected by indirect impacts.
- The 'locality' is the area within a 10 km radius of the indicative construction footprint.

3.2 Desktop assessment

A desktop database review was carried out to create a list of threatened flora and fauna species, populations and ecological communities (biota) listed under the BC Act and FM Act, and MNES listed under the EPBC Act that could be expected to occur in the locality based on previous records, known distribution ranges, and habitats present. The database review assisted with focusing field survey techniques and effort. Biodiversity databases and existing literature and information pertaining to the study area and locality (i.e. within a 10 kilometres radius of the site) that were reviewed prior to conducting field investigations included:

- The NSW Office of Environment and Heritage (OEH) BioNet Atlas for records of threatened species listed under the BC Act and EPBC Act which have been recorded within the locality (OEH, 2019a)
- The Australian Government Department of the Environment and Energy (DoEE) Protected Matters Search Tool (PMST) for MNES listed under the EPBC Act which may occur in the area (DoEE 2019a)
- OEH threatened biota profiles for descriptions of the distribution and habitat requirements of threatened biota (OEH, 2019b)
- DoEE online species profiles and threats database (DoEE 2019b)
- DPI indicative distributions of threatened freshwater fish (DPI, 2019a).
- Existing regional-scale vegetation mapping of the study area (Tozer et al., 2010)
- The NSW Vegetation Information System (VIS) Classification 2.1 - Community Identification (OEH 2019c) to identify matching plant community types (PCTs) in the study area
- Priority weed declarations for Greater Sydney Region (DPI 2019b)
- Aerial photography of the study area.

Following collation of database records and species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the broad habitats at the study area. This was further refined following field surveys and assessment of habitats present. The results of this assessment are presented in Appendix A.

3.3 Field surveys

3.3.1 Overview

Field surveys of the site were conducted by two GHD ecologists on 10 December 2019. The field surveys focussed on the identification of vegetation types, condition and conservation significance within the site and an assessment of the value of habitats present for threatened biota known or predicted to occur in the locality.

3.3.2 Flora surveys

Vegetation mapping and threatened flora searches

Vegetation within the site was mapped based on observed species composition and vegetation structure, and with reference to regional vegetation mapping (NPWS 2013). All vegetation types were then mapped using aerial photographic interpretation within a geographical information system (GIS) as guided by the field survey results. Searches for threatened flora species previously recorded or predicted to occur in the locality were conducted in any areas of potentially suitable habitat (see Thompson 2013; OEH 2013).

Fauna assessment

General fauna habitat assessments were undertaken throughout the site, including active searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as particular food trees, hollow-bearing trees, the density of understorey vegetation, the composition of ground cover, leaf litter and ground debris were noted if present. Opportunistic and incidental observations of fauna species were recorded at all times during field surveys.

3.3.3 Survey effort limitations

It is likely that some species that occur in the study area either permanently, seasonally or transiently were not detected during the survey. These species may include annual, ephemeral or cryptic flora species; nocturnal fauna; birds and frogs that call at other times of year and mobile or transient fauna in general. The habitat assessment conducted allows for identification of habitat resources for such species, in order to make an assessment of their likelihood of occurring within the study area. As such, the survey was not designed to detect all species, rather to provide an overall assessment of the ecological values and constraints within the study area. This information was used to predict potential impacts of the project on biodiversity values and to assist with the development of a design and approach to construction that specifically avoids and/or reduces impacts on threatened ecological communities and known and potential habitat for threatened species as far as possible.

3.4 Likelihood of occurrence of threatened and migratory biota

Following collation of database records and review of species and community profiles, a ‘likelihood of occurrence’ assessment was prepared with reference to the habitats contained within the study area. Identification of potential habitat for threatened and migratory species was based on information provided in the species profiles (DoEE 2019b, OEH 2019b), recovery plans, journal articles, and the field staffs’ knowledge of species habitat requirements. The likelihood of occurrence assessment was further refined following field surveys. The likelihood of threatened and migratory biota occurring in the study area was assessed based on presence of records from the locality for the last 20 years (since 1999), species distribution and habitat preferences, and the suitability of potential habitat present in the study area. The results of this assessment are provided in Appendix A.

4. Existing environment

4.1 Site context

The indicative construction footprint occurs at the following locations:

- a section of Parsley Bay Reserve
- cliff line vegetation along Diamond Bay Headland, extending from the southern side of Diamond Bay Reserve to the northern edge of Eastern Avenue Reserve
- Oceanview Avenue, part of Eastern Avenue, Carlisle and part of Dover Road, Vaucluse and Rose Bay.

4.1.1 Study area

Topography and soil landscape

Topography over the three sites is mostly level to gently inclined, although the cliff edges along Diamond Bay are precipitous.

The topsoil at most parts of the subject site appear to have undergone past and recent disturbances, including cutting and filling for parkland and urban development. The original soils around Parsley Bay would have been derived from soils of the Hawkesbury (ha) Soil Landscape Group. Soils of the Hawkesbury Group are derived from Hawkesbury Sandstone and consist of "…medium to coarse-grained quartz sandstone with minor shale and laminite lenses (see Chapman and Murphy 1989)

Soils along the cliff edge at Diamond Bay as well as the Vaucluse and Rose Bay streets which are included in this survey are derived from soils of the Lambert (la) Soil Landscape Group. Soils of the Lambert Group occur on "….undulating low hills on Hawkesbury Sandstone…" (see Chapman and Murphy 1989).

Photo 1 gently inclined topography, Parsley Bay Reserve

Photo 2 Steep to precipitous topography, Diamond Bay Reserve

Photo 3 level to very gently inclined topography, Carlisle Street

Hydrology

Parsley Creek flows down a gully from Hopetoun Road and through Parsley Bay Reserve before entering Parsley Bay. The creek flows between the car park and the indicative construction footprint in the eastern Section of the Reserve. The creek flows down outcropping sandstone, with waterfalls present upstream of the study area. The creek bed is generally sandstone bedrock. Adjacent to the indicative construction footprint, the creek is about one metre wide, with banks of up to one metre high. Tree ferns, Lilly Pillies, bracken and other groundcover grow along the margins of the creek. There is no emergent aquatic vegetation present. Water depth at the time of the survey was about 20 cm.

4.2 Vegetation

Vegetation types recorded in the study area are described below and mapped on Figure 3. A flora species list is provided in Appendix B.

4.2.1 Parsley Bay Reserve

Parsley Bay Reserve was managed as a Reserve by Vaucluse Council from 1907 and by Woollahra Council from 1948, after the two Councils merged. "….the Reserve remains a popular place for more intimate picnic parties, and, since the 1970s, for weddings. It has also formed the backdrop for a number of films, commercials and television programs in recent decades. Woollahra Council has continued to maintain the Reserve and beachfront and in

recent years has pioneered a bush regeneration program in the gully area, allowing the native species to prevail following the eradication of exotics" (Woollahra Library History Centre 2005).

Original vegetation on the site would have consisted of Tall Woodland and Open-forest on Sandstone, with closed forest along sheltered creek lines (see Benson and Howell 1990; Woollahra Municipal Council 2015). It is apparent that much of the original vegetation has been cleared, with subsequent regrowth supplemented in some instances by planting of native and exotic tree and shrub species (see Woollahra Municipal Council 2015). The existing vegetation within the Reserve is described according to NSW NPWS 2013 vegetation classification as Sydney Foreshore Shale Forest on the level areas, with Coastal Sandstone Foreshore Forest on the slopes and sandstone terraces (see NSW NPWS 2013; Woollahra Municipal Council 2015). Common tree species would have included Smooth-barked Apple *Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*), Old Man Banksia (*Banksia serrata*) and Black Oak (*Allocasuarina littoralis*). Mid-storey species would have included Black Wattle (*Callicoma serratifolia*), Water Gum (*Tristaniopsis laurina*) and Ironwood (*Backhousia myrtifolia*).

These species are still present in vegetation patches, either as natural occurrences or the result of planting (see Woollahra Municipal Council 2015).

Coastal Sandstone Foreshores Forest

Complete, continuous canopy cover of indicative species such as Smooth-barked Apple (*Angophora costata*), Bangalay (*Eucalyptus botryoides*) and Blackbutt (*Eucalyptus pilularis*) occur over a large portion of the uncleared Section of the Reserve, and in sheltered sites, such as adjacent to the creekline and below sandstone outcrops, there is a mid-storey of indicative mesic species, especially Brush Daphne (*Pittosporum undulatum*), Smooth Cheese-tree (*Glochidion ferdinandi* var. *ferdinandi*), Blueberry Ash (*Elaeocarpus reticulatus*) and Murrogun (*Myrsine variabilis*). There are also additional species, apparently as a result of regeneration planting, including Palms (*Archontophoenix cunninghamiana* and **Howea forsteriana*), Tree Ferns (*Cyathea* spp), Plum Pine (*Podocarpus elatus*), Broad-leaved Paperbark (*Melaleuca quinquenervia*), Lilly Pilly (*Syzygium smithii*), Brush Cherry (*Syzygium australe*) and the threatened Magenta Lilly Pilly (*Syzygium paniculatum*). Groundcover species depend on factors including location, pedestrian traffic and planting history. Common species include Bracken (*Pteridium esculentum*), Rainbow Fern (*Calochlaena dubia*), Mat-rush (*Lomandra longifolia*) and grasses, especially Weeping Grass (*Microlaena stipoides* var. *stipoides*).

Structure: Trees to 20 m; Foliage Projective Cover (FPC) 15 to 20%. Shrubs to 5 m; FPC to 22%; Groundcover to 1.5 m; FPC from 10 to 20%.

Photo 4 Coastal Sandstone Foreshores Forest, looking south from carpark, Parsley Bay Reserve

Photo 5 Coastal Sandstone Foreshores Forest with evidence of planting, Parsley Bay Reserve: Note Broad-leaved Paperbarks (*Melaleuca quinquenervia*)

Urban - exotic/native

Patches of this vegetation type occur around cleared areas, including the carpark and lawns. Of special note are the mature specimens of the indigenous Small-leaved fig (*Ficus obliqua* subsp. *obliqua*), growing adjacent to the toilets and carpark entrance and the line of Hill's Weeping Fig (*Ficus microcarpa* var. *hillii*) to the north of the playground. Hill's Weeping Fig occurs in North-east Queensland, although it has been a popular ornamental planting along the east coast of NSW for at least the last 100 years.

Planted tree species which are indigenous but atypical of the local habitat include Forest Red Gum (*Eucalyptus tereticornis*) and Spotted Gum (*Corymbia maculata*). Disturbed vegetation along urban edges include plantings of exotic ornamental trees, as well as self-recruited exotic species, including *Fatsia japonica, Asparagus aethiopicus, Hedychium gardnerianum, Schefflera actinophylla, Cinnamomum camphora, Ligustrum sinense, Ehrharta erecta, Celtis sinensis, Eriobotrya japonica* and *Tradescantia fluminensis*.

Photo 6 Urban- exotic/native; planted line of Hill's Weeping Figs, Parsley Bay Reserve

4.2.2 Diamond Bay Headland

In describing the landscape and original vegetation of Woollahra, Benson and Howell (1990) comment that "…..on the higher more exposed sites was heathland with a variety of shrubby species…..*Sydney Heads*, a painting by Eugene von Guerard showing the South Head

peninsula in 1865 clearly shows the disposition of extensive heath and scrub on the exposed ridges….".

It is apparent that most of the vegetation in the subject site has either been planted or allowed to self-recruit after initial clearing. There is evidence of occasional bush regeneration work close to Craig Avenue, although the incidence of exotic species increases near the cliff edge and downslope of residential buildings.

The vegetation in the subject site is described, as closely as possible, according to NSW NPWS 2013 vegetation classifications.

Coastal Headland Banksia Heath (including Coastal Headland Cliffline Scrub)

The vegetation appears to form an intergrade between Coastal Headland Banksia Heath and Coastal Headland Cliffline Scrub, in response to factors including location and disturbance, but as most of the vegetation patches appear to have been planted within the last ten years, there are no distinct floristic and structural differences between the two vegetation types.

Patches of this vegetation type occur along both sides of the Diamond Bay Cliffwalk within Diamond Bay Reserve, with the largest patch extending from the north-western extent of the Reserve to near the lookout. Smaller patches occur along the cliffwalk heading south towards Eastern Avenue Reserve. With a narrow planted strip following the safety fence and several planted patches adjacent to Oceanview Avenue. These planted areas have been included in the extent of this vegetation type mapped on Figure 3.

Common small tree species include Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*) and Brush Daphne (*Pittosporum undulatum*). Common shrub species include Coastal Rosemary (*Westringia fruticosa*), Wadanggari (*Banksia ericifolia* subsp. *ericifolia*), Sydney Green Wattle (*Acacia longifolia* subsp. *longifolia* and *Acacia longifolia* subsp. *sophorae*), Coast Tea-tree (*Leptospermum laevigatum*) and Fringed Heath Myrtle (*Micromyrtus ciilata*). Common grasses and sedges include *Lomandra longifolia*, *Chordifex fastigiatus, Ficinia nodosa, Lepidosperma* spp, *Entolasia stricta* and *Cyathochaeta diandra*. *Dampiera stricta* and *Scaevola calendulacea* are commonly occurring forbs.

Structure: Trees to 5 m, generally scattered individuals or small thickets. Shrubs: to 2 m; FPC 25%. Groundcover: to 1 m; FPC 20%.

Photo 7 Coastal Headland Banksia Heath; recently planted, at western edge of Reserve

Photo 8 Coastal Headland Banksia Heath

Coastal Clifftop Marsh

One distinct patch of this vegetation type occurs on the lower slopes, south of the Cliffwalk, and west of the lookout at Diamond Bay Reserve. The patch appears to receive additional moisture from seepage further upslope.

The largest portion of this vegetation type consists of a dense sward of Coastal Rosemary. Other common species, especially close to the cliffwalk include Knobby Club-rush (*Ficinia nodosa*) and Prickly Couch (*Zoysia macrantha*). Other sedge species, occurring in small thickets include *Schoenus maschalinus*, *Chordifex fastigiatus*, *Lepidosperma concavum* and *Baumea juncea*.

Photo 9 Coastal Cliff-top Marsh, Diamond Bay Reserve: dense sward of Coastal Rosemary (*Westringia fruticosa)*

Urban -exotic/native

This vegetation type differs from Weeds Exotic in terms of floristics. This vegetation type mainly occurs as self-recruited (or previously planted) exotic coastal trees and shrubs. Common species include Pohutukawa (*Metrosideros excelsa*), Taupata (*Coprosma repens*) and Norfolk Island Hibiscus (*Lagunaria patersonii*). Areas of grassland are also included because of their high occurrence of native grass species, growing in association with exotic species. Native grass species include *Themeda triandra*, *Cynodon dactylon*, *Dichelachne crinita*, *Entolasia stricta*, *Entolasia marginata*, *Imperata cylindrica* and *Microlaena stipoides* var. *stipoides*. Native forb species include *Dichondra repens* and *Centella asiatica*.

Photo 10 Urban_Exotic/native; with high proportion of native forbs and grass species, growing in association with exotic species

Photo 11 Urban_Exotic/native; established Pohutukawa and Norfolk Island Hibiscus, growing in association with native coastal headland heath species

Weeds – exotic

This vegetation type consists almost completely of exotic species, including several Priority Weed species. A large patch of this vegetation type occurs on a batter downslope of several houses with swimming pools. There are also small patches on cliff edges. Common weed species in the large patch include Kurnell Curse (*Hydrocotyle bonariensis*), Fishbone Fern (*Nephrolepis cordifolia*) and Panic Veldtgrass (*Ehrharta erecta*). Patches of Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*) are common, especially on the cliffs facing due east.

Photo 12 Weeds- Exotic: Dense covering of weed species, especially Fishbone Fern, Kurnell Curse and Panic Veldtgrass

Photo 13 Weeds- Exotic: Patches of Bitou Bush on cliff

4.2.3 Street trees

Trees in Carlisle Street and part of Dover Road

Carlisle Street is a broad street with wide nature strips on both sides. The road has a south-easterly aspect and mostly gently inclined topography, apart from a Section of sandstone outcrop. There is evidence of recently removed and poisoned vegetation (including *Ficus* spp.) on the steepest Section of sandstone outcrop.

Mature trees line both sides of the road. Species include *Agonis flexuosa*, *Angophora costata*, *Angophora floribunda, Syzygium luehmannii, Schinus areira* var. *molle, Phoenix canariensis*, *Eucalyptus robusta, Eucalyptus propinqua, Corymbia citriodora/C. maculata* hybrid and *Acacia implexa*. A large specimen, tentatively identified as the threatened *Syzygium paniculatum* is growing on the western side of the road, near the Dover Road intersection. This specimen is growing near a large, mature *Ficus rubiginosa*, which although located within the adjacent church property has a canopy which extends over the footpath and road.

Several trees have been protected because of their proximity to construction sites. This includes one *Angophora costata* growing on the footpath and one in the adjacent property. An *Agonis flexuosa* has been fenced although it was noted that building materials have been stored within the Tree Protection Zone (TPZ).

Mature Brushbox (*Lophostemon confertus*) have been planted along both sides of Dover Road, although the trees on the northern side have required regular lopping, because of their location beneath powerlines.

No evidence of surface disruption from root growth was recorded in the roadway along the surveyed Sections of Dover Road and Carlisle Street (see Photo 14). There is the potential for overhanging branches to hinder machinery operation dependent on the location of the construction footprint and construction methodology (see Photos 15 and 16).

Photo 14 Brushboxes along Dover Road. No evidence of surface disruption in roadway

Photo 15 Tree protection; *Angophora costata* growing adjacent to construction site; 9 Carlisle Street

Photo 16 *Agonis flexuosa* and *Schinus areira* var. *molle* with overhanging canopies; 24 and 25 Carlisle Street

Trees in Oceanview Avenue and parts of Eastern Avenue and Ray Street

Both streets have easterly aspects and most street trees close to the cliff line indicate stress factors including wind-shear, necrotic leaf margins and stunted growth. The roads are wide and the trees are growing in broad nature strips. Coastal species, especially *Cupaniopsis anacardioides*, *Metrosideros excelsa* and *Banksia integrifolia* subsp. *integrifolia* appear to be the most successful street tree plantings. It is apparent that surface root growth of some of the larger, mature trees has been restricted to the surrounding grassed areas or garden beds and it is likely that the concrete kerbs have acted as root barriers.

One mature Weeping Fig (*Ficus benjamina*) appears to have been regularly trimmed and there is some evidence of surface disruption in the adjacent roadway. It is likely that most of the surface disruption has been caused by mats of fine roots, rather than by large supporting roots and it is also apparent that the surface disruption (and therefore root growth) does not extend to the centre of the road.

No evidence of surface disruption from root growth was recorded elsewhere in the survey area. It is likely that the only overhanging branch which may hinder machinery operation is a mature Coast Banksia outside 10 Oceanview Avenue (see Photo 19).

Photo 17 Eastern end of Eastern Avenue: Planted trees in nature strip are *Metrosideros excelsa*

Photo 18 Weeping fig with evidence of surface disruption to adjacent roadway, Oceanview Avenue, at interSection with Military Road. The shrub with the red flowers is *Malvaviscus arboreus*

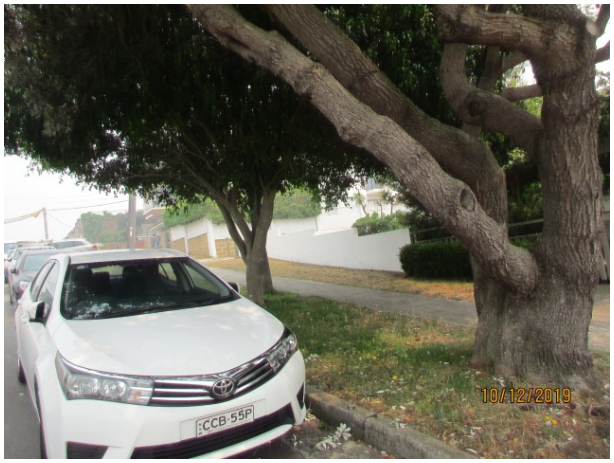
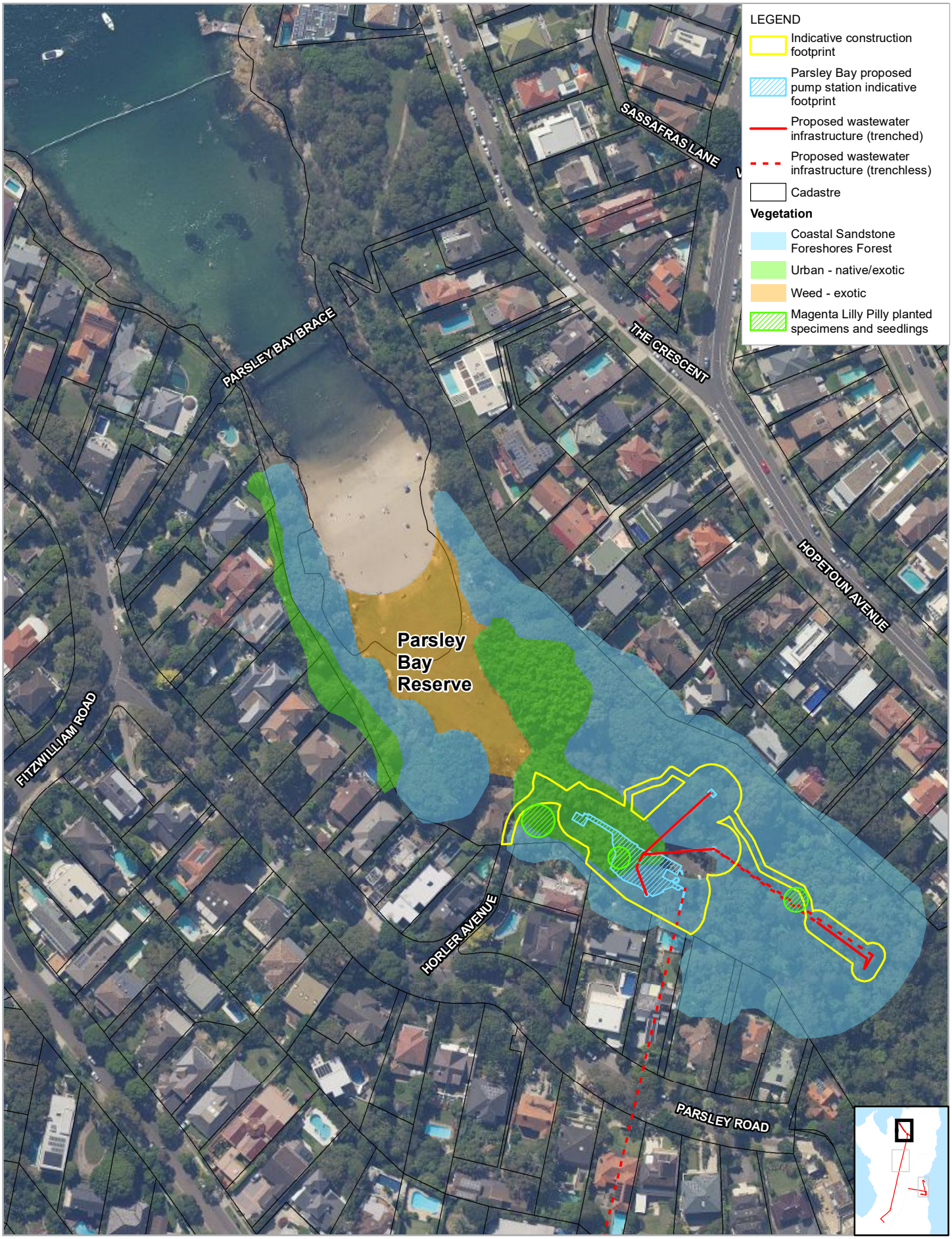


Photo 19 Mature Coast Banksia and early-mature Weeping Fig, 10 Oceanview Avenue. Note lateral extending over roadway



Paper Size ISO A4

0 40 80

Metres

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

N

Sydney Water
Vaucluse Diamond Bay Concept Design
Biodiversity Assessment

Vegetation Types

Project No. **21-28225**
Revision No. **-**
Date **02 Apr 2020**

FIGURE 3

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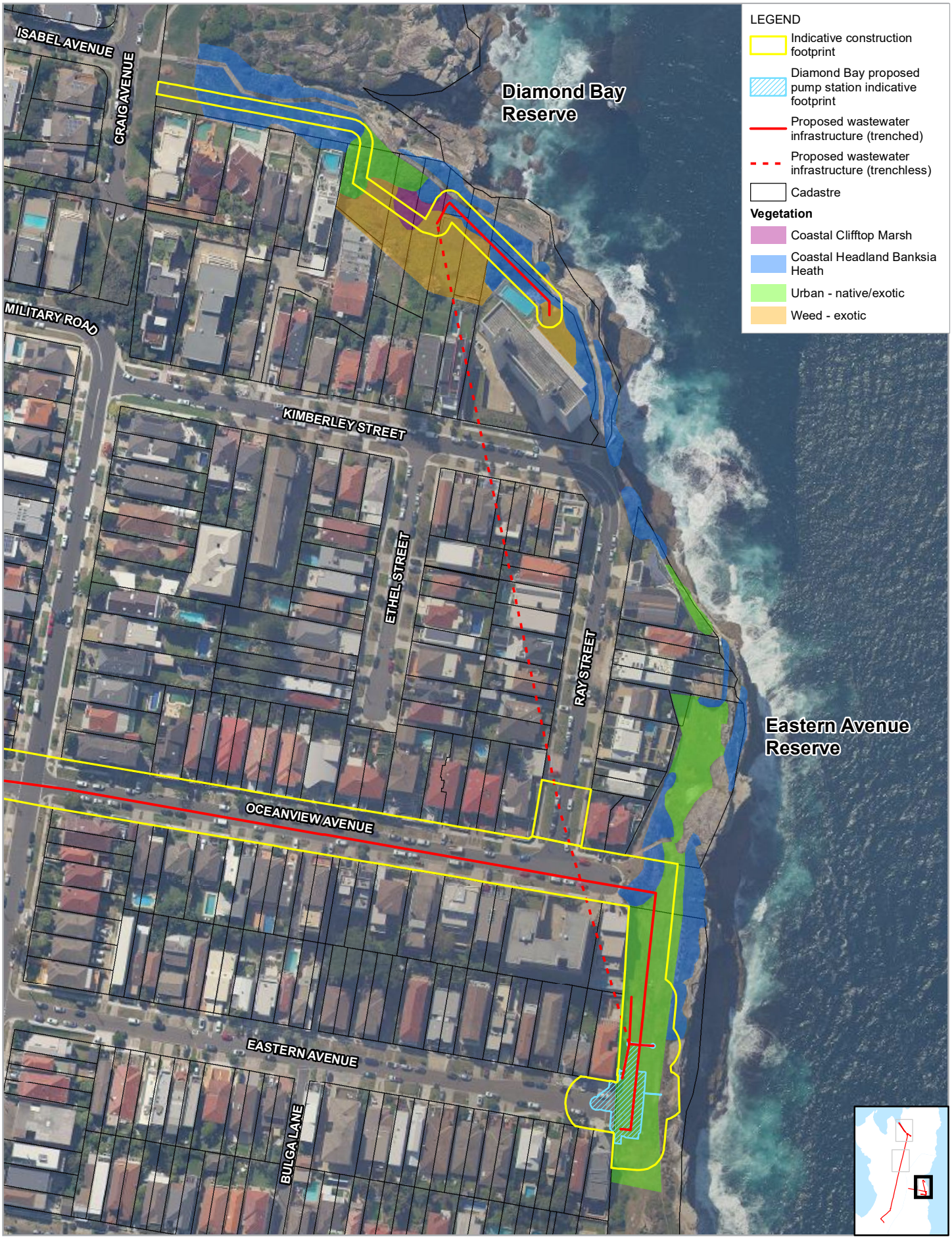
Data source: General Topo - NSW LPI DTDB 2018. Cadastre - NSW LPI DCDB 2018. Aerial Imagery - Sixmaps 2020 © Department of Finance, Services & Innovation 2017; Heritage listed trees - Artefact.

Created by: jrprice



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Map Projection: Transverse Mercator
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Sydney Water
Vaucluse Diamond Bay Concept Design
Biodiversity Assessment

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Vegetation Types

FIGURE 4

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Data source: General Topo - NSW LPI DTDB 2018. Cadastre - NSW LPI DCDB 2018. Aerial Imagery - Sixmaps 2020 © Department of Finance, Services & Innovation 2017; Heritage listed trees - Artefact.

Created by: jrprice

4.2.4 Priority weeds

Three priority weeds for the Greater Sydney region (which includes the local council area of Woollahra) occur within the study area, and are shown in Table 1.

Table 1 Priority weeds recorded within the study area

Common name	Scientific name	Locations
Ground Asparagus	*Asparagus aethiopicus*	Growing on steep batters, Carlisle Street Occasional patches in weedy vegetation close to cliff edges at Diamond Bay Occasional occurrence in moist areas along creek-line and around toilet block at Parsley Bay
Bitou Bush	*Chrysanthemoides monilifera* subsp. *rotundata*	Cliff edges at Diamond Bay Occasional occurrence at Parsley Bay
African Olive	*Olea europaea* subsp. *cuspidata*	Occasional self-recruited specimens close to cliff walk at Diamond Bay Occasional self-recruited specimens growing within vegetation along the creek-line at Parsley Bay

4.3 Fauna and habitat resources

A low diversity of fauna were recorded during the field survey, due in part to short duration of the survey and high temperatures and smoke haze present on the day. In total, 10 native bird species and three introduced bird species were recorded.

The fauna habitats that occur in the subject site are described in Tables 2 and 3 below.

Table 2 Fauna habitats – Parsley Bay Reserve

Habitat type:	
Description	Fauna habitats within the indicative construction footprint at Parsley Bay Reserve are associated with Coastal Sandstone Foreshores Forest and planted urban vegetation comprising a mixture of native and exotic species. The canopy of eucalypts including Smooth-barked Apple (*Angophora costata*), Bangalay (*Eucalyptus botryoides*) and Blackbutt (*Eucalyptus pilularis*) and large fig trees which would provide foraging and nesting habitat for a range of bird and bat species and common possums. Hollows are present in some of the larger eucalypts that provide potential roosting and nesting habitat for cockatoos, parrots, possums and microbats. The large fig trees contain trunk crevices and hollows that may be used as roost sites by microbats and possums. The mid-storey includes a range of shrubs, including Brush Daphne (*Pittosporum undulatum*), Smooth Cheese-tree (*Glochidion ferdinandi* var. *ferdinandi*), and Blueberry Ash (*Elaeocarpus reticulatus*), as well as planted species including palms, tree ferns, paperbarks and lilly pillies. These provide foraging and shelter habitat for a range of birds. Groundcover included areas dominated by Bracken (*Pteridium esculentum*), Rainbow Fern (*Calochlaena dubia*), Mat-rush (*Lomandra longifolia*) and grasses, with areas of dense leaf litter. Small bird species and reptiles would utilise these areas for shelter and foraging. Other parts of the indicative construction footprint consist of cleared pathways, car park areas, mulched areas and mown grass which provide only limited habitat for fauna species.
Typical fauna species	Common bird species were recorded at Parsley Bay, with large numbers of Noisy Miners (*Manorina melanocephala*) and Rainbow Lorikeets (*Trichoglossus moluccanus*) observed. These species would

Habitat type:	
	forage throughout the forested and planted areas. Also recorded were large birds such as the Pied Currawong (*Strepera graculina*) and Laughing Kookaburra (*Dacelo novaeguinea*). The Satin Bowerbird (*Ptilinorhynchus violaceus*) would forage throughout the area and use the dense midstorey for its bower. The Australian Magpie (*Cracticus tibicen*), Welcome Swallow (*Hirundo neoxena*) and introduced rock Pigeon (*Columba livia*) were observed in more open areas.
Threatened or migratory biota	Grey-headed Flying-fox (*Pteropus poliocephalus*) – would forage on occasion at the site when appropriate species are flowering or fruiting. The reserve does not contain a known roost/camp site of this species. Threatened microchiropteran bats, such as the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) could potentially forage within vegetated areas and roost in hollow-bearing trees. There is some potential for cave-roosting bats to roost in the toilet block, although no evidence of their presence was observed during the field inspection. The Powerful Owl (*Ninox strenua*) could forage in vegetated areas and may potentially roost in areas of dense creekline vegetation outside of the indicative construction footprint. There are no hollows of a suitable size to .provide nesting sites for this species.

Table 3 Fauna habitats – Diamond Bay Headland and Street Trees

Habitat type:	
Description	Fauna habitats at Diamond Bay comprise coastal heath and scrub, weedy areas and planted trees and shrubs. Coastal heath and scrub vegetation includes Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*) and Brush Daphne (*Pittosporum undulatum*) and a range of smaller shrubs. These areas provide foraging and shelter habitat for a range of common birds and reptiles. Weedy areas have a dense cover of low shrubs, reeds and grasses. Roadside vegetation comprises planted trees including eucalypts, palms, banksias and pines, among others.
Typical fauna species	Common bird species were recorded in heath and scrub at Diamond Bay, including small birds such as the Superb Fairy-wren (*Malurus superbus*) and the larger Australian Magpie (*Cracticus tibicen*). This habitat type may also provide habitat for species such as the Common Ringtail Possum (*Pseudocherirus peregrinus*), reptiles and frogs. Planted roadside trees provide foraging and roosting habitat for common bird species such as the Rainbow Lorikeet (*Trichoglossus moluccanus*) and Sulphur-crested Cockatoo (*Cacatua galerita*). Introduced bird species including the Spotted Dove (*Spilopelia chinensis*) and Common Myna (*Acridotheres tristis*) were also observed in these areas.
Threatened or migratory biota	Grey-headed Flying-fox (*Pteropus poliocephalus*) – may forage on occasion in planted Eucalypts, Figs and Palms or naturally occurring Banksias when appropriate species are flowering or fruiting.

4.4 Conservation significance

4.4.1 Overview

4.4.2 Threatened ecological communities

The Likelihood of Occurrence Table (Appendix A; Table 1) includes a list of Threatened Ecological Communities (TECs) which have been recorded or have been predicted to occur in the locality.

No Threatened Ecological Communities are indicated as occurring within the subject site in vegetation mapping by NSW NPWS (2012). No patches of Threatened Ecological Communities were recorded in the subject site during this survey. The vegetation types which are described as occurring within the subject site: Coastal Sandstone Foreshores Forest; Coastal Headland Banksia Heath and Coastal Clifftop Marsh are not described as components of any Threatened Ecological Communities by NSW NPWS (2012).

There are components of Littoral Rainforest, following the creekline at Parsley Bay Reserve. However, most of these rainforest components appear to have been planted. Additionally, under the Coastal Management SEPP, there is no Littoral Rainforest mapped within 2.5 km of Parsley Bay.

At the Diamond Bay subject sites there are areas of white-coloured aeolian sand which would have originally provided habitat for Eastern Suburbs Banksia Scrub, and possibly Themeda grassland on seacliffs and coastal headlands, although it is apparent that all original vegetation has been cleared and the regrowth vegetation is regularly maintained, thereby inhibiting self-recruitment of original plant assemblages.

4.4.3 Endangered populations

No endangered populations listed under the BC Act have been previously recorded within the locality.

4.4.4 Threatened flora species

The following threatened species have previously been recorded at or near Parsley Bay Reserve (OEH 2019a):

- *Syzygium paniculatum*
- *Acacia terminalis* subsp. *terminalis*
- *Callistemon linearifolius.*

During this survey previously recorded specimens (see GHD 2019a) of *Syzygium paniculatum* and *Acacia terminalis* subsp. *terminalis,* growing on the carpark edge, near the toilets were found to have been removed during garden maintenance. Several apparently planted juvenile specimens, as well as numbers of (probably) self-recruited seedlings of *Syzygium paniculatum* were recorded within the subject site (Photos 20 and 21). Their locations are indicated in Figure 3.

A mature street tree, growing at the south-western end of Carlisle Street was tentatively identified as *Syzygium paniculatum*, based on leaf shape, leaf apex and leaf venation. The presence of fruit in Autumn 2020 would confirm identification of this specimen.

No individuals of *Acacia terminalis* subsp. *terminalis* or *Callistemon linearifolius* were recorded within the subject site (*i.e.* in areas which have been identified as potential disturbance areas).

Appendix A; Table 2 includes a list of twenty eight (28) threatened plant species which have been recorded or have been predicted as occurrences within the subject site. The following species which are included in Table 2 were listed as “possible”. These species are discussed below:

- *Euphorbia psammogeton*: (syn. *Chamaesyce psammageton*), which has been (rarely) recorded on headlands, but is more typically recorded on sand dunes (G. Leonard pers. obs.). No individuals of *Euphorbia psammogeton* were recorded, although several specimens of the exotic *Euphorbia prostrata* were recorded close to the cliff edge at Diamond Bay.
- Searches were carried out for individuals of *Melaleuca biconvexa* and *Rhodamnia myrtifolia* along the creek line at Parsley Bay Reserve. No individuals were recorded within the subject site during this survey.
- Searches were carried out in patches of *Themeda triandra* at Diamond Bay for individuals of *Thesium australe.* No individuals were recorded within the subject site during this survey.

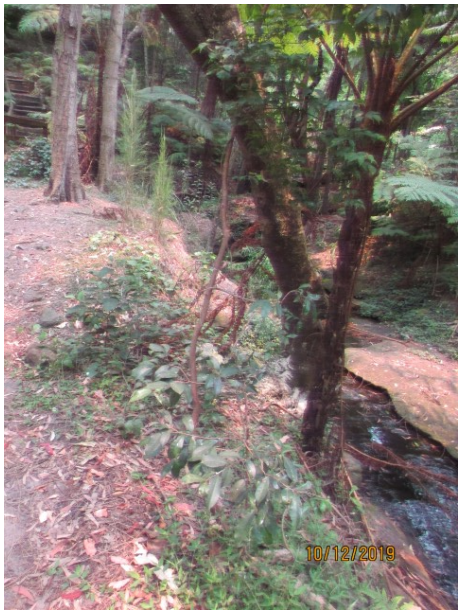

Photo 20 (Probably) planted juvenile specimen of *Syzygium paniculatum* (thin stem in centre of picture, to left of tree fern), growing in appropriate habitat on creek bank

Photo 21 Palm grove to the west of toilet. Numerous seedlings of *Syzygium paniculatum* have self-recruited in this patch

4.4.5 Threatened fauna species

No threatened fauna species were observed during the site inspection. Based on the results of the desktop review, a range of threatened species listed under the BC Act have been previously recorded in the locality, or are predicted to occur. A large number of the species known or predicted to occur in the locality can be excluded from occurring in the current study area, given their specific habitat requirements (refer to Appendix A).

Some mobile threatened fauna species may occur at Parsley Bay on occasion. Species most likely to occur include:

- Grey-headed Flying-fox (*Pteropus poliocephalus*) – this species is likely to forage in eucalypts and figs at Parsley Bay, and in planted trees along roadsides when these species are flowering or fruiting. No roost colonies are located within or adjacent to the indicative construction footprint. A breeding colony is located at Centennial Park, about 5 km to the south-west of the subject sites.
- Microbats - A range of microbats, including some threatened species are likely to forage in vegetation within Parsley Bay Reserve. Hollow-bearing trees provide potential roosting and breeding habitat for hollow-dependent species such as the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) which has been previously recorded (OEH 2019a) and for other species known from the locality, including the Eastern Coastal Freetail Bat (*Mormopterus norfolkensis*) and the Greater Broad-nosed Bat (*Scoteanax rueppellii*). The toilet block could potentially provide roosting habitat for cave-roosting species previously recorded in the wider locality, although these species are considered unlikely to occur on site (Appendix A) and no evidence of roosting bats was observed during the site inspection.
- Powerful Owl (*Ninox strenua*) – A breeding pair is known from Centennial Park and there are records of the species at Neilson Park, located about 0.5 km to the west of Parsley Bay (OEH 2019a). It is therefore possible that this species may forage at Parsley Bay Reserve and the dense vegetation along the gully provides potential roost habitat for this species. There are no hollow-bearing trees identified within or adjacent to the indicative construction footprint that contain hollows of a suitable size to provide breeding habitat for this species. This species is unlikely to occur at Diamond Bay given the limited native vegetation that is present.

The indicative construction footprint does not contain any defined watercourses or waterbodies that provide suitable habitat for threatened fish listed under the FM Act. The species predicted to occur in the locality (Appendix A) would not occur in the creek line adjacent to the indicative construction footprint in Parsley Bay Reserve.

4.4.6 Migratory fauna species

There is some potential for a number of migratory species to forage on occasion within the indicative construction footprint area during their migration to breeding habitats elsewhere. Species that may occur on occasion include the Black-faced Monarch (*Monarcha melanopsis*). Similarly, migratory waders may occur on the sandflats at Parsley Bay on rare occasions.

No important habitat for migratory species as defined in the significance criteria for listed migratory species (DoEE 2013) is present at either Parsley Bay or Diamond Bay, given that the habitat present:

- does not support an ecologically significant proportion of the population of any migratory species
- is not of critical importance to any migratory species at particular life-cycle stages
- is not utilised by a migratory species which is at the limit of the species range

- Is not located within an area where particular migratory species are declining.

While it is possible that migratory species may occur on occasion, they would be highly unlikely to rely on the habitats present for their survival in the locality.

A list of migratory fauna species recorded in the locality or predicted to occur is provided in Appendix A, together with their habitat requirements and likelihood of occurrence.

5. Impact assessment

5.1 Construction methodology

The two sewage pumping stations at Vaucluse and Diamond Bay would be constructed mainly below existing ground level. The wastewater mains would be constructed by a mix of open trenching and trenchless methods such as horizontal directional drilling or microtunnelling. The indicative construction footprint is indicated on Figure 2.

5.2 Direct construction impacts

5.2.1 Removal of vegetation

Overview

The project has been designed to avoid or minimise the extent of vegetation to be removed or disturbed as far as possible. The pumping stations at Parsley Bay will be predominantly constructed on the existing toilet block and rock outcrop which are already disturbed. Mature canopy trees, including large figs and hollow-bearing eucalypts within or adjoining the construction footprint at Parsley Bay Reserve will be retained and protected during construction. The HDD launching pit will be constructed at the existing car park site which is already disturbed. The proposed Eastern Reserve pumping station and micro-tunnelling launching pit will be constructed on the grassed area.

The extent of vegetation to be affected for the proposed works is summarised in Table 4. For the purposes of calculating the extent of vegetation to be affected, a worst case scenario, involving clearing of all vegetation within the indicative construction footprints at Diamond Bay, Eastern Avenue and Parsley Bay Reserves has been assumed. In reality, clearing in these areas will largely be restricted to groundcover and mid-story vegetation.

The proposed wastewater infrastructure along Carlisle Street, Dover Road, Oceanview Avenue and Eastern Avenue will be trenched along one side of the road within the road corridor and it is unlikely that the street trees located within adjoining nature strips will require removal. There is some potential for impacts on adjacent street trees if the tree roots extend into the road corridor or if overhanging branches require trimming to enable machinery access during construction. The requirement for specific measures for the protection and management of retained street trees proximate to the construction footprint would need to be assessed by an arborist once the construction footprint has been confirmed (Section 6.1).

Each component of the project would be subject to detailed design before construction, involving confirmation of the location, layout and specifications for the project components. Dependent on construction techniques and detailed design, there would likely be potential to further avoid or reduce impacts on biodiversity values, including in particular areas of native vegetation at Diamond Bay Reserve and large, mature trees and some planted specimens of *Syzygium paniculatum* at Parsley Bay Reserve (Section 6.1).

The impacts associated with the removal of vegetation for various components of the project are discussed in more detail below.

Table 4 Areas of vegetation to be affected within the indicative construction footprint shown on Figures 3 and 4.

Vegetation type	Diamond Bay Reserve	Eastern Avenue Reserve	Parsley Bay Reserve	Total area (ha)
Coastal Clifftop Marsh	0.01	0	0	0.01
Coastal Headland Banksia Heath	0.08	0.02	0	0.1
Coastal Sandstone Foreshores Forest	0	0	0.23	0.23
Total native vegetation	**0.09**	**0.02**	**0.23**	**0.34**
Urban - exotic/native	0.01	0.2	0.11	0.32
Weed - exotic	0.03	0	0	0.03
Total urban and exotic vegetation (ha)	**0.04**	**0.20**	**0.11**	**0.35**
Total vegetation removal (ha)	**0.13**	**0.23**	**0.34**	**0.69**

Diamond Bay Reserve

A 5 m disturbance corridor for access, extending from Craig Avenue, then widening to 10 m in the area proposed for trenching would require the removal of patches of native and exotic vegetation.

A total area of 0.13 ha of vegetation would be affected within the indicative construction footprint extending between Craig Avenue downslope of residences towards Kimberley Street. This comprises 0.09 ha of native vegetation, made up of 0.08 ha of Coastal Headland Banksia Heath and 0.01 ha of Coastal Clifftop Marsh. The remainder of the vegetation to be removed comprises planted exotic tree species and patches of weeds (see Figure 3 and Figure 4).

Native small tree species which would require removal include Coast Banksia and Brush Daphne. Native heath and marsh species which would require removal include Coastal Rosemary, Knobby Club-rush, Heath-leaved Banksia, Scale-rush and Bracelet Honey-myrtle. Exotic tree species which would require removal include Canary Island Date Palm, Pohutukawa, Taupata and Norfolk Island Hibiscus. There are also extensive patches of weed species, especially Kurnell Curse, Fishbone Fern and Panic Veldt-grass which would require removal.

The small patch of Coastal Clifftop Marsh vegetation comprises a sensitive habitat of limited local distribution and opportunities to avoid or minimise impacts on this vegetation should be considered during detailed design (see Section 6.1).

Section of Eastern Avenue Reserve between Oceanview Avenue and Eastern Avenue

The proposed sewage pumping station and trenching for proposed wastewater infrastructure will take place in a Section of Eastern Avenue Reserve in areas which mainly consist of open grassland. The grassland is regularly mown and consists of a mixture of native and exotic grasses and forbs. It is, however likely that some recently planted garden beds at the eastern end of Eastern Avenue will require disturbance to allow access and excavation. The plantings are native sedges and shrubs which are representative of the original headland heath vegetation.

A total area of 0.23 ha of planted native vegetation representative of Coastal Headland Banksia Heath and maintained mixed native and exotic grassland would be removed in Eastern Avenue Reserve.

Carlisle Street, Dover Road, Oceanview Avenue and Eastern Avenue

Trenching for wastewater infrastructure will be carried out along one side of the road within the existing roadway. It is unlikely that street trees located within the adjacent nature strips will require removal, however there may be some impact on tree roots if they extend under the road pavement within the construction footprint. One Weeping Fig growing near the corner of Military Road and Oceanview Avenue appears to have extensive root growth beneath the road-seal, although it is apparent that the root growth consists of fine roots, rather than supporting roots. The extent of impacts on the tree's root zone would be dependent on the location of the proposed excavation footprint.

There may also be a requirement to trim overhanging branches to enable machinery access during construction dependent on the location of the construction footprint. For example, one Coast Banksia, outside 10 Oceanview Avenue has a large lateral which extends over the road (see Photo 19) and which may be susceptible to damage during machinery access.

Although no evidence of root growth beneath the road seal in Carlisle Street was recorded during the survey, there are several large mature specimens with canopies extending over the road (see Photo 16). Laterals which are low and extend over the road may be susceptible to damage during machinery access.

The requirement for specific measures for the protection and management of retained street trees proximate to the construction footprint would need to be assessed by an arborist once the construction footprint has been confirmed (Section 6.1).

Parsley Bay Reserve

The proposed construction of the pump station and wastewater infrastructure at Parsley Bay Reserve will require some disturbance of native Coastal Sandstone Foreshore Forest and planted urban vegetation in landscaped areas. While up to 0.23 ha of native Coastal Sandstone Foreshore Forest and 0.11 ha of urban planted vegetation occurs within the indicative construction footprint, it is likely that the project will largely be restricted to the removal of groundcover and understory vegetation within the majority of this area. It is expected that only a small number of midstorey or young canopy species would be removed.

Large canopy trees are proposed to be retained. These include a mature Small-leaved Fig growing next to the toilet block which will require protection and some branch removal to facilitate demolition and construction of the pumphouse and a mature Plum Pine adjacent to Horler Avenue which has overhanging branches which may be susceptible to mechanical damage from large machinery. Measures for the protection of these trees are outlined in GHD (2019).

Sections of vegetation along the footpath which is adjacent to the proposed wastewater infrastructure (trenched and trenchless Sections) at the eastern end of the reserve will be affected by clearing for machinery access and construction activities. Most of the trees appear to have been planted within the last fifteen years. Species include Swamp Oak, Tree fern species, Native Olive, Ironwood and Blueberry Ash. The groundcover includes a dense sward of Rainbow Fern (see Photo 22). It is assumed that more mature, hollow-bearing canopy trees closer to the creek line can be avoided and protected from disturbance during construction (see Section 6.1).

Temporary storage of pipes or other equipment within Parsley Bay Reserve may extend over the Tree Protection Zones of a line of Hill's Weeping Figs within the central portion of the reserve (see Photo 6). The TPZs of these trees would be susceptible to soil compaction, from the weight of the pipes and machinery, therefore if practicable such activities should not be carried out beneath the trees' canopies, but in the adjacent area of grassland (see Table 6).

Photo 22 Proposed impact area adjacent to creekline, Parsley Bay

5.2.2 Removal of fauna habitats

The removal of vegetation within the construction areas would mainly affect habitat for common fauna species capable of persisting in urban areas. In areas where excavation activities are required (e.g. open trenching), these activities could disturb habitat for small, common, less mobile ground-dwelling fauna such as lizards and frogs. More mobile fauna such as birds displaced during construction activities would likely seek refuge in areas of adjoining habitat. Impacts in these areas would be temporary with proposed groundcover revegetation replacing habitat in disturbed areas over the medium term.

Large Small-leaved Figs within the indicative construction footprint at Parsley Bay Reserve that provide foraging and nesting habitat for birds, bats and possums are to be retained and protected. A number of large, old hollow-bearing trees that occur along the creek line and which provide foraging and roosting/nesting habitat for native fauna should also be avoided and protected from disturbance during construction. There may be removal of some younger, planted trees within some areas of the construction footprint but the small number of trees removed would comprise a negligible impact on habitat values and fauna in Parsley Bay Reserve.

5.2.3 Fauna injury and mortality

More mobile native fauna such as native birds, bats, terrestrial and arboreal mammals that may be sheltering in vegetation in the site are likely to evade injury during construction activity. Construction may result in the injury or mortality of some individuals of less mobile fauna species such as nestlings and other small terrestrial fauna that may be sheltering in vegetation within the development footprint during clearing activities.

Mitigation measures to reduce the potential for direct and indirect impacts on native fauna and habitat features during construction are described in Section 6.2 and include fauna management procedures.

5.2.4 Aquatic impacts

There would be no direct impact on the creek line located within Parsley Bay Reserve or the drainage line running into Diamond Bay. Construction along the track and in the carpark area has the potential to result in indirect impacts which would be managed through implementation of the CEMP (see Section 5.3.3 and GHD 2019b).

5.3 Indirect construction impacts

5.3.1 Habitat fragmentation

The construction area is largely within or adjacent to existing roads, tracks or cleared areas, with impacts restricted to the edges of patches of native vegetation. As a result, construction of the project is unlikely to directly isolate or fragment any areas of habitat. Fauna movement, pollination and seed fall of plants and other ecological processes would continue to occur through the study area during and following construction.

5.3.2 Weed invasion and edge effects

Weeds are already present in the study area. Construction has the potential to introduce new weeds or spread existing weeds.

Mitigation measures to reduce the potential for direct and indirect impacts are described in Section 6.2, and include appropriate weed management prior to construction, stabilisation of surfaces following construction and revegetation where possible along the creek line.

5.3.3 Soil and water pollution

Construction of the project has the potential to result in sedimentation, pollution, contaminated runoff or erosion within the subject site and adjoining native vegetation and aquatic habitats, through soil disturbance and construction activities. Potential sources of soil and water pollution include:

- Soil disturbance during excavation and construction works.
- Inappropriate management of soil and material stockpiles.
- Hydrocarbon leaks or spills from vehicles or equipment used in construction.
- Increased sediment transfer and erosion potential in areas cleared of vegetation.

Mitigation measures to reduce the potential for direct and indirect impacts on downstream habitats will be implemented during construction (Section 6.2).

5.3.1 Introduction of pathogens

Construction activities have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) in the site through vegetation disturbance and increased visitation. No threatened frog species are likely to be present that may be at risk of Chytrid fungus infection, however this could impact common frog species.

The potential for impacts associated with these pathogens is low, given the existing modified nature of the landscape and high visitation rates to the site.

Mitigation measures to reduce the potential for introduction of diseases are described in Section 6.2.

5.3.2 Noise and vibration

Habitats adjacent to much of the indicative construction footprint already experience disturbance due to their location in urban areas. There would be additional temporary noise and vibration as a result of construction. Most of the species that are likely to nest or roost in the site are common species typical of urban areas and would be habituated to noise to a large extent. Most mobile species such as common birds may move out of the area temporarily during construction.

5.4 Operational impacts

The project would include installation of an underground pipeline that would require periodic maintenance, involving associated access. Given the periodic nature of the activities proposed and the disturbance associated with existing adjoining land uses, this would have a negligible impact on areas of retained native vegetation and habitats adjoining the subject site.

The proposed pump stations will be located underground and consequently will have a negligible impact on existing noise levels.

5.5 Key threatening processes

A key threatening process (KTP) is a process that threatens, or may threaten, the survival, abundance or evolutionary development of a native species or ecological community. A number of KTPs are listed under the BC, EPBC and FM Acts.

Table 5 Key threatening processes of relevance to the project

KTP	Status	Comment
Clearing of native vegetation	BC Act; EPBC Act	Clearing of native vegetation refers to the removal of one or more strata within a stand of native vegetation. There are numerous impacts as a result of clearing native vegetation, including: destruction of habitat causing a loss of biological diversity; fragmentation of populations; riparian zone degradation; disturbed habitat which may permit the establishment and spread of exotic species; and loss of leaf litter, removing habitat for a wide variety of vertebrates and invertebrates. Clearing of native vegetation has occurred historically within the study area. The project would result in the disturbance of up to 0.34 ha of native vegetation, predominantly at Parsley Bay and largely comprising groundcover and understorey vegetation. Implementation of vegetation management measures would minimise impacts on any nearby native vegetation (see Section 6.2).
Removal of hollow-bearing trees	BC Act	Tree hollows are cavities formed in the trunk or branches of a living or dead tree. Hollows are usually more characteristic of older, mature to over mature trees. Hollows occur primarily in old eucalypts trees, and are uncommon in many other native and introduced species. The presence, abundance and size of hollows is positively correlated with tree trunk diameter, which is an index of age. As such, large old hollow-bearing trees are relatively more valuable to hollow-using fauna than younger hollow-bearing trees. The latter are important as a future resource. Hollow-bearing trees along the creek line at Parsley Bay Reserve should be avoided and protected during construction.
Removal of dead wood and dead trees	BC Act	Fallen timber and hollow-bearing stags provide important habitat for a range of native species and are important to ecosystem health. The vegetation to be removed is regrowth and the project would result in the removal of only a small amount of fallen timber, within the indicative construction footprint. Implementation of fauna management measures would minimise impacts on fauna and their habitats (see Section 6.2).
Invasion of plant communities by perennial exotic grasses	BC Act	There is evidence that perennial grass species have significant adverse impacts on biodiversity, including increases to fuel loads that result in changes to fire regimes that can alter the structure of native vegetation communities and lead to local extinctions of some native

KTP	Status	Comment
		species. Exotic perennial grasses are already established throughout the study area, including all stands of native vegetation. Weed management procedures would be implemented to avoid the introduction of new weeds and to limit any further spread of weeds as a result of the project (see Section 6.2).
Infection of native plants by Phytophthora cinnamomi	BC Act; EPBC Act	*Phytophthora cinnamomi* is a soil borne pathogen that occurs in warm, moist conditions. Infected species may show a range of symptoms, and some plants may be killed, leading to areas of dieback. The project has the potential to introduce the pathogen to the study area, through the transport and movement of plant, machinery and vehicles. Implementation of hygiene protocols would minimise the risk of introduction or spread of this pathogen (see Section 6.2).
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	BC Act	No instream works are proposed. There is unlikely to be any alteration of natural flow regimes. The implementation of erosion and sediment control measures and water quality management measures is recommended to limit impacts on aquatic habitat values (see Section 6.2).
The degradation of native riparian vegetation along NSW water courses	FM Act	The project would remove some native vegetation located near drainage lines in the study area. The implementation of weed management measures, erosion and sediment control measures is recommended to limit impacts on areas of riparian vegetation outside of the indicative construction footprint. The implementation of weed management measures, erosion and sediment control measures and aquatic management measures is recommended to limit impacts on riparian vegetation or further reduction in water quality (see Section 6.2).

5.6 Impacts on threatened biota and migratory species

5.6.1 Threatened ecological communities

The construction area does not pass through any patches of vegetation which have been identified as TECs listed under the BC Act or EPBC Act.

5.6.2 Threatened species and populations

Several apparently planted juvenile specimens, as well as numbers of (probably) self-recruited seedlings of *Syzygium paniculatum* occur within the subject site at Parsley Bay Reserve (Figure 3) (See Woollahra Library Local History Centre 2005 and Woollahra Municipal Council 2015 for lists of plantings in Parsley Bay Reserve). These specimens, being planted and of uncertain provenance, have not been attributed the conservation significance of a threatened species and have therefore not been assessed further. It may be possible at some locations to avoid these specimens, and efforts should be made to provide protection during excavation and construction works, where possible.

The proposed works are unlikely to have more than a negligible impact on potential habitat for the threatened fauna species that may occur in Parsley Bay Reserve on occasion, including the Grey-headed Flying-fox, threatened micro bats and the Powerful Owl. Impacts will be largely restricted to the removal of small areas of groundcover and understorey vegetation, including areas that have been planted. Only a small number of midstorey and young canopy trees would be removed which would not comprise important habitat elements for these species in the areas

to be affected. Large fig trees and mature canopy trees with hollows that provide foraging and roosting resources for these species would be retained and protected.

The proposed works would not affect a known camp site for the Grey-headed Flying Fox or nesting habitat for the Powerful Owl. The small areas of understorey and groundcover vegetation to be removed would not fragment areas of habitat or provide a barrier to movement between roost/nest sites and foraging areas for any of these threatened species.

There is a slight potential for cave-dwelling microbats to use the toilet block as a temporary roost site, although no evidence of current or recent occupation by roosting bats was observed during the field survey. An inspection of the building prior to demolition is recommended to determine the presence of any roosting bats and to implement appropriate assessment and management measures if detected (see Section 6.2)

There are unlikely to be any material operational impacts on threatened fauna. Increases in noise associated with the proposed pump station are likely to be negligible given existing noise and activity in the area.

5.6.3 Migratory species

As described in Section 4.4.6, the study area is not considered important habitat for any migratory species, according to the significant impact criteria for migratory species (DoEE 2013). The removal of small areas of vegetation at the subject site is unlikely to have a significant impact on any migratory species.

5.7 Significance of likely impacts

The construction footprint and adjoining areas do not contain any threatened ecological communities or naturally occurring threatened flora listed under the BC Act.

The small areas of vegetation to be affected within the construction footprint, half of which comprise urban native and exotic plantings, do not comprise habitat likely to be important for the persistence of any local population of threatened fauna or migratory fauna listed under the BC Act, FM Act or EPBC Act.

Based on the above findings, the project is unlikely to have a significant impact on any threatened species, population or ecological community listed under the BC Act. As such, a Species Impact Statement of biodiversity offset under the NSW Biodiversity Offsets Scheme is not required for the project. Similarly, the project would not have a significant impact on threatened biota or migratory species listed under the EPBC Act and a Referral to the Commonwealth is therefore not required.

6. Mitigation

6.1 Opportunities to avoid and minimise impacts

For the purposes of calculating the extent of vegetation to be removed at Diamond Bay, Eastern Avenue and Parsley Bay Reserves, a worst case scenario, involving clearing of all vegetation within the indicative construction footprints has been assumed. In reality, clearing will largely be restricted to groundcover and mid-story vegetation. Mature canopy trees, including large figs and hollow-bearing eucalypts within or adjoining the construction footprint at Parsley Bay Reserve will be retained. An Arboricultural Assessment has been prepared (GHD 2019a) which includes protection measures for three mature fig trees to be retained in Parsley Bay Reserve.

Each component of the project would be subject to detailed design before construction, involving further confirmation of the construction foot print and precise location, construction method, layout and specifications for the project components and identification of opportunities to avoid or reduce potential impacts on sensitive areas and biodiversity values.

The following opportunities to avoid or minimise impacts will be considered during the detailed design phase:

- Design and construction method options to reduce potential impacts on the small patch of Coastal Clifftop Marsh in Diamond Bay Reserve, including realignment of the proposed access pathway to avoid this vegetation (if possible given space constraints) or installation of temporary bridging over the vegetation to allow access of workers and machinery without direct impacts on the vegetation, micro-alignment of trenches to avoid encroachment into the vegetation and mitigation measures to minimise the potential for indirect impacts from adjacent construction activities (e.g. release of sediment, contaminants, weed encroachment)
- Trenchless including directional drilling/micro-tunnelling and other measures to minimise the extent of clearing to avoid removal/disturbance of the large hollow-bearing trees along the pathway and creek line at Parsley Bay Reserve
- Any temporary storage of pipe lengths or other material or equipment at Parsley Bay should be located in areas of grassland and not beneath tree canopies to avoid impacts on TPZs
- Measures to minimise the extent of vegetation disturbance/clearing required to avoid the removal of *Syzygium paniculatum* specimens, where possible, at Parsley Bay Reserve.

The trenching for wastewater infrastructure along Carlisle Street, Dover Road, Oceanview Avenue and Eastern Avenue has the potential to impact adjacent street trees if tree roots extend under the road pavement within the construction footprint or where overhanging branches may hinder machinery access. Environmental safeguards, including appointment of a project arborist to identify appropriate tree protection and management measures during construction, will be incorporated into the CEMP (see Table 6).

6.2 Mitigation measures

The environmental safeguards outlined in Table 6 would be implemented to address the potential impacts of the project on biodiversity values. A Construction Environmental Management Plan (CEMP) would be prepared, that would identify the specific measures to be implemented during the ‘Pre-construction’ and ‘Construction’ stages of the project and would include work methods, contingencies, roles and responsibilities.

Table 6 Environmental safeguards

Issue	Safeguard	Timing	Responsibility
Environmental management	A CEMP will be prepared, including the specific mitigation/management measures and sub-plans listed below along with work methods, contingencies, roles and responsibilities The mitigation/management measures included in the CEMP and sub-plans would be implemented during pre-construction and construction stages	Pre-construction	Construction contractor
Worker inductions	Ensure all workers are provided with an environmental induction prior to starting construction activities on site. This would include information on the biodiversity values of the site and protection measures to be implemented to protect biodiversity during construction	Pre-construction	Construction contractor. Site ecologist/ environmental officer
Erosion and sediment	Erosion and sediment control measures would be established prior to construction in accordance with the principles and guidelines included in Managing Urban Stormwater: Soils and Construction - Volume 1 (Landcom, 2004) and Volume 2D of Managing Urban Stormwater: Soils and Construction (DECC 2008a). • Erosion and sediment control plans would be established prior to the commencement of construction • Controls would be managed and maintained in accordance with the CEMP to ensure their ongoing functionality • Erosion and sediment control controls would be regularly inspected, particularly following rainfall events, to ensure their ongoing functionality • All stockpiled material should be stored in bunded areas and kept away from waterways to avoid sediment or contaminants entering waterways.	Pre-construction	Construction contractor
Dust	Specific measures will be incorporated into the CEMP to minimise the generation of dust and associated impacts on natural environments adjacent and downstream of the construction footprint.	Pre-construction/ construction	Construction contractor
Contaminants	Specific measures will be incorporated into the CEMP to minimise the potential for chemical spills and associated impacts on natural environments adjacent to and downstream of the construction footprint.	Pre-construction/ construction	Construction contractor

Issue	Safeguard	Timing	Responsibility
Vegetation clearance and Habitat disturbance	Disturbance and removal of some areas of native vegetation and habitat will be unavoidable during the construction phase. To reduce the potential for adverse impacts on ecologically sensitive areas the following measures are recommended: • Clearing and disturbance of the small patch of Coastal Clifftop Marsh at Diamond Bay should be avoided as far as possible through detailed design and this area identified as a vegetation protection area through erection of temporary fencing and signage • Clearing of mature and hollow-bearing trees should be avoided wherever possible • A suitably qualified ecologist/arborist must be engaged prior to any clearing works to clearly demarcate with temporary fencing vegetation protection areas, clearing limits, *Syzygium paniculatum* specimens to be avoided (if possible) and hollow-bearing trees to be retained • Pruning and branch removal should only be carried out by the Project Arborist, according to recommendations outlined in GHD (2019) • Any leaf litter and woody debris removed should be salvaged and placed in remaining vegetated areas following construction • Implement hygiene and weed management protocols to prevent the introduction and spread of weed propagules and soil pathogens • Implement erosion and sediment, and water quality controls to avoid indirect impacts on adjacent and downstream sensitive areas.	Pre-construction/ construction	Construction contractor. Site ecologist/ environmental officer
Tree protection	An Arboricultural Assessment has been prepared (GHD 2019a) which includes protection measures for three mature trees in Parsley Bay Reserve. A Project Arborist would supervise installation of protective fencing, carry out pruning and branch removal where required and carry out any remedial measures where necessary. A project arborist would identify any trees requiring removal or appropriate protection and management measures for retained street trees proximate to the construction footprint for wastewater infrastructure along Carlisle Street, Dover Road, Oceanview Avenue and Eastern Avenue once the construction footprint has been confirmed. A project arborist would be required to supervise installation of protective fencing, carry out pruning and branch removal where required and carry out any remedial measures where necessary.	Pre-construction/ Construction/ Post-construction	Construction contractor / Project Arborist

Issue	Safeguard	Timing	Responsibility
	Any temporary storage of pipe lengths or other material or equipment at Parsley Bay should be located in areas of grassland and not beneath tree canopies to avoid impacts on TPZs.		
Biosecurity and weed management	Manage biosecurity in accordance with: • Biosecurity Act 2015 (see NSW Weedwise) • Contemporary bush regeneration practices, including disposal of sealed, bagged weeds to a licenced waste disposal facility. Weed management may include: • Consultation with the existing local bushcare group(s) to align weed management measures with current practices • manual weed removal in preference to herbicides • replacing non-target species removed/killed because of weed control activities • protecting non-target species from spray drift • Using only herbicides registered for use within or near waterways for the specific target weed • Applying herbicides during drier times when the waterway level is below the high water mark • Not applying herbicide if it is raining or if rain is expected • Mixing and loading herbicides, and cleaning equipment away from waterways and drains • To prevent spread of weeds, clean all equipment including PPE prior to entering or leaving the work sites.	Pre-construction/ construction	Construction contractor
Damage to vegetation	If any damage occurs to vegetation outside of the direct disturbance area, notify the Sydney Water Project Manager and Environmental Representative so that appropriate remediation strategies can be developed.	Construction	Construction contractor / Sydney Water Environmental Representative

Issue	Safeguard	Timing	Responsibility
Fauna management	Fauna management protocols to be implemented during vegetation clearing and construction activities will be prepared as part of the CEMP, including: • Inspection and survey of the existing toilet block to determine the presence of roosting microbats prior to demolition. Reassessment of the likely significance of impacts of demolition of the toilet block would be required if bats are occupying the structure and preparation of a Bat Management Plan as a sub plan to the CEMP • An experienced, licenced wildlife carer or ecologist would be present to supervise any vegetation clearing and capture and relocate fauna into safe nearby areas of suitable habitat (if required) • open trenches would be backfilled or covered (e.g. with boards) at the completion of construction each day to minimise the risk of injury or mortality to animals as a result of falling into the excavated trench line • open trenches would be checked each morning, before the start of construction, to salvage any fauna that have fallen in, and move them to a safe (and appropriate) nearby location. Protocols would be developed to deal with the removal of injured or dangerous animals (e.g. snakes) • Salvage of habitat features (e.g. leaf litter, hollow logs and branches) from construction areas and relocation into adjoining areas of habitat • If native fauna is encountered on site, during construction works stop work and allow the fauna to move away un-harassed. A local wildlife rescue service should be engaged to assist with any fauna injured during clearing or construction activities.	Pre-construction/ construction	Construction contractor. Site ecologist/ environmental officer
Aquatic habitats and water quality	Implement reasonable and feasible water quality control measures to prevent pollution of waterways and drainage lines in the area downstream of the proposed works.	Pre-construction/ construction	Construction contractor
Unexpected finds	If any threatened species (flora or fauna) is discovered during the works, stop work immediately and notify the Sydney Water Environmental Representative. Work will only recommence once the impact on the species has been assessed and appropriate control measures provided.	Pre-construction/ Construction	Construction contractor / Sydney Water

Issue	Safeguard	Timing	Responsibility
			Environmental Representative
Pathogen management	Implement measures to mitigate potential impacts associated with plant and animal disease and pathogens such as Phytophthora, Myrtle Rust and Chytrid fungus. Mitigation measures would include: • exclusion zones around retained areas of native vegetation • adopting a clean on entry policy for machinery • Implementing protocols to prevent introduction or spread of chytrid fungus with consideration of OEH Hygiene protocol for the control of disease in frogs (DECC, 2008b).	Construction	Construction contractor

7. Conclusion

The construction of proposed wastewater infrastructure at Vaucluse and Diamond Bay will require the removal of some small areas of vegetation at Parsley Bay Reserve, Diamond Bay Reserve and Eastern Avenue Reserve. For the purposes of calculating the extent of vegetation to be affected, a worst case scenario, involving clearing of all vegetation within an indicative construction footprint at Diamond Bay, Eastern Avenue and Parsley Bay Reserves has been assumed. In reality, clearing in these areas will largely be restricted to groundcover and mid-story vegetation. Mature canopy trees, including large figs and hollow-bearing eucalypts within or adjoining the construction footprint at Parsley Bay Reserve will be retained.

The proposed wastewater infrastructure along Carlisle Street, Dover Road, Oceanview Avenue and Eastern Avenue will be trenched along one side of the road within the road corridor but the precise construction footprint is yet to be confirmed. While it is unlikely that the street trees located within adjoining nature strips will require removal, there is some potential for impacts on street trees if the tree roots extend into the road corridor or if overhanging branches require trimming to enable machinery access during construction. The requirement for specific measures for the protection and management of retained street trees proximate to the construction footprint would need to be assessed by an arborist once the construction footprint has been confirmed (Section 6.1).

Each component of the project would be subject to detailed design before construction, involving confirmation of the location, construction method, layout and specifications for the project components and identification of opportunities to further avoid or reduce potential impacts on sensitive areas and biodiversity values.

The vegetation to be affected in the indicative construction footprint for the project is not commensurate with a threatened ecological community listed under the EPBC Act or the BC Act. No threatened flora species would be affected by the proposed works. While several planted juvenile specimens, as well as some (probably) self-recruited seedlings of Search *Syzygium paniculatum* occur within the indicative construction footprint at Parsley Bay Reserve, these specimens have been planted and therefore have not been attributed the conservation significance of a threatened species for the purposes of this assessment.

The proposed activity would remove small areas of habitat for common and widespread native fauna, including birds typical of urban areas, parks and gardens. The proposed removal of small areas of predominantly groundcover and understory vegetation and will not affect important breeding, roosting or nesting habitat for threatened fauna species, including the Grey-headed Flying-fox, threatened micro bats and the Powerful Owl which are known to occur in the locality and which may potentially occur in Parsley Bay Reserve on occasion. The proposed works would have a negligible impact on potential habitat for these threatened fauna species and would not threaten the persistence of any local populations.

Given the above findings, the proposed works is unlikely to have a significant impact on threatened species, populations or ecological communities listed under the BC Act. Consequently, a Species Impact Statement or further assessment and provision of biodiversity offset in accordance with the NSW Biodiversity Offset Scheme is not required.

Similarly, the proposed works would not result in any significant effects on threatened biota or migratory species listed under the EPBC Act, and there is no requirement for a Referral or biodiversity offsets under the EPBC Act and associated offset policy (DSEWPaC, 2012).

A range of environmental safeguards and management measures will be implemented by the construction contractor as part of the Construction Environmental Management Plan for the

project to further minimise the potential for any adverse impacts on retained trees, sensitive vegetation, habitat features and native fauna species that may be present in the project area during construction.

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Appendices

Appendix A - Likelihood of occurrence assessment

Appendix Table 1 Threatened ecological community likelihood of occurrence

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Blue Gum High Forest in the Sydney Basin Bioregion	Blue Gum High Forest in the Sydney Basin Bioregion	E	CE	OEH 2019a	Occurs on the Hornsby Plateau, north eastern edge of the Cumberland Plain with most remnants in Hornsby, Ku-ring-gai and Baulkham Hills LGAs. Typically occurs in high rainfall areas on fertile soils derived from Wianamatta shale. Grades into Sydney Turpentine-Ironbark Forest at lower rainfall areas. Moist, tall open forest characterised by Eucalyptus saligna and E. pilularis. Usually has small tree layer of Pittosporum undulatum, Elaeocarpos reticulatus and Allocasuarina torulosa over a low, open shrub layer and an understorey of grasses, herbs and ferns.	Nil
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	V	OEH 2019a	Occurs on landward side of mangrove stands in intertidal zones along the shores of estuaries and lagoons that are permanently or intermittently open to the sea. Characterised by Baumea juncea, Juncus kraussii, Sarcocornia quinqueflora, Sporobolus virginicus, Triglochin striata, Ficinia nodosa, Samolus repens, Selliera radicans, Suaeda australis and Zoysia macrantha, with occasional scattered mangroves occurring throughout the saltmarsh. Saltpans and tall reeds may also occur.	Nil
Coastal Upland Swamp in the Sydney Basin Bioregion	Coastal Upland Swamp in the Sydney Basin Bioregion	E	E	OEH 2019a	Includes open graminiod heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaus. Generally associated with soils that are acidic and vary from yellow or grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peat soils with pallid subsoils. May include tall open scrubs, tall closed scrubs, closed heaths, open graminoid heaths, sedgelands and fernlands.	Nil
Duffys Forest Ecological Community in the Sydney Basin Bioregion	Duffys Forest Ecological Community in the Sydney Basin Bioregion	E		OEH 2019a	"Extensively fragmented distribution, occurring primarily within Warringah, and Ku-ring-gai Local Government Areas (LGA) with minor occurrences in the Pittwater, Manly and Hornsby LGAs. Occurs in association with shale lenses and ironstone soils in Hawkesbury Sandstone. Rock outcrops are usually absent from this community, except on the fringes, where it adjoins typical sandstone	Nil

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
					vegetation, generally characterised by extensive sandstone outcrops.	
Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion	Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion	CE	E	OEH 2019a	Surviving stands toal 146 hectares. Found in the LGAs of Botany, Randwick, Waverly and Manly. Occurs in disjunct patches of nutrient poor aeolian dune sand (OEH 2013). Predominently a sclerophyllous heath or scrub community with some remnants containing small patches of woodland (OEH 2013).	Nil
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		OEH 2019a	Occurs in coastal areas subject to periodic flooding with standing fresh water for at least part of the year. Typically on silts, muds or humic loams below 20 m elevation in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes. Structure and composition varies spatially and temporally depending on the water regime, though is usually dominated by herbaceous plants and has few woody species.	Nil.
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	CE	OEH 2019a	Occurs along the NSW coast, usually within 2 km of the ocean on a variety of substrates. Variable structure and composition, typically with closed canopy. Generally rainforest species with vines a major component.	Nil
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	E	CE	OEH 2019a	Occurs north of the Hawkesbury River to the Qld border. Associated with a range of high-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks, on coastal plains and plateaux, footslopes and foothills. Includes subtropical rainforest and related, structurally complex forms of dry rainforest. In undisturbed state has a closed canopy with high tree diversity. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. Scattered	Nil

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
					eucalypt emergents (e.g. Eucalyptus grandis, E. saligna) may occasionally be present.	
Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion	Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion	E		OEH 2019a	Occurs entirely within Pittwater LGA on the Barrenjoey Peninsula and Western Pittwater Foreshores (OEH 2013). Remnants are typically small and on private properities and council reserves. Associated with shale derived soils and high rainfall on lower hillslopes on the Narrabeen Group. Structual form - typically open forest but may now exist as woodland or remnant trees (OEH 2013)	Nil
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		OEH 2019a	Occurs on flats, drainage lines and river terraces of coastal floodplains where flooding is periodic and soils generally rich in silt, lack deep humic layers and have little or no saline (salt) influence. Occurs south from Port Stephens in the NSW North Coast, Sydney Basin and South East Corner bioregions. Characterised by a tall open canopy layer of eucalypts with variable species composition.	Nil
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	E	CE	OEH 2019a	Well adapted to fire, being often close to sandstone areas. Some species in areas with greater shale influence regenerate from profuse annual seeding and underground tubers. High-sandstone-influence sites have poor rocky soils, and many shrubs which rely on nitrogen-fixing root nodules and soil/root fungi to obtain nutrients. High-shale-influence sites often have a diverse and moderately dense groundcover stratum, with grasses a prominent and diverse component. Shrubs are usually less abundant and less diverse in shale sites.	Nil

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	E		OEH 2019a	Restricted to sheltered heads and upper slopes of gullies on transitional zones where sandstone outcrops may exist, but where soils are influenced by lateral movement of moisture, nutrients and sediment from more fertile substrates in an area bounded by Hurstville, Carss Park, Bundeena, Otford, Stanwell Tops, Darkes Forest, Punchbowl Creek and Menai. Open forest dominated by Angophora costata, Eucalyptus piperita and occasionally E. pilularis over scattered subcanopy trees, a diverse shrub layer and well-developed groundcover of ferns, forbs, grasses and graminoids. Variable species composition.	Nil
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	E	OEH 2019a	Typically occurs below 20m asl on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes on coastal floodplains of NSW. Associated with grey-black clay-loams and sandy loams, saline or sub-saline groundwater. Structure variable from open forests to scrubs or reedlands with scattered trees. Canopy dominated by Casuarina glauca (north of Bermagui) or Melaleuca ericifolia (south of Bermagui). Understorey characterised by frequent occurrences of vines, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter.	Nil
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		OEH 2019a	Usually occurs below 20m asl (sometimes up to 50m). Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Characterised by open to dense tree layer of eucalypts and paperbarks, with trees up to or higher than 25 m. Includes areas of fern land and tall reed or sedge land, where trees are sparse or absent.	Nil
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	E		OEH 2019a	Occurs on sand dunes and low-nutrient sandplains along coastal areas in Sydney Basin bioregion. Known from Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Woollahra, Waverly, Botany, Rockdale , Randwick, Sutherland and Wollongong LGAs. Largely restricted to	Nil

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
					freshwater swamps and swales and depressions on sand dunes and low nutrient sandplains (OEH 2013).	
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E		OEH 2019a	Themeda triandra is the dominant species in the Themeda Grassland on seacliffs and coastal headlands EECThe EEC is found on a range of substrates Themeda triandra is an extremely widespread species, but in this community it may have a distinctive appearance, being prostrate and having glaucous leaves. Banksia integrifolia subsp. integrifolia, Westringia fruticosa and Acacia longifolia subsp. sophorae occur as emergent shrub or as a dense cover where they have recruited over grasslands. Smaller shrubs occur often as prostrate to dwarf forms.	Nil
Western Sydney Dry Rainforest in the Sydney Basin Bioregion	Western Sydney Dry Rainforest in the Sydney Basin Bioregion	E	CE	OEH 2019a	Restricted to hilly country where it occurs on clay soils derived from Wianamatta shale on sheltered lower slopes and gullies. Very restricted and occurs mostly in the Razorback Range near Picton. Outlying occurrences at Grose Vale and Cattai. Canopy trees include Melaleuca styphelioides, Acacia implexa and Alectryon subcinereus. Shrub layer includes rainforest species Notolaea longifolia, Clerodendrum tomentosum and Pittosporum revolutum. The shrub layer combines with vines to form dense thickets in sheltered locations.	Nil

Appendix Table 2 Threatened flora likelihood of occurrence

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Casuarinaceae	*Allocasuarina glareicola*		E	E	Species or species habitat may occur within area (DoEE 2019a)	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Nil
Casuarinaceae	*Allocasuarina portuensis*	Nielsen Park She-oak	E	E	Species or species habitat known to occur within area (DoEE 2019a)	Restricted to within Nielsen Park (part of Sydney Harbour NP) in Woollahra. Cultivars have been planted throughout Sydney Harbour NP e.g. Gap Bluff, Hermit Point and Vaucluse House. Originally found on a sandstone shelf approximately 20 m above the harbour, on shallow sandy soils in tall closed woodland. Has been planted in a variety of habitats.	Nil
Doryanthaceae	*Doryanthes palmeri*	Giant Spear Lily	V		recorded within 10km (OEH 2019a)	Giant Spear Lily occurs in far north-east NSW and south-east Queensland. In NSW, it occurs on the coastal ranges that are part of the Mt Warning Caldera. Its southern distributional limit is Mount Billen. The species is currently known from eleven sites within NSW, five of which are conservation reserves. Most populations consist of only a few hundred individuals. Giant Spear Lily occurs on exposed rocky outcrops on infertile soils or on bare rock. It grows in a narrow band of vegetation along the cliff-tops and on steep cliff-faces or rocky ledges in montane heath next to subtropical rainforest, warm temperate rainforest or wet eucalypt forest.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Ericaceae	*Epacris purpurascens var. purpurascens*		V		recorded within 10km (OEH 2019a)	Occurs from Gosford in the north, Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Grows in a range of sclerophyll forest, scrubs and swamps, most of which have a strong shale soil influence.	Nil
Euphorbiaceae	*Euphorbia psammogeton*	Sand Spurge	E		recorded within 10km (OEH 2019a)	Sparse populations along the coast from south of Jervis Bay to Queensland. Grows on fore-dunes and exposed headlands, often with Hairy Spinifex.	Possible; no individuals recorded during this survey
Fabaceae (Mimosoideae)	*Acacia bynoeana*	Bynoe's Wattle	E	V	Species or species habitat may occur within area (DoEE 2019a)	Endemic to central eastern NSW, known at a limited number of locations, often comprising populations of few plants. Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. Flowers September to March, and fruit matures in November.	Nil
Fabaceae (Mimosoideae)	*Acacia pubescens*	Downy Wattle	V	V	Species or species habitat may occur within area (DoEE 2019a)	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravely, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers August to October.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Fabaceae (Mimosoideae)	*Acacia terminalis subsp. terminalis*	Sunshine Wattle	E	E	Species or species habitat known to occur within area (DoEE 2019a)	Occurs in near-coastal areas from northern shores of Sydney Harbour south to the northern and western shores of Botany Bay. Occurs on sandy soil on creek banks, hillslopes of in shallow soil in rock crevices and sandstone platforms on cliffs. Grows in scrub and open eucalypt woodland or forest (Bremner and Goeth 2010).	Possible; one individual previously recorded in the subject site but since removed (see GHD 2019a). Other records occur in Parsley Bay, but not within the subject site
Lamiaceae	*Prostanthera junonis*	Somersby Mintbush	E	E	Species or species habitat known to occur within area (DoEE 2019a)	Restricted to nine populations within the Somersby Plateau in Gosford/Wyong LGAs. Grows on gently undulating country on Hawkesbury Sandstone. Inhabits open forest, low woodland and open scrub, in disturbed and undisturbed sites. Predominately found in low woodland dominated by Scribbly Gum and associated ecotone areas (NSW NPWS 2000).	Nil
Lamiaceae	*Prostanthera marifolia*	Seaforth Mintbush	E	CE	Species or species habitat known to occur within area (DoEE 2019a)	Only known from a 2 x 2 km area in Seaforth, northern Sydney. Associated with the endangered Duffys Forest ecological community. Grows on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Myrtaceae	*Callistemon linearifolius*	Netted Bottle Brush	V		1 record within 10km (OEH 2019a)	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Possible; one previous record in Parsley Bay but no individuals recorded in subject site
Myrtaceae	*Eucalyptus camfieldii*	Camfield's Stringybark	V	V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs from Raymond Terrace to Waterfall, with populations known from Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai and the Royal NP. Occurs in exposed situations on sandstone plateaus, ridges and slopes near the coast, often on the boundary of tall coastal heaths or low open woodland. It grows in shallow sandy soils overlying Hawkesbury sandstone.	Nil
Myrtaceae	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V	V	recorded within 10km (OEH 2019a)	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Possible; planted street tree specimens occur in LGA, but no specimens recorded in subject site
Myrtaceae	*Leptospermum deanei*	0	V	V	Species or species habitat may occur within area (DoEE 2019a)	Occurs in NW Sydney, in the Hornsby, Warringah, Ku-ring-gai and Ryde LGAs. Grows in woodland on lower hill slopes or near creeks, in sandy alluvial soil or sand over sandstone. Occurs in riparian scrub , woodland and open forest.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Myrtaceae	*Melaleuca biconvexa*	Biconvex Paperbark	V	V	Species or species habitat may occur within area (DoEE 2019a)	Scattered, disjunct populations in coastal areas from Jervis Bay to Port Macquarie, with most populations in the Gosford-Wyong areas. Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Possible; no individuals recorded during this survey
Myrtaceae	*Melaleuca deanei*	Deane's Paperbark	V	V	Species or species habitat may occur within area (DoEE 2019a)	Occurs from Nowra- St Albans and west to the Blue Mountains, with most records in Ku-ring-gai / Berowra and Holsworthy/Wedderburn areas. Mostly grows on broad flat ridgetops, dry ridges and slopes and strongly associated with low nutrient sandy loam soils, sometimes with ironstone. Grows in heath-open forest, often in sandstone ridgetop woodland communities.	Nil
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	E		recorded within 10km (OEH 2019a)	Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of R. rubescens typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	Possible' no individuals recorded during this survey
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E	V	Species or species habitat known to occur within area (DoEE 2019a)	Occurs in narrow coastal strip from Bulahdelah to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.	Present; recorded in Parsley Bay. One mature street tree specimen tentatively recorded in Carlisle Street

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Orchidaceae	*Caladenia tessellata*	Thick Lip Spider Orchid	E	V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs from Central Coast NSW to southern Victoria. Mostly coastal but extends inland to Braidwood in southern NSW. In NSW grows in grassy dry sclerophyll woodland on clay loam or sandy soils, and less commonly in heathland on sandy loam soils (Duncan 2010).	Nil
Orchidaceae	*Cryptostylis hunteriana*	Leafless Tongue Orchid	V	V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with Large Tongue Orchid and the Bonnet Orchid. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	Nil
Orchidaceae	*Diuris arenaria*	Sand Doubletail	E		recorded within 10km (OEH 2019a)	Known from Tomaree Peninsula near Newcastle, in three locations. Inhabits coastal heath and dry grassy eucalypt forest on sandy flats on clay soil.	Nil
Orchidaceae	*Genoplesium baueri*	Bauer's Midge Orchid	E	E	Species or species habitat known to occur within area (DoEE 2019a)	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Polygonaceae	*Persicaria elatior*	Tall Knotweed	V	V	Species or species habitat may occur within area (DoEE 2019a)	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Nil
Proteaceae	*Persoonia hirsuta*	Hairy Geebung	E	E	Species or species habitat known to occur within area (DoEE 2019a)	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600m above sea level.	Nil
Rutaceae	*Asterolasia elegans*		E	E	Species or species habitat may occur within area (DoEE 2019a)	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. 7 known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	Nil
Santalaceae	*Thesium australe*	Austral Toadflax	V	V	Species or species habitat may occur within area (DoEE 2019a)	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass.	Possible; no individuals recorded during this survey

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Thymelaeaceae	*Pimelea curviflora var. curviflora*		V	V	Species or species habitat known to occur within area (DoEE 2019a)	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/ironstone soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Nil
Thymelaeaceae	*Pimelea spicata*	Spiked Rice-flower	E	E	Species or species habitat may occur within area (DoEE 2019a)	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (DEC 2005).	Nil

Appendix Table 3 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Accipitridae	*Pandion cristatus*	Eastern Osprey	V		1 record within 10km (OEH 2019a)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea, though there are a handful of records from inland areas.	Possible
Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern	E	E	Species or species habitat known to occur within area (DoEE 2019a)	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly Typha spp.and Eleocharis spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	Nil
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew	E		recorded within 10km (OEH 2019a)	Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory (DEC 2006).	Nil
Burhinidae	*Esacus magnirostris*	Beach Stone-curlew	E		1 record within 10km (OEH 2019a)	In NSW occurs regularly from the Manning River north, with occasional vagrants to South-east NSW and VIC. Inhabit a range of beaches, islands, reefs and in estuaries. Often seen near mangroves. Forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Nests in shallow scrapes above the littoral zone, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves or on sandbanks.	Unlikely

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V		2 records within 10km (OEH 2019a)	Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).	Unlikely
Charadriidae	*Thinornis rubricollis*	Hooded Plover	E	V	Species or species habitat likely to occur within area (DoEE 2019a)	The Hooded Plover is endemic to southern Australia and is nowadays found mainly along the coast from south of Jervis Bay. It has not been seen in the Sydney area since the 1940s. Occasionally, individual birds are sighted slightly further north to the Shoalhaven River and Comerong Beach and one bird was sighted at Lake Illawarra in March 2001. Hooded Plovers prefer sandy ocean beaches backed by sparsely vegetated sand-dunes for shelter and nesting. Hooded Plovers display high nest site fidelity and nest solitarily. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh.	Nil
Columbidae	*Ptilinopus superbus*	Superb Fruit-Dove	V		recorded within 10km (OEH 2019a)	Occurs mainly north from NE NSW, much less common further south and largely confined to pockets of habitat south to Moruya. Vagrants occur south to VIC and TAS. Inhabits rainforest and closed forests, may also forage in eucalypt or acacia woodland with fruit-bearing trees. Nests 5-30 m above ground in rainforest/rainforest edge tree and shrub species. Part of the population migratory/nomadic.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Dasyornithidae	*Dasyornis brachypterus*	Eastern Bristlebird	E	E	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Nil
Haematopodidae	*Haematopus fuliginosus*	Sooty Oystercatcher	V		2 records within 10km (OEH 2019a)	Evenly distributed along NSW coast, including offshore islands. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide. Breeds almost exclusively on offshore islands, and occasionally on isolated promontories.	Possible
Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	E		recorded within 10km (OEH 2019a)	Scattered along NSW coast. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide. Nests mostly on coastal or estuarine beaches; occasionally saltmarsh or grassy areas.	Possible
Laridae	*Onychoprion fuscata*	Sooty Tern	V		1 record within 10km (OEH 2019a)	Occurs over tropical and subtropical seas and islands around northern NSW. Occasionally seen along coastal NSW, especially after cyclones. Breeds in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Laridae	*Sternula nereis*	Fairy Tern		V	Species or species habitat known to occur within area (DoEE 2019a)	Occurs along NSW coast. Inhabit offshore, estuarine or lake islands, wetlands, beaches and spits. Nests on coral shingle on continental islands or coral cays, on sandy islands and beaches inside estuaries and on open sandy beaches.	Nil
Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	E	CE	Species or species habitat known to occur within area (DoEE 2019a)	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	Unlikely
Meliphagidae	*Grantiella picta*	Painted Honeyeater	V	V	Species or species habitat may occur within area (DoEE 2019a)	Nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Inhabits Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests. Specialist forager on the fruits of mistletoes, preferably of the Amyema genus. Nests in outer tree canopy.	Unlikely

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V		1 record within 10km (OEH 2019a)	Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts. Most breeding records are from the western slopes.	Nil
Psittacidae	*Neophema chrysogaster*	Orange-bellied Parrot	E	CE	Species or species habitat may occur within area (DoEE 2019a)	Breeds in Tasmania and migrates in winter to SE South Australia and southern Victoria. There are occasional reports from NSW, including Shellharbour, Maroubra and the Shoalhaven. In winter, usually found within 3 km of the coast in saltmarsh and strandline/ foredune vegetation. May also occur on golf-courses and other grassy areas, including improved pasture.	Nil
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E	E	Species or species habitat likely to occur within area (DoEE 2019a)	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Spheniscidae	*Eudyptula minor*	Little Penguin in the Manly Point Area	E		27 records within 10km (OEH 2019a)	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.	Nil
Strigidae	*Ninox connivens*	Barking Owl	V		1 record within 10km (OEH 2019a)	Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts. Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	Unlikely
Strigidae	*Ninox strenua*	Powerful Owl	V		70 records within 10km (OEH 2019a)	Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas.	Unlikely

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Tytonidae	*Tyto novaehollandiae*	Masked Owl	V		recorded within 10km (OEH 2019a)	Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.	Unlikely
Serranidae	*Epinephelus daemelii*	Black Rockcod		V	Species or species habitat likely to occur within area (DoEE 2019a)	Found in warm temperate/sub-tropical parts of south-western Pacific. Naturally occur along NSW Coastincl. Lord Howe Island. Adults generally found on rocky reefs. Juveniles found in coastal rock pools and around rocky shores in estuaries. (DPI 2013).	Possible
Percichthyidae	*Macquaria australasica*	Macquarie Perch			Species or species habitat may occur within area (DoEE 2019a)	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas. Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing Sections of river systems.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Retropinnidae	*Prototroctes maraena*	Australian Grayling		V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse et al 2008).	Unlikely
Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E	V	Species or species habitat known to occur within area (DoEE 2019a)	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (Typha spp.) or spike rushes (Eleocharis spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. Gambusia holbrooki is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.	Nil
Myobatrachidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Myobatrachidae	*Mixophyes balbus*	Stuttering frog	E	V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs along the east coast of Australia. Has undergone a massive range reduction particularly in the south of its range: within the Sydney Basin, White (2008a) located only 3 populations south of Sydney (Macquarie Pass and Mt Werong) and Daly et al. (2002, in White 2008a) found only 2 extant populations between Macquarie Pass and Victoria. Inhabits rainforest and wet, tall, open forest. Shelter in deep leaf litter and thick understorey vegetation on the forest floor. Feeds on insects and smaller frogs, breeding in streams during summer after heavy rain. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts (Mahony et al 1997).	Nil
Myobatrachidae	*Pseudophryne australis*	Red-crowned Toadlet	V		44 records within 10km (OEH 2019a)	Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	Unlikely

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Burramyidae	*Cercartetus nanus*	Eastern Pygmy-possum	V		291 records within 10km (OEH 2019a)	Occurs along the east coast of NSW, and inland to the Pillaga, Dubbo, Parkes and Wagga Wagga. Inhabits range of habitats from coastal heath and woodland though open and closed forests, subalpine heath and rainforest (Tulloch and Dickman 1995). Inhabits rainforest, sclerophyll forests and heath. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting subject sites in drier habitats. Diet mostly pollen and nectar from Banksia spp., Eucalyptus spp., Callistemon spp. and insects (Ward and Turner 2008). Nests in hollows in trees, under the bark of Eucalypts, forks of tea-trees, abandoned bird nests and Xanthorrhoea bases (Ward and Turner 2008, Tulloch and Dickman 2006).	Unlikely
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V		1 record within 10km (OEH 2019a)	Migrates from tropics to SE Aus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings (Churchill 2008).	Nil
Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E	V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Miniopteridae	*Miniopterus australis*	Little Bent-winged Bat	V		1 record within 10km (OEH 2019a)	Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats (Churchill 2008, Hoye and Hall 2008).	Unlikely
Miniopteridae	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V		13 records within 10km (OEH 2019a)	Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).	Unlikely
Muridae	*Pseudomys novaehollandiae*	New Holland Mouse	P	V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).	Unlikely

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Peramelidae	*Isoodon obesulus obesulus*	Southern Brown Bandicoot (eastern)	E	E	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs mainly in 2 areas: Ku-ring-gai Chase and Garigal National Parks N of Sydney, and far SE NSW including Ben Boyd National Park, East Boyd State Forest, Nadgee Nature Reserve, Nadgee State Forest, South East Forest and Yambulla State Forest but also occurs between these areas. Inhabits scrubby vegetation, including heath, shrubland, and heathy forest and woodland. Often associated with well-drained soils and dry heathland communities, and prefers periodically burnt areas as this increases insect abundance.	Nil
Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V		1 record within 10km (OEH 2019a)	Occurs along the drier inland slopes as well as coastal habitats. Inhabits woodland and open forest with a Eucalyptus, Corymbia or Angophora overstorey and a shrubby understorey of Acacia or Banksia. Key habitat components include reliable winter and early-spring flowering Eucalypts, Banksia or other nectar sources, and hollow-bearing trees for roost and nest sites (van der Ree and Suckling 2008, Quin et al 2004), with social groups moving between multiple hollows. Social groups include one or two adult males and females with offspring, and have home ranges of 5-10ha within NSW (van der Ree and Suckling 2008, Kavanagh 2004).	Nil
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	Nil

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Pseudocheiridae	*Petauroides volans*	Greater Glider		V	Species or species habitat likely to occur within area (DoEE 2019a)	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Nil
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	recorded within 10 km (OEH 2019a)	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	Likely
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	Species or species habitat likely to occur within area (DoEE 2019a)	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Hoye and Schulz 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds (Churchill 2008). In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	Unlikely
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V		recorded within 10km (OEH 2019a)	Occurs on southeast coast and ranges. Prefers tall (>20m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts in hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12km foraging	Possible.

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
						movements recorded) (Churchill 2008, Law et al 2008).	
Vespertilionidae	*Myotis macropus*	Southern Myotis	V		23 records within 10km (OEH 2019a)	Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008).	Possible
Elapidae	*Hoplocephalus bungaroides*	Broad-headed Snake	E	V	Species or species habitat likely to occur within area (DoEE 2019a)	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Unlikely

Appendix Table 4 Migratory species likelihood of occurrence

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V	C	11 records within 10km (OEH 2019a)	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	Possible
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	P	C,J,K	Species or species habitat known to occur within area (DoEE 2019a)	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	Unlikely
Charadriidae	*Charadrius leschenaultii*	Greater Sand-plover	V	V,C,J,K	Species or species habitat known to occur within area (DoEE 2019a)	Does not breed in Australia. In NSW, recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; forage on wet ground at low tide.	Unlikely
Charadriidae	*Charadrius mongolus*	Lesser Sand-plover	V	E,C,J,K	Species or species habitat known to occur within area (DoEE 2019a)	Does not breed in Australia. Found along the entire coast of Australia, most common in northern NSW, QLD and the Gulf of Carpentaria. Rarely recorded south of the Shoalhaven. In NSW almost entirely coastal, on beaches of sheltered bays, harbours and estuaries with large intertidal sand or mudflats,	Unlikely

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
						occasionally on sandy beaches, coral reefs and rock platforms.	
Charadriidae	*Pluvialis squatarola*	Grey Plover		C,J,K	records within 10km (OEH 2019a)	Breed in the northern Hemisphere. Widespread on Australian coasta in the non-breeding season. Occur almost entirely in coastal areas, usually in sheltered embayments with mud or sandflats and occasionally on rocky coasts or near-coastal lakes and swamps. Very occasionally recorded further inland. Forage on exposed mudflats and beaches.	Unlikely
Psittacidae	*Lathamus discolor*	Swift Parrot	E	CE	Species or species habitat known to occur within area (DoEE 2019a)	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.	Nil
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper		C,J,K	1 record within 10km (OEH 2019a)	Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.	Unlikely

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
Scolopacidae	*Calidris canutus*	Red Knot		E,C,J,K	Species or species habitat known to occur within area (DoEE 2019a)	Breeds in northern hemisphere. Occurs in coastal areas around Australia, with important sites in VIC, SA, WA, NT and Qld. Mainly inhabits intertidal mudflats, sandflats and sandy beaches. Occasionally seen in terrestrial saline wetlands but rarely in freshwater wetlands. Forage in soft substrates in intertidal areas.	Unlikely
Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	E	CE,C,J,K	Species or species habitat likely to occur within area (DoEE 2019a)	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Nil
Scolopacidae	*Calidris tenuirostris*	Great Knot	V	CE,C,J,K	Species or species habitat known to occur within area (DoEE 2019a)	Breeds in northern hemisphere. In Australia, prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, mangroves, saltwork ponds, near-coastal swamps, saltlakes and non-tidal lagoons. Rarely occurs on inland lakes and swamps. Roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding areas.	Unlikely
Scolopacidae	*Limosa lapponica baueri*	Bar-tailed Godwit (baueri)		V,C,J,K	Species or species habitat known to occur within area (DoEE 2019a)	Has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Breeds in the north of Scandinavia, Russia and north-west Alaska. Found mainly in coastal habitats such as large	Unlikely

Family	Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat description	likelihood of occurrence
						intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	
Scolopacidae	*Limosa lapponica menzbieri*	Northern Siberian Bar-tailed Godwit		CE	Species or species habitat may occur within area (DoEE 2019a)	The Northern Siberian Bar-tailed Godwit is a large Migratory shorebird which breeds in northern Siberia, Russia between the Khatanga River and the delta of the Kolyma River. During the non-breeding period, the distribution of L. l. menzbieri is predominantly in the north and north-west of Western Australia and in south-eastern Asia.	Nil
Scolopacidae	*Numenius madagascariensis*	Eastern Curlew		CE,C,J,K	Species or species habitat known to occur within area (DoEE 2019a)	Within Australia, the species has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Breeds in Russia and north-eastern China. Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms.	Unlikely

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Appendix B - Flora species list

Scientific Name	Common Name	Parsley Bay	Diamond Bay	Streets, Vaucluse
Aspleniaceae				
Asplenium australasicum	Bird's Nest Fern	u		
Blechnaceae				
Blechnum wattsii	Hard Water Fern	u		
Doodia aspera	Prickly Rasp Fern	o		
Cyatheaceae				
Cyathea australis	Rough Tree Fern	o		
Cyathea cooperi	Scaly Tree Fern	o		
Dennstaedtiaceae				
Histiopteris incisa	Bat'swing Fern	o		
Hypolepis muelleri	Harsh Ground Fern	o		
Pteridium esculentum	Bracken Fern	o	o	
Dicksoniaceae				
Calochlaena dubia	Rainbow Fern	o	o	
Drypoteridaceae				
**Cyrtomium falcatum*	Holly Fern		u	
Lomariopsidaceae				
**Nephrolepis cordifolia*	FishboneFern	u	u	
Osmundaceae				
Todea barbara	King Fern	u		
Polypodiaceae				
Platycerium bifurcatum	Elkhorn Fern	u		
Pteridaceae				
Adiantum aethiopicum	Maidenhair Fern	o		
Adiantum formosum	Giant maidenhair Fern	o		
Coniferopsida				
Cupressaceae				
**Cupressus goveniana*	Gowen Cypress			u
Podocarpaceae				
Podocarpus elatus	Plum Pine	u		
Magnoliopsida				

Scientific Name	Common Name	Parsley Bay	Diamond Bay	Streets, Vaucluse
Acanthaceae				
Pseuderanthemum variabile	Pastel Flower	u	u	
Aizoaceae				
Carpobrotus glaucescens	Pigface		u	
Tetragonia tetragonioides	Warrigal Greens		u	
Amaranthaceae				
Alternanthera denticulata	Lesser Joyweed	u	u	
**Alternanthera pungens*	Kakhi Weed		u	
**Anacardiaceae*				
**Schinus areira* var. *molle*	Pepper Tree			u
**Apiaceae*				
Centella asiatica	Gotu Kola	u	u	
**Foeniculum vulgare*	Fennel		u	
**Hydrocotyle bonariensis*	Kurnell Curse		o	
Platysace lanceolata	Shrubby Platysace		u	
Xanthosia pilosa	Woolly Xanthosia		u	
Xanthosia tridentata	Rock Xanthosia		u	
**Apocynaceae*				
**Araujia sericifera*	Moth Vine	u	u	
**Gomphocarpus fruticosus*	Narrow-leaved cotton bush		u	
Tylophora barbata	-	o		
**Araliaceae*				
**Fatsia japonica*	Fatsia	u		
Polyscias sambucifolia subsp. *Long leaflets (P.G.Neish 208) Vic. Herbarium*	Elderberry Panax	u		
**Schefflera actinophylla*	Umbrella Tree	u		
**Asteraceae*				
**Ageratina adenophora*	Crofton Weed	o	o	
**Aster subulatus*	Bushy Starwort		o	
C Bidens pilosa	Pitchforks		u	
**Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush		o	
**Cirsium vulgare*	Thistle		u	
**Conyza sumatrensis*	Tall fleabane	u	u	
**Hypochaeris radicata*	Cat's Ear	u	u	u

Scientific Name	Common Name	Parsley Bay	Diamond Bay	Streets, Vaucluse
Leptinella longipes	-		u	
Senecio spathulatus var. *attenuatus*	Coast Grounsdel		u	
Sigesbeckia orientalis subsp. *orientalis*	Indian-weed	u		
**Sonchus oleraceus*	Common Sowthistle		u	
**Taraxacum officinale*	Dandelion	u	u	u
Bignoniaceae				
Pandorea pandorana subsp. *pandorana*	Wonga Wonga Vine	o		
Campanulaceae				
Lobelia anceps	-		u	
Lobelia purpurascens	Whiteroot	u	u	
Cannabaceae				
**Celtis sinensis*	Hackberry	o	o	
Caprifoliaceae				
**Lonicera japonica*	Japanese Honeysuckle		u	
Caryophyllaceae				
**Cerastium fontanum*	Mouse-ear Chickweed		u	
Casuarinaceae				
Allocasuarina distyla	Scrub Oak		u	
Allocasuarina littoralis	Black Oak	o		
Casuarina equisetifolia subsp. *incana*	Coastal Oak		u	
Casuarina glauca	Swamp Oak	c	o	
Chenopodiaceae				
Rhagodia candolleana subsp. *candolleana*	Coastal Saltbush		u	
Convolvulaceae				
Dichondra repens	Kidney Weed	u	u	
**Ipomoea cairica*	Mile-a-minute		u	
Dilleniaceae				
Hibbertia dentata	Trailing Guinea-flower	u		
Hibbertia scandens	Golden Guinea Flower		u	
Elaeocarpaceae				
Elaeocarpus reticulatus	Blueberry Ash	o		
Ericaceae				
Leucopogon ericoides	Pink Beard-heath		u	

Scientific Name	Common Name	Parsley Bay	Diamond Bay	Streets, Vaucluse
Monotoca elliptica	Tree Broom-heath	u	u	
Euphorbiaceae				
**Euphorbia prostrata*	Red Caustic Weed		u	
Homalanthus populifolius	Bleeding Heart	o		
Fabaceae (**Faboideae**)				
Dillwynia glaberrima	-		u	
Dillwynia floribunda			u	
**Erythrina x sykesii*	Indian Coral		u	
Glycine clandestina		o		
Kennedia rubicunda	Dusky Coral pea	u	u	
**Robinia pseudoacacia* 'Frisia'	Golden Robinia			u
**Trifolium fragiferum*	Strawberry Clover			o
Fabaceae (Mimosoideae)				
Acacia implexa	Whitewood			
Acacia longifolia subsp. *longifolia*	Sydney Golden Wattle	o	o	
Acacia longifolia subsp. *sophorae*	Wadanguli		o	
Acacia suaveolens	Sweet Wattle		u	
Gentianaceae				
**Centaurium erythraea*	Pink Stars		u	u
Goodeniaceae				
Dampiera stricta	-		o	
Scaevola calendulacea	Scented Fanflower		o	
Selliera radicans	Swamp Weed		u	
Hypericaceae				
Hypericum gramineum	Small St John's Wort			u
Lamiaceae				
Westringia fruticosa	Coastal Rosemary		c	
Lauraceae				
Cassytha pubescens	-	o	o	
**Cinnamomum camphora*	Camphor Laurel	u	u	
Malvaceae *sens lat.*				
Brachychiton acerifolius	Illawarra Flame	o		
**Lagunaria patersonii*	Norfolk Island Hibiscus		c	
**Malva parviflora*	Mallow		u	u

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**Malvaviscus arboreus*	Wax Mallow			u
Meliaceae				
Melia azedarach	White Cedar	u		
Synoum glandulosum subsp. *glandulosum*	Scentless Rosewood	u		
Toona ciliata	Red Cedar	u		
Menispermaceae				
Sarcopetalum harveyanum	Pearl Vine	u		
Stephania japonica var. *discolor*	Snake Vine	o		
Moraceae				
**Ficus benjamina*	Weeping Fig			u
Ficus coronata	Sandpaper Fig	u		
Ficus macrophylla	Moreton Bay Fig	u		
**Ficus microcarpa* var. *hillii*	Hill's Weeping Fig	o		
Ficus obliqua subsp. *obliqua*	Small-leaved Fig	u		
Ficus rubiginosa	Port Jackson Fig	o		
**Morus alba*	Mulberry		u	
Myrtaceae				
**Agonis flexuosa*	Willow Peppermint			o
Angophora costata	Smooth-barked Apple	c		o
Angophora floribunda	Rough-barked Apple			u
Backhousia myrtifolia	Ironwood	o		
Baeckea imbricata	Heath myrtle		o	
Callistemon linearis	Narrow-leaved Bottlebrush	u		
**Corymbia citriodora*	Lemon-scented Gum			u
**Corymbia citriodora/Corymbia maculata* hybrid	Hybrid Spotted Gum			u
Corymbia maculata	Spotted Gum	u		
Eucalyptus botryoides	Bangalay	o		u
Eucalyptus piperita	Sydney Peppermint	u		
Eucalyptus pilularis	Blackbutt	u		
**Eucalyptus propinqua*	Small-fruited Grey Gum			u
Eucalyptus resinifera subsp. *resinifera*	Red Mahogany	o		
Eucalyptus robusta	Swamp Mahogany	u		u

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**Eucalyptus scoparia*	Wallangarra White Gum			u
Eucalyptus tereticornis	Forest Red Gum			u
Kunzea ambigua	Tick Bush		u	
Leptospermum laevigatum	Coast Tea-tree		c	
Leptospermum squarrosum	Peach blossom Tea-tree		u	
**Lophostemon confertus*	Brushbox	u		o
Melaleuca armillaris subsp. *armillaris*	Honey Bracelet-myrtle		o	
Melaleuca nodosa	Prickly-leaved Paperbark		u	
Melaleuca quinquenervia	Broad-leaved Paperbark	o		u
**Metrosideros excelsa*	Pohutukawa		c	u
Micromyrtus ciliata	Fringed heath-myrtle		o	
Syncarpia glomulifera subsp. *glomulifera*	Turpentine	u		
Syzygium australe	Brush Cherry	o		u
**Syzygium luehmannii*	Riberry			u
#Syzygium paniculatum	Magenta Lillypilly	o		u
Syzygium smithii	Lillypilly	o		
Oleaceae				
**Fraxinus griffithii*	Evergreen Ash	u		
**Ligustrum lucidum*	Large-leaved Privet	u		
**Ligustrum sinense*	Small-leaved Privet	u	u	
Notelaea longifolia f. *longifolia*	Native Olive	o		
**Olea europaea* subsp. *cuspidata*	African Olive	u	u	
Onagraceae				
Epilobium billardierianum subsp. *cinereum*	Willow Herb		u	
Passifloraceae				
**Passiflora edulis*	Passionfruit	u		
Phyllanthaceae				
Breynia oblongifolia	Coffee Bush	o	u	
Glochidion ferdinandi var. *ferdinandi*	Smooth Cheesetree	o	u	
Pittosporaceae				
Pittosporum revolutum	Wild Yellow Jasmine	u		
Pittosporum undulatum	Brush Daphne	c	c	

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Plantaginaceae				
Plantago debilis	Slender Plantain		u	
Plantago hispida	Coastal Plantain		u	
**Plantago lanceolata*	Plantain	o	o	
Platanaceae				
**Platanus x acerifolia*	London Plane			u
Polygonaceae				
**Acetosa sagittata*	Turkey Rhubarb	u	u	
Rumex brownii	Swamp Dock		u	
**Rumex crispus*	Curled Dock		u	
Primulaceae				
Myrsine variabilis	Murrogun	o		
Samolus repens	Creeping Brookweed		u	
Proteaceae				
Banksia ericifolia subsp. *ericifolia*	Wadanggari		o	
Banksia integrifolia subsp. *integrifolia*	Coast Banksia	c	c	o
Persoonia lanceolata	Lance-leaf Geebung	u	u	
Ranunculaceae				
Ranunculus inundatus	River Buttercup		u	
Rosaceae				
**Eriobotrya japonica*	Loquat	u		
Rubiaceae				
Asperula conferta	Common Woodruff	u		
**Coprosma repens*	Taupata		o	
Opercularia aspera	Coarse Stinkweed	u	u	
Rutaceae				
Correa alba var. *alba*	White Correa		o	
Phebalium squamulosum subsp. *argenteum*	Silvery Phebalium		u	
Sapindaceae				
Cupaniopsis anacardioides	Tuckeroo			o
Dodonaea triquetra	Large-leaf Hop Bush	o	o	
Scrophulariaceae				
Myoporum boninense subsp. *australe*	Boobialla		u	
Solanaceae				

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**Cestrum parqui*	Green Cestrum		u	
Thymelaeaceae				
Pimelea linifolia subsp. *linifolia*	Riceflower	u	u	
Liliidae				
Amaryllidaceae				
**Clivia miniata*	Kaffir Lily	u		
Crinum pedunculatum	Swamp Lily		u	
Araceae				
Alocasia brisbanensis	Cunjevoi	o		
Arecaceae				
Archontophoenix cunninghamiana	Bangalay Palm	o		
**Howea forsteriana*	Kentia Palm	o		
Livistona australis	Cabbage Palm	o		
**Phoenix canariensis*	Canary Island Date Palm	u	u	u
**Syagrus romanzoffiana*	Cocos Palm		u	
Asparagaceae				
**Asparagus aethiopicus*	Asparagus fern	u	o	u
**Dracaena* (?) *reflexa*	Song of India	u		
Asteliaceae				
Cordyline stricta	Narrow-leaved Palm Lily	u		
Cannaceae				
**Canna* x *generalis*	Canna lily	u	u	
Commelinaceae				
Commelina cyanea	Scurvy Weed	u	u	
**Tradescantia fluminensis*	Wandering Jew	o	o	
Cyperaceae				
Baumea juncea	-		o	
Carex appressa	Tall Sedge		u	
Cyathochaeta diandra	-		u	
**Cyperus brevifolius*	Mullumbimby Couch		u	u
**Cyperus eragrostis*	-		o	
Cyperus gracilis	-	u	o	
Cyperus laevigatus	-		u	
C Cyperus polystachyos	-	o	o	

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Cyperus sanguinolentus	-	u	u	
Ficinia nodosa	Knobby Club-rush		c	
Lepidosperma concavum	-		u	
Lepidosperma laterale	-	u		
Lepidosperma neesii	-		u	
Schoenus brevifolius	Zig-zag Bog Rush		c	
Schoenus maschalinus	-		o	
Iridaceae				
**Romulea longifolia*	Guildford Grass		u	u
Juncaceae				
Juncus continuus	-		u	
Juncus usitatus	-	o	o	
Lomandraceae				
Lomandra longifolia	Spiny-headed Mat-rush	o	c	
Luzuriagaceae				
Eustrephus latifolius	Wombat Berry	o		
Geitonoplesium cymosum	Scrambling Lily	o		
Marantaceae				
**Ctenanthe oppenheimiana*	Bamburanta	u		
Phormiaceae				
Dianella caerulea var. *caerulea*	Blue Flax Lily	o	u	
Dianella revoluta var. *revoluta*	Blueberry	u		
Poaceae				
Anisopogon avenaceus	Oat Speargrass	u	u	
**Axonopus fissifolius*	Carpet Grass	u	o	o
**Cenchrus clandestinus*	Kikuyu	c	c	c
**Cenchrus setaceus*	Fountain Grass			u
Cynodon dactylon	Couch	c	c	c
Dichelachne crinita	Longhair Plumegrass		o	
Entolasia marginata	Bordered Panic		o	
Entolasia stricta	Wiry panic	o	o	
**Ehrharta erecta*	Panic Veldtgrass	o	o	u
Imperata cylindrica	Blady Grass	u	u	
Microlaena stipoides var. *stipoides*	Weeping Grass	o	o	u

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Paspalum distichum	Water Couch	u	u	u
**Stenotaphrum secundatum*	Buffalo		u	u
Themeda triandra	Kangaroo Grass		o	
Zoysia macrantha	Prickly Couch		o	
Restionaceae				
Chordifex fastigiatus	Tassel Rush		o	
Lepyrodia scariosa	-		u	
Smilacaceae				
Smilax glyciphylla	Sweet Sarsparilla	u	o	
Zingiberaceae				
**Hedychium gardnerianum*	Ginger Lily	u		

Note: c – common, o – occasional, u - uncommon

*not indigenous to Woollahra LGA C Cosmopolitan species

planted threatened species

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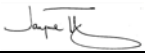
Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name			Signature	Date
0	Gary Leonard	Jayne Tipping		Andrew Chitty	on file	6.3.2020

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