

# 18 Biodiversity

This chapter provides a summary of the biodiversity impacts associated with the M4-M5 Link project (the project). A detailed biodiversity assessment report (BAR), including an arboriculture impact assessment, has been prepared for the project and is included in **Appendix S** (Technical working paper: Biodiversity).

The Secretary of the NSW Department of Planning and Environment (DP&E) has issued environmental assessment requirements for the project. These are referred to as the Secretary's Environmental Assessment Requirements (SEARs). **Table 18-1** sets out these requirements and the associated desired performance outcomes that relate to biodiversity, and identifies where they have been addressed in this environmental impact statement (EIS).

**Table 18-1 SEARs - biodiversity**

Desired performance outcome	SEARs	Where addressed in the EIS
<p><b>1. Environmental impact assessment process</b></p> <p>The process for assessment of the proposal is transparent, balanced, well focused and legal.</p>	<p>2. It is the Proponent's responsibility to determine whether the project needs to be referred to the Commonwealth Department of the Environment for an approval under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act). The Proponent must contact the Commonwealth Department of the Environment immediately if it is determined that an approval is required under the EPBC Act, as supplementary environmental assessment requirements may need to be issued to ensure a streamlined assessment under the Bilateral agreement can be achieved.</p>	<p>An assessment of the project on matters of national environmental significance is included in <b>section 18.3</b>.</p> <p>A referral to the Australian Government Department of the Environment and Energy for an approval under the EPBC Act is not required for the project. The assessment process and determination that the project does not need to be referred to the Australian Government Department of the Environment and Energy is included in <b>Chapter 2</b> (Assessment process).</p>
<p><b>6. Biodiversity</b></p> <p>The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity.</p> <p>Offsets and/or supplementary measures are assured which are equivalent to any remaining impacts of project construction and operation.</p>	<p>1. The Proponent must assess biodiversity impacts in accordance with the current guidelines including the Framework for Biodiversity Assessment (FBA) and be carried out by a person accredited in accordance with section 142B(1)(c) of the <i>Threatened Species Conservation Act 1995</i> (NSW).</p>	<p>The biodiversity assessment was undertaken by an accredited assessor, in accordance with the requirements of the FBA and relevant legislation (refer to <b>section 18.1</b> and <b>Appendix S</b> (Technical working paper: Biodiversity)).</p>
	<p>2. The Proponent must assess any impacts on biodiversity values not covered by the FBA. Impacts on species, populations and ecological communities that will require further consideration and provision of information specified in section 9.2 of the FBA include any identified through consultation with the Office of Environment and Heritage (OEH).</p>	<p>An assessment of biodiversity impacts which are not covered by the FBA is provided in <b>section 18.3</b> and <b>Appendix S</b> (Technical working paper: Biodiversity).</p> <p>The methodology adopted for, and the findings of the targeted species surveys are included in</p>

Desired performance outcome	SEARs	Where addressed in the EIS
	<p>Species specific surveys shall be undertaken for those species and in accordance with the survey requirements specified by the OEH.</p> <p>The Proponent must identify whether the project as a whole, or any component of the project, would be classified as a Key Threatening Process (KTP) in accordance with the listings in the <i>Threatened Species Conservation Act 1995</i> (TSC Act), <i>Fisheries Management Act 1994</i> (FM Act) and <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act).</p>	<p><b>section 18.1, section 18.2 and Appendix S</b> (Technical working paper: Biodiversity).</p> <p>A determination of whether the project would be classified as a Key Threatening Process is included in <b>section 18.3 and Appendix S</b> (Technical working paper: Biodiversity).</p>
	<p>3. The Proponent must assess any impacts on trees within the project area. Impacts should be minimised; following the hierarchy of avoid, minimise and mitigate impacts on trees.</p>	<p>An assessment of the project's impact on trees is included in <b>section 18.3</b>. An arboricultural impact assessment is included as Annexure G of <b>Appendix S</b> (Technical working paper: Biodiversity).</p>

## 18.1 Assessment methodology

### 18.1.1 Overview

The key components of the biodiversity assessment included:

- Desktop analysis to describe the existing environment and landscape features of the study area and to identify threatened terrestrial and aquatic values potentially affected by the project
- Field surveys to identify the biodiversity values of the project footprint and to determine the likelihood of threatened species and their habitats occurring in the project footprint or being affected by the project
- Qualitative assessment of potential impacts of the project on biodiversity values, including threatened species
- An arboricultural impact assessment, including a visual tree assessment for trees potentially affected by the project.

A summary of the tasks undertaken to inform the BAR is included in **section 18.1.3** and **section 18.1.4**. The arboricultural impact assessment is located in Annexure G of **Appendix S** (Technical working paper: Biodiversity).

#### Study area

The study area for the biodiversity assessment comprises a 550 metre buffer around the project footprint, as required by the *Framework for Biodiversity Assessment* (FBA) (NSW Office of Environment and Heritage (OEH) 2014b). The study area includes existing roads, motorways, residential areas, industrial areas, urban landscaped areas, and exotic vegetation and is shown in **Figure 18-1**.

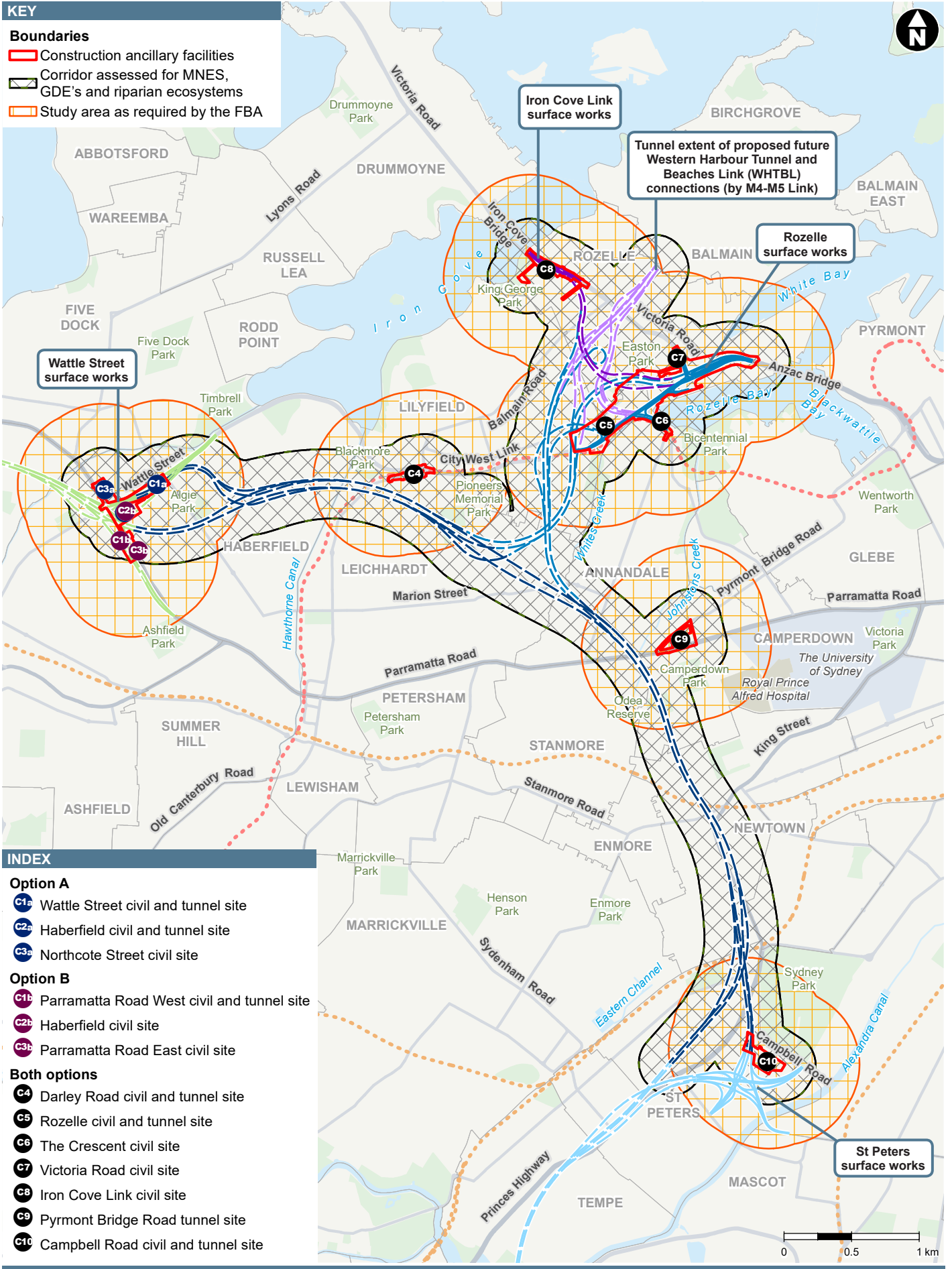
**Figure 18-1** also shows the corridor assessed for matters of national environmental significance (MNES), groundwater dependant ecosystems (GDEs) and riparian ecosystems. Riparian ecosystems are those associated with (and often located adjacent or close to) waterbodies, or dependent on surface or subsurface drainage. GDEs are defined and discussed in further detail in **section 18.2.6**.

Some desktop assessment tools for biodiversity have a minimum search area of a 10 kilometre radius. This area is referred to as the locality in this chapter (see **section 18.2**).

**KEY**

**Boundaries**

- Construction ancillary facilities
- Corridor assessed for MNES, GDE's and riparian ecosystems
- Study area as required by the FBA



**INDEX**

**Option A**

- C1a Wattle Street civil and tunnel site
- C2a Haberfield civil and tunnel site
- C3a Northcote Street civil site

**Option B**

- C1b Parramatta Road West civil and tunnel site
- C2b Haberfield civil site
- C3b Parramatta Road East civil site

**Both options**

- C4 Darley Road civil and tunnel site
- C5 Rozelle civil and tunnel site
- C6 The Crescent civil site
- C7 Victoria Road civil site
- C8 Iron Cove Link civil site
- C9 Pyrmont Bridge Road tunnel site
- C10 Campbell Road civil and tunnel site

**LEGEND**

- |   |  |  |   |   |   |   |
|---|--|--|---|---|---|---|
| <b>Existing features</b>  | <span style="border-bottom: 1px dashed orange; width: 20px; display: inline-block;"></span> Railway      | <b>New M5</b>  | <b>M4-M5 Link</b>   | <b>Rozelle interchange</b>  | <b>Iron Cove Link</b>   | <b>Proposed future WHTBL connections (civil construction only)</b>                                      |
| <span style="border-bottom: 1px solid grey; width: 20px; display: inline-block;"></span> Waterway         | <span style="border-bottom: 1px dashed red; width: 20px; display: inline-block;"></span> Light rail      | <span style="border-bottom: 1px solid blue; width: 20px; display: inline-block;"></span> Surface road  | <span style="border-bottom: 1px solid blue; width: 20px; display: inline-block;"></span> Surface road | <span style="border-bottom: 1px solid blue; width: 20px; display: inline-block;"></span> Surface road | <span style="border-bottom: 1px solid purple; width: 20px; display: inline-block;"></span> Surface road | <span style="border-bottom: 1px solid purple; width: 20px; display: inline-block;"></span> Surface road |
| <span style="border-bottom: 1px solid grey; width: 20px; display: inline-block;"></span> Subarterial road | <span style="border-bottom: 1px solid grey; width: 20px; display: inline-block;"></span> Suburb boundary | <span style="border-bottom: 1px dashed blue; width: 20px; display: inline-block;"></span> Tunnel       | <span style="border-bottom: 1px dashed blue; width: 20px; display: inline-block;"></span> Tunnel      | <span style="border-bottom: 1px dashed blue; width: 20px; display: inline-block;"></span> Tunnel      | <span style="border-bottom: 1px dashed purple; width: 20px; display: inline-block;"></span> Tunnel      | <span style="border-bottom: 1px dashed purple; width: 20px; display: inline-block;"></span> Tunnel      |
| <span style="border-bottom: 1px solid grey; width: 20px; display: inline-block;"></span> Arterial road    |  | <span style="border-bottom: 1px solid green; width: 20px; display: inline-block;"></span> Surface road |   |   |   |   |
|   |  | <span style="border-bottom: 1px dashed green; width: 20px; display: inline-block;"></span> Tunnel      |   |   |   |   |

Figure 18-1 Biodiversity assessment study area

## 18.1.2 Legislation and policy framework

The BAR has been prepared to assess the impacts of the project in accordance with relevant legislation as described in **Table 18-2**.

**Table 18-2 Legislation relevant to the biodiversity assessment of the project**

<b>Legislation</b>	<b>Relevance to project</b>
<i>Threatened Species Conservation Act 1995</i> (NSW) (TSC Act)	<p>The TSC Act provides for listing of 'threatened species, populations and ecological communities', 'Key Threatening Processes', and the preparation and implementation of Recovery Plans and Threat Abatement Plans.</p> <p>As detailed in <b>section 18.3</b>, the project is not expected to have a significant impact on any species or communities listed under the TSC Act.</p>
<i>Fisheries Management Act 1994</i> (NSW) (FM Act)	<p>The FM Act aims to conserve, develop and share the fishery resources of the state. It provides listings of 'threatened species, populations and ecological communities', 'Key Threatening Processes', and the preparation and implementation of Recovery Plans and Threat Abatement Plans. The FM Act has been considered for the purpose of this assessment with regard to aquatic biodiversity (including listed protected and threatened species and populations) and Key Threatening Processes.</p> <p>Sections 201, 205 and 219 of the FM Act require permits to be obtained for dredging or reclamation work (including any excavation of land submerged by water), harming marine vegetation and blocking of fish passage respectively. However, permits under the FM Act are not required for approved State significant infrastructure (in accordance with section 115ZG of the <i>Environmental Planning and Assessment Act 1979</i> (NSW) (EP&amp;A Act)).</p> <p>In accordance with Section 199 of the FM Act, notification to the NSW Department of Primary Industries (Fisheries) (DPI-Fisheries) is required if dredging or reclamation work are required in water land classed as key fish habitat (for example Rozelle Bay). Following detailed design, DPI-Fisheries would be notified regarding construction works at Rozelle Bay and their response would be considered (refer to <b>Chapter 2</b> (Assessment process)).</p>
<i>Native Vegetation Act 2003</i> (NSW) (NV Act)	<p>The NV Act regulates clearing of native vegetation, remnant native vegetation and protected regrowth. The NV Act is intended to protect and promote the conservation of native vegetation, but excludes National Park, State Forest and urban areas.</p> <p>The project footprint does not include any remnant native vegetation that meets the definition in the NV Act. The NV Act is also not applicable to the Sydney metropolitan area.</p>
<i>Noxious Weeds Act 1993</i> (NSW) (NW Act)	<p>The NW Act provides for the declaration of noxious weeds and the making of weed control orders specifying control measures that are to be used to control noxious weeds. Noxious weeds may be considered noxious on a national, state, regional or local scale. All private landowners, occupiers, public authorities and councils are required to control noxious weeds on their land under Part 3 Division 1 of the NW Act. Impacts of the project in relation to weeds are discussed in <b>section 18.3</b>.</p>
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth) (EPBC Act)	<p>Under the EPBC Act, an action includes a project, undertaking, development, activity, series of activities or alteration. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is a 'controlled action' and may not be undertaken without approval from the Australian Government Minister for the Environment. The project would not have a significant impact upon any MNES and therefore does not require approval from the Australian Government Minister for the Environment as outlined in <b>section 18.3</b>.</p>

## Policy and guidelines

The BAR has been prepared to assess the impacts of the project on biodiversity values in accordance with the requirements of the *NSW Biodiversity Offsets Policy for Major Projects* (OEH 2014a) (the Biodiversity Offset Policy) and the FBA.

The Biodiversity Offset Policy and the SEARs require the FBA to be applied to assess impacts on biodiversity. The FBA outlines the assessment methodology to quantify and describe the biodiversity values in the project footprint, and the biodiversity offsets required for any unavoidable impacts. The FBA applies predominantly to terrestrial biodiversity. The assessment of impacts of the project on aquatic environments and biodiversity has been undertaken in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (update 2013) (DPI 2013) which incorporates *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge 2003).

The BAR has also considered the following guidelines:

- *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (DPI 2012)
- *NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft November 2004* (NSW Department of Environment and Conservation (DEC) 2004)
- *NSW Threatened species survey and assessment guidelines: field survey methods for fauna (Amphibians)* (NSW Department of Environment and Climate Change (DECC) 2009)
- *NSW Sustainable Design Guidelines Version 3.0* (Transport for NSW 2013)
- *Aquatic Ecology in Environmental Impact Assessment – EIA Guideline* (Marcus Lincoln Smith 2003)
- *Commonwealth Survey Guidelines for Australia's Threatened Frog* (Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010a)
- *Commonwealth Survey Guidelines for Australia's Threatened Bats* (DEWHA 2010b)
- *Matters of National Environmental Significance Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2013)
- *Referral guideline for management actions in Grey-Headed and Spectacled Flying-fox camps* (Commonwealth of Australia 2015).

### 18.1.3 Desktop assessment

A desktop review was undertaken to identify the potential presence of any threatened species, populations or ecological communities listed under the TSC Act and FM Act, as well as MNES listed under the EPBC Act within the study area. The desktop review included a review of the following databases:

- OEH Atlas of NSW Wildlife (OEH 2016a) (NSW Department of the Environment and Energy (DEE) 2016a)
- NSW Threatened Species Profile Database (OEH 2016b)
- EPBC Act Protected Matters Search Tool (PMST) (DEE 2016b)
- FM Act listed protected and threatened species and populations, including species profiles, 'Primefact' publications and expected distribution maps (Riches et al 2016)
- Online Zoological Collections of Australian Museums (OZCAM)
- Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (searched 27 September 2016)
- *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 - Appendix 2* (NSW Government 2011).

A number of documents were also reviewed to assist with identifying biodiversity values within the study area. These documents included:

- Rozelle Rail Yards Review of Environmental Factors (REF) – Biodiversity Assessment (Ecological Australia (ELA) 2016)
- WestConnex M4 East EIS – Biodiversity Impact Assessment (GHD Pty Ltd 2015)
- WestConnex New M5 EIS – Biodiversity Assessment Report (ELA 2015)
- WestConnex M4-M5 Geotechnical Investigations – Flora and Fauna Assessment (Niche 2016)
- Central Business District (CBD) Metro – Environmental Assessment (SKM 2010)
- Aerial photography of the study area
- Visual Information System online vegetation classification database (OEH 2016c)
- Native Vegetation Maps of the Sydney Metropolitan Catchment Management Authority Area (OEH 2013a)
- Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy 1989)
- Local council action plans or strategies:
  - The City of Sydney Urban Ecology Strategic Action Plan (2014)
  - City of Sydney Environmental Action 2016-2021 Strategy and Action Plan (2016)
  - Marrickville Council Biodiversity Action Plan 2011-2015 (2011)
  - Marrickville Council Biodiversity Strategy 2011-2021 (2011)
  - The Inner West Council Greenway Strategy including the Greenway Biodiversity Strategy (2012), Greenway Revegetation and Bushcare Plan (2011) and Greenway Flora and Fauna Literature Review (2010).

### **Likelihood of occurrence assessment**

Based on the desktop assessment, further assessment was undertaken to determine how likely a particular species is to occur within the project footprint. A likelihood ranking was then assigned to each species, according to whether the species was 'known', 'likely', 'possible', 'unlikely' or 'absent'. The likelihood of occurrence assessment was used to guide and inform the field surveys that were undertaken for the project. Refer to Annexure A of **Appendix S** (Technical working paper: Biodiversity) for the likelihood of occurrence assessment and description of likelihood rankings.

#### **18.1.4 Field surveys**

##### **Flora**

The existing vegetation community mapping (OEH 2013a) within the study area was verified to confirm the presence or absence of native vegetation communities, including the presence of any threatened ecological communities (TECs). Vegetation communities were identified from a combination of floristic surveys and checked to see if a plant community type (PCT) could be assigned or whether they constituted non-native vegetation, by comparing the dominant canopy species, the general description of location, soil type and other attributes.

No biometric plots were completed as part of this assessment, as no PCTs were present within the study area.

## Fauna

Fauna surveys were carried out over several nights between August and October 2016 within the Rozelle Rail Yards and at the confluence of Whites Creek and Rozelle Bay, as these areas were considered the only potential habitat for species within the project footprint. Details of the field surveys, survey extents and survey conditions are provided in **Appendix S** (Technical working paper: Biodiversity). In summary, these surveys included:

- Fauna habitat assessments to identify potential habitat for threatened fauna species (such as hollow-bearing trees, rock habitats, known food trees, presence of termite mounds and evidence of fauna usage)
- An assessment of aquatic habitat within Whites Creek and at the foreshore at Rozelle Bay.

Other waterways considered in the desktop assessment included Iron Cove (at the eastern abutment of Iron Cove Bridge and at Haberfield), Hawthorne Canal at Darley Road, Johnstons Creek at Camperdown and Alexandra Canal at St Peters.

Targeted surveys for threatened microbats were carried out within the Rozelle Rail Yards to inform the biodiversity assessment for site management works (see **section 18.2.1**). The results of these targeted surveys were used to assess the potential for any additional impacts of the M4-M5 Link project (such as the demolition of the Victoria Road bridge). The cumulative impacts of the site management works and the M4-M5 Link project on biodiversity values are assessed in **Chapter 26** (Cumulative impacts).

## 18.2 Existing environment

### 18.2.1 Rozelle Rail Yards

Roads and Maritime is separately carrying out site management works (that includes vegetation clearing) at part of the Rozelle Rail Yards site. The works are needed to manage the existing environmental and safety issues at the site and would also improve access to surface conditions, which would allow for further investigation into the location of utilities and the presence of contamination and waste. The works would benefit future uses of the site (including construction of the M4-M5 Link project if it is approved) because the works would remove material and redundant facilities associated with rail and rail related infrastructure from the site. The site management works were subject to a separate environmental assessment and are excluded from the scope of the project that is the subject of this EIS. The works were assessed in an REF which was approved by Roads and Maritime under Part 5 of the EP&A Act in April 2017.

Site management works will be carried out over a period of around 12 months and commenced in mid-2017. After completion of the works, the 'finished site' would be managed and maintained to ensure that the surface cover and stormwater controls are operating effectively. For the purposes of this EIS, it has been assumed that the site management works are completed prior to construction of the project commencing. **Chapter 2** (Assessment process) provides further information on the scope and timing of activities to be undertaken as part of the site management works at the Rozelle Rail Yards.

A biodiversity assessment was undertaken by ELA to support the REF for site management works at the Rozelle Rail Yards (Roads and Maritime 2016). As part of the assessment, targeted threatened fauna surveys were completed for the Green and Golden Bell Frog (*Litoria aurea*), Long-nosed Bandicoot (*Perameles nasuta* – endangered population) and threatened microchiropteran bats (microbats). The assessment concluded the following for the Rozelle Rail Yards site survey:

- No threatened flora species or listed ecological communities were identified, or are considered as having the potential to occur within the Rozelle Rail Yards
- The Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) was recorded and may be roosting in the cavities under the Victoria Road bridge, or using it as a flyway. The Victoria Road bridge would not be impacted during site management works, however it would be demolished as part of the M4-M5 Link project (further discussion is provided in **section 18.3**)
- The Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) was recorded and may be using the site to forage



- The White-striped Freetail Bat (*Tadarida australis*) was recorded; however, this species is not threatened under NSW or Commonwealth legislation
- Grey-headed Flying-fox were observed feeding on fig trees immediately adjacent to the site and therefore were assumed to be present
- No other threatened fauna species were observed, or are considered present within the site (including the Green and Golden Bell Frog).

## 18.2.2 Landscape features

The landscape features of the study area have been determined in accordance with the requirements of the FBA. Landscape features contribute to the overall biodiversity value of the study area and are used to inform appropriateness of offsets where required. **Table 18-3** summarises the biodiversity landscape features of the study area. Figures showing landscape features of the study area are included in **Appendix S** (Technical working paper: Biodiversity).

**Table 18-3 Biodiversity landscape features of the study area**

Landscape feature	Description
Interim Biogeographic Regionalisation for Australia (IBRA) region and subregion	The study area is located within the Sydney Basin Bioregion which extends north to the Hunter Valley, west to Mudgee and south to Batemans Bay. The project footprint crosses two IBRA subregions; the Cumberland subregion and the Pittwater subregion. The study area is highly urbanised and surrounded by extensive areas of established urban development.
Mitchell landscapes	The majority of the study area occurs within the Mitchell landscape of Sydney – Port Jackson and Ashfield Plains. The Sydney–Newcastle Barriers and Beaches landscape also occurs within the study area.
Rivers and streams	<p>Riparian corridors of three waterways occur within or adjacent to the project footprint; Whites Creek (first order stream), Rozelle Bay (Estuarine Area) and Iron Cove (second order stream).</p> <p>Whites Creek is not mapped as a key fish habitat, as defined in the <i>Fisheries Policy and Guidelines for Fish Habitat Conservation and Management – update 2013</i> (Fairfull 2013). Rozelle Bay is mapped as a key fish habitat and would be directly impacted by the project, which includes piling for a pedestrian and cyclist bridge and rock revetment work for the drainage outlet from the Rozelle Rail Yards to Rozelle Bay. A coffer dam would be required to carry out these works.</p> <p>Iron Cove is mapped as key fish habitat and would not be directly impacted by the construction of the Iron Cove Link (near the eastern abutment of Iron Cove Bridge). The bioretention facility at Manning Street at Rozelle would connect to an existing underground stormwater pipe that would discharge to Iron Cove via the existing outlet.</p> <p>Hawthorne Canal is mapped as a key fish habitat and would not be directly impacted by the project. A potential option for the discharge of treated water from the Darley Road water treatment facility would be to Hawthorne Canal via an existing outlet and would not require any works to the Hawthorne Canal.</p> <p>Notwithstanding the presence of areas mapped as key fish habitat, waterways within or adjacent to the project footprint are not suitable habitat for threatened fish species.</p>
Wetlands	There are no coastal wetlands mapped under the State Environmental Planning Policy No. 14- Coastal Wetlands (SEPP 14) within the study area. Artificial waterbodies are scattered across the study area and surrounds as detention basins and ponds.

Landscape feature	Description
State or regionally significant biodiversity links (connectivity)	No formal regional or state biodiversity links recognised by the FBA methodology occur within the study area.
Vegetation cover	The assessment for the buffer area (550 metres from the project footprint in accordance with the FBA) recorded around 0.62 hectares of native vegetation cover. This represents 0.05 per cent native vegetation cover.
Patch size of vegetation	Vegetation within the study area comprises patches of urban native and exotic vegetation and is surrounded by extensive urbanised areas. These patches of vegetation do not meet the definition of native vegetation under the FBA.
Change in area to perimeter ratio	As the native vegetation within the study area does not meet the definition for native vegetation, the proportional change in area to perimeter ratio could not be assessed.

### 18.2.3 Terrestrial flora

#### Native vegetation communities

All vegetation in the study area is mapped as 'urban exotic and native cover' (OEH 2013a) and considered to be in a low ecological condition. No PCTs were recorded in the study area and thus no native vegetation as defined by the FBA is considered to be present.

Urban exotic and native cover within the study area consists of planted indigenous, non-indigenous native and exotic species within local parklands, urban backyards, riparian areas and the Rozelle Rail Yards. These areas often contain large expanses of exotic grasses and other weeds and generally occur where the soil profile has been extensively modified. Some areas, such as parklands, only contain large established trees (native and exotic) and exotic grasses, with no shrub layer or evidence of regenerating overstorey species.

The study area is entirely modified and disturbed and contains exotic species, weeds and planted native or non-indigenous species. The study area is generally characterised by urban parks, landscaped road verges, compacted soils, introduced fill, existing dwellings and other infrastructure, and is considered to be in a poor ecological condition, with little ecological value, and is unlikely to have any native resilience or recovery potential.

#### Threatened ecological communities

The desktop survey identified 16 threatened ecological communities (TECs) within the locality of the project. Of these, all are listed under the TSC Act and 11 are listed under the EPBC Act. An assessment of likelihood for these TECs occurring within the study area is provided in Annexure A of the **Appendix S** (Technical working paper: Biodiversity).

No TECs were recorded or assessed as likely to occur within the project footprint and no remnant native vegetation as defined by the FBA is mapped within the project footprint. Three TECs listed under the TSC Act and/or EPBC Act, previously mapped as being within around two kilometres of the project footprint are described in **Table 18-4**. Given this distance, impacts on these TECs would not occur as a result of the project.

**Table 18-4 TECs within proximity to the project footprint**

<b>Common name</b>	<b>TSC Act listing</b>	<b>EPBC Act listing</b>	<b>Nearest occurrence</b>
Coastal Saltmarsh	Endangered: Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions	Vulnerable: Subtropical and Temperate Coastal Saltmarsh	Mapped within the study area around 300 metres southeast of the works associated with the widening of The Crescent and 600 metres southeast of the Rozelle Rail Yards. Occurs along the banks of Johnstons Creek at Bicentennial Reserve, and in small patches along the northern shores of Iron Cove.
Sydney Turpentine Ironbark Forest	Endangered: Sydney Turpentine Ironbark Forest	Critically endangered: Turpentine Ironbark Forest in the Sydney Basin Bioregion	Mapped at Five Dock Park and Russell Lea Infants School, around 900 metres and 1,800 metres north of the Wattle Street interchange.
Swamp Oak Floodplain Forest	Endangered: Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Mapped along the banks of Iron Cove around 400 metres west of Victoria Road and the Iron Cove Link civil site (C8).

The FBA requires identification of ecosystem credit species (species that can be reliably predicted based on the PCT) and species credit species (species that generate species credits). In accordance with the requirements of the FBA, the identification of ecosystem credit species is required based on the PCT, IBRA subregion of the study area and the condition and patch size of vegetation to be impacted (see **Table 18-3**). If these factors are not present, ecosystem credit species present in the study area cannot be identified. As no PCTs were identified within the study area, no ecosystem credit species were predicted to occur.

### **Threatened flora**

Desktop searches of the EPBC Act PMST and the Atlas of NSW Wildlife identified 38 threatened flora species listed under the TSC Act and/or EPBC Act as potentially occurring within the locality of the project. No threatened flora populations were identified. An assessment of likelihood for these threatened flora species to occur within the study area is provided in Annexure A of **Appendix S** (Technical working paper: Biodiversity).

No threatened flora was considered likely to occur within the study area, or was recorded opportunistically during the vegetation and fauna surveys. The study area is representative of a highly disturbed and degraded environment, dominated by exotic vegetation or native species that have been planted.

In accordance with the FBA requirements, a list of species credit species is generated based on an assessment of the IBRA sub region, past records and habitat elements (see **Table 18-3**). As no species credit species were identified, these species were not considered for further assessment.

### **Weeds**

Weeds are common throughout the study area with some areas supporting weed infestations. Although some exotic weed species would be removed as part of the site management works at the Rozelle Rail Yards, weeds are also present in areas outside the site management works area. Weeds identified in the study area during the field surveys are summarised in **Table 18-5**.

**Table 18-5 Noxious and environmental weed species recorded in the study area**

Scientific name	Common name	Class of weeds for Inner West and City of Sydney local government area*	Weed of National Significance
<i>Anredera cordifolia</i>	Madeira Vine	-	X
<i>Asparagus asparagoides</i>	Bridal Creeper	5	X
<i>Cenchrus echinatus</i>	Spiny Burr Grass	5	
<i>Cestrum parqui</i>	Green Cestrum	3	
<i>Cortaderia selloana</i>	Pampas Grass	4	
<i>Lantana camara</i>	Lantana	4	X
<i>Ligustrum lucidum</i>	Broad-leaved Privet	4	
<i>Ligustrum sinense</i>	Small-leaved Privet	4	
<i>Oxalis sp.</i>	Oxalis	5	
<i>Parietaria judaica</i>	Pellitory	4	
<i>Ricinus communis</i>	Castor Oil Plant	4	
<i>Rubus fruticosus</i>	Blackberry	4	X

Notes:

\* Noxious weeds classes as defined under the NW Act:

- Class 3: The plant must be fully and continuously suppressed and destroyed
- Class 4: The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its reproduction
- Class 5: The requirements in the NW Act for a notifiable weed must be complied with.

## 18.2.4 Terrestrial fauna

### Threatened fauna and habitat

The EPBC Act PMST and the Atlas of NSW Wildlife identified 51 threatened fauna species (or their habitat) listed under the TSC Act or EPBC Act as potentially occurring within the locality of the project. A full list of these species is provided in **Appendix S** (Technical working paper: Biodiversity).

In accordance with the FBA, no candidate species were predicted to occur within the study area. However, some species have habitat requirements that are not predicted by PCTs, and require expert input, particularly those species that can use man-made or exotic environments. As such, a conservative list of eight final candidate species (including one population) was developed, as summarised in **Table 18-6**.

This list of candidate species is based on each species' likelihood of occurrence, which was informed from database searches, previous studies and specific habitat features present within the study area. The likelihood of occurrence assessment is detailed in Annexure A of **Appendix S** (Technical working paper: Biodiversity). The list of final candidate species was then used to determine whether or not the species requires further assessment in the form of targeted surveys.

Two threatened microbat species, the Eastern Bentwing-bat and Yellow-bellied Sheathtail-bat, were recorded during targeted surveys at the Rozelle Rail Yards. The Eastern Bentwing-bat was recorded within the Rozelle Rail Yards and may be roosting in the cavities under the Victoria Road bridge, or using it as a flyway. The Yellow-bellied Sheathtail-bat was also recorded (as a possible call) within the Rozelle Rail Yards and may be using the site to forage.

No targeted surveys were conducted for the Grey-headed Flying-fox as the species was assumed to be present within the study area. The Commonwealth survey guidelines (DEWHA 2010) indicate that surveys based on animal sightings for this species are unlikely to be reliable as this species is highly mobile and occupies most areas in its distribution in highly irregular patterns. A more effective survey method is to determine the likelihood of occurrence via desktop assessment and to conduct vegetation surveys to identify feeding habitat. It was assumed likely that the Grey-headed Flying-fox would use the study area on occasion for foraging.

It should be noted that the targeted surveys were undertaken to inform the biodiversity assessment for the Rozelle Rail Yards site management works, which targeted amphibian and mammalian species that may be present on this site. While the Rozelle Rail Yards would be mostly cleared following site management works, the M4-M5 Link project has the potential for additional impacts on these species (from additional vegetation removal and the demolition of the Victoria Road bridge), as assessed in **section 18.3**.

### Migratory species

Forty migratory species listed under the EPBC Act were assessed for their likelihood of occurrence within the study area, including a number of predominantly marine species. The assessment considered it was unlikely for any migratory species to occur within the study area, primarily due to the lack of suitable habitat and the highly urbanised environment. Marine migratory species are not relevant to this assessment.

**Table 18-6 Species and ecosystem credit species and their initial likelihood of occurrence within the study area**

Species name	Species or ecosystem credit species	Likelihood of occurrence	Habitat assessment	Targeted survey required
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	Species (breeding camps) and ecosystem (foraging)	High	Potential feed trees scattered across the study area. However, these are limited in number and may occur as individual trees. Records exist close to the study area and are common in the locality. There are known breeding camps at the Royal Botanic Gardens, Sydney and at Turrella.	No – assumed to be present for foraging
Little Bentwing-bat ( <i>Miniopterus australis</i> )	Species (breeding sites) and ecosystem (foraging)	Low	Uses caves, hollows and man-made structures as roost sites. Only one record exists for this species within the locality. This record is within 100 metres of Iron Cove bridge and over 20 years old. The record is noted as being dubious within the Atlas of NSW Wildlife, as the record is well outside the species known range.	Yes
Eastern Bentwing-bat ( <i>Miniopterus schreibersii oceanensis</i> )	Species (breeding sites) and ecosystem (foraging)	Moderate	Uses caves, hollows and man-made structures as roost sites. A number of records exist for this species within the locality. This closest record is over 20 years old from an old Balmain power station. It occurs within 100 metres of Iron Cove Bridge. Other records are from Goat Island (10 years' old), 2.5 kilometres north of the study area within Sydney Harbour.	Yes

Species name	Species or ecosystem credit species	Likelihood of occurrence	Habitat assessment	Targeted survey required
Eastern Freetail-bat ( <i>Mormopterus norfolkensis</i> )	Ecosystem	Moderate	Primarily uses hollows as roost sites, but can also use man-made structures. Nearest record is 10 years' old from Goat Island, 2.5 kilometres north of the study area in Sydney Harbour.	Yes
Southern Myotis ( <i>Myotis macropus</i> )	Species (breeding sites) and ecosystem (foraging)	Low	Species has specific roost requirements, which primarily include tree hollows within riparian zones. Nearest record (10 years old) is from Goat Island, 2.5 kilometres north of the study area in Sydney harbour.	Yes
Yellow-bellied Sheath-tail-bat ( <i>Saccolaimus flaviventris</i> )	Ecosystem	Low	Primarily uses hollows as roost sites. No records for this species exist within the locality.	Yes

### 18.2.5 Aquatic biodiversity

The foreshore of Rozelle Bay near Whites Creek consists of reclaimed land, vertical seawalls, jetty structures, riprap (ie rocks used to armour shorelines) embankments and gently sloping intertidal land. At the lower end of Whites Creek, the marine environment is highly modified, consisting of a concrete channel around nine metres wide with vertical walls and a concrete base (Whites Creek channel). The subtidal substrate of Rozelle Bay is silty-sand covered with leaves and branches discharged from Whites Creek. Decomposition of this organic material likely results in anoxic conditions close to the sediment, providing unsuitable habitat for seabed fauna. This area is mapped as key fish habitat.

The Crescent crossing over Whites Creek channel is a low bridge, 46 metres wide by nine metres long. Sydney Water is planning to naturalise sections of Whites Creek further upstream of the crossing, which would be continued to the confluence with Rozelle Bay outfall as part of the M4-M5 Link project (refer to **Chapter 5** (Project description)).

The riparian vegetation in the study area is mapped as urban exotic and native cover, and represents planted and landscaped native and exotic species. Within the study area, both the Whites Creek and Hawthorne Canal riparian corridors are highly modified environments, consisting of a concrete channel with vertical walls and concrete base. This riparian vegetation does not contribute to the ecological functioning of the waterways. The vegetation provides little ecological value, and is of limited habitat for fauna species.

Immobile marine organisms have adapted to the concrete walls of Whites Creek, including the Sydney Rock Oyster (*Saccostrea commercialis*) and Honeycomb Barnacle (*Chamaesipho tasmanica*). The habitat is not suitable for mangroves and saltmarsh due to the low horizontal intertidal zone. The Whites Creek channel is covered with a thin layer of sediment and debris, but does not support seagrass or marine macroalgae. Woody debris and leaf litter has accumulated in Rozelle Bay at the discharge point immediately east of the road crossing. No marine algae or seagrass occurs near the outlet. Riparian vegetation upstream comprises a row of planted Swamp Oak (*Casuarina glauca*) and Canary Island Date Palm (*Phoenix canariensis*).

There are two existing large pipe culverts at the confluence of Easton Park drain and Rozelle Bay, partially below the high tide mark. This intertidal habitat is in poor condition with limited aquatic value comprising few oysters and marine molluscs. No seagrass or macroalgae are present. There are no aquatic ecology communities within the project footprint (NSW Department of Planning, Infrastructure and Natural Resources 2005). The following areas of aquatic biodiversity sensitivity are located within and near the study area:

- A patch of seagrass (*Halophila*) is located in the shallow subtidal zone at the opposite end of Rozelle Bay, around two kilometres northeast of the project footprint (near Ewenton Park in Balmain)
- A small patch of mangroves is located around 800 metres east of the Rozelle interchange at Rozelle Bay (Creese et al 2009)
- A small mangrove/saltmarsh restoration zone is located 250 metres east of the Rozelle interchange at Bicentennial Park in Glebe.

As Whites Creek is concrete lined, it is not considered key fish habitat and does not receive a waterway crossing classification for fish passage in accordance with the *Fisheries Policy and Guidelines for Fish Habitat Conservation and Management – update 2013* (Fairfull 2013). Rozelle Bay is classed as key fish habitat, however this location does not provide suitable habitat for fish life.

Johnstons Creek also flows into Rozelle Bay, and like Whites Creek, it is concrete lined and does not have any valuable aquatic habitat mapped by DPI-Fisheries and the Sydney Harbour – Foreshores and Waterways Area Development Control Plan: Ecological Communities and Landscape Characters and Wetlands Protection Map (SHFWDCP). Sydney Water has plans to naturalise sections of Johnstons Creek.

Dobroyd Canal (Iron Cove Creek) and Hawthorne Canal are first order tributaries of Iron Cove estuary. Both waterways are concrete lined channels, transitioning from freshwater to estuarine where they are mapped as key fish habitat. These provide limited value aquatic habitat with limited opportunities for water quality improvement before water reaches Rozelle Bay. The SHFWDCP map does not identify the creeks within/near the project footprint as having any notable aquatic ecological community, besides being 'Rivers and Creeks'.

Iron Cove estuary is a narrow arm of Sydney Harbour. The foreshore is heavily developed, with extensive areas of habitat lost to reclamation and seawalls. The SHFWDCP map identifies the area beneath Victoria Road at Iron Cove Bridge as 'Grassland', 'Mixed Rock Intertidal and Mudflats', 'Water' and 'Area not mapped – site specific investigations required'. Mapping by DPI-Fisheries (Creese et al 2009) shows a narrow band of *Zostera/Halophila* seagrasses about 400 metres west of the project footprint and a small patch of *Zostera* around 500 metres east of the project footprint.

The Alexandra Canal, near the St Peters interchange, is a realigned waterway flowing to Botany Bay. The channel has limited habitat variety, with similar depth, width, stone lined banks and poor riparian vegetation. It is mapped as key fish habitat, which would provide optional open water habitat for fish navigating Wolli Creek and Cooks River. This canal does not provide habitat for threatened aquatic species. The nearest seagrass beds are several kilometres downstream in Botany Bay.

It is considered unlikely that there would be valuable or specific aquatic habitat for threatened aquatic/estuarine species (including fish, sharks, rays, aquatic mammals and birds), populations or communities listed under the FM Act, TSC Act or EPBC Act present within the study area. It is possible some species may opportunistically pass near the study area at Whites Creek, given the connectivity to the broader harbour and coastal habitats, but those species are unlikely to depend on the habitat within Whites Creek.

### 18.2.6 Groundwater dependent ecosystems

GDEs are defined as ecosystems whose current species composition, structure and function are reliant on a supply of groundwater, as opposed to surface water supplies from overland flow paths. In Australia, many ecosystems are dependent on groundwater, although a complete understanding of the role of groundwater in maintaining ecosystems is generally poor. Most wetland communities and many river systems have some degree of dependence on groundwater.

The most likely GDE types in the Sydney region are terrestrial vegetation communities with deep roots that use groundwater, wetlands and river baseflow systems. A search of the GDE Atlas (Bureau of Meteorology) and the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources* (2011) indicated that there are no ecosystems within the study area that are likely to be dependent on groundwater.

## 18.3 Assessment of potential impacts

### 18.3.1 Terrestrial flora

#### **Loss of vegetation (including native vegetation)**

There is no native vegetation (as defined by the FBA) located within the project footprint. Around 1,675 trees would potentially require removal to facilitate the project. Based on the current concept design for the project, it is unlikely these trees could be retained. Of these trees, around 107 have been identified as having a high retention value in accordance with the Institute of Australian Consulting Arboriculturists Significance of a Tree, Assessment Rating System (refer to Annexure G of **Appendix S** (Technical working paper: Biodiversity)).

The majority of trees to be removed are located at Rozelle around the Rozelle Rail Yards and associated surface road upgrades and active transport connections. This includes trees within the Rozelle Rail Yards and Ports Authority land (those remaining following site management works), along City West Link and Lilyfield Road, and areas adjacent to Whites Creek at The Crescent and Brenan Street.

Around 355 trees were identified to be investigated further during detailed design to determine their suitability for retention, 34 of which were identified as high retention value. These trees include groups of trees along Lilyfield Road and on the approaches to Anzac Bridge that may offer visual screening.

Trees to be retained would be protected in accordance with Australian Standard (AS) 4970-2009 Protection of trees on development sites and suitable ground protection measures to protect the tree protection zone. Tree removal would be carried out by a suitably qualified arborist and in accordance with AS 4373-2007 Pruning of Amenity Trees and the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998).

This assessment has been based on the current project footprint and concept design for the project. Further opportunities to retain trees may emerge during detailed design. All opportunities for retaining additional trees through tree sensitive design and construction methods would be considered. Where retention of trees is not possible, compensatory planting would be carried out. Replacement trees should be planted within, or close to, the project footprint where feasible and practicable.

Compensatory planting would seek to use opportunities presented by the new open space at the Rozelle Rail Yards, including along Lilyfield Road and City West Link and the remaining project land at Iron Cove Link, to be consistent with the Urban Design and Landscape Plan (see **section 18.5**) to be developed for the project.

#### **Removal of threatened flora**

The project would not involve the removal of any threatened flora species listed under the TSC Act or EPBC Act.

#### **Spread of weeds**

As part of the site management works, most of the weeds within the Rozelle Rail Yards would be removed. Weeds throughout the remainder of the study area (and in other parts of the Rozelle Rail Yards east of Victoria Road) are intermittent. Given the presence of weeds in the study area, there is potential for disturbance of vegetation to lead to the spread and/or intensification of weeds. If not appropriately managed, this may indirectly affect native flora and fauna in adjoining areas by further reducing habitat quality, altering the structure and composition of vegetation and increasing competition for resources.

The implementation of management measures outlined in **section 18.5** would minimise the potential for the spread of weeds from construction activities.



## 18.3.2 Terrestrial fauna

### Edge effects

With regard to biodiversity, edge effects are changes in population or community structures that occur at the boundary of two habitats. No remnant native vegetation occurs within the study area. Therefore, edge effects on native vegetation are not considered likely to occur as a result of the project. Habitat for native species within the study area includes non-remnant native and exotic vegetation (such as planted street trees and exotic species). Edge effects on these areas are likely to occur, but would be limited through the implementation of mitigation measures outlined in **section 18.5**.

### Fauna injury and mortality of fauna

Fauna injury or mortality could occur during construction of the project, as a result of direct collision with vehicles and equipment within the project footprint. Mobile species (such as birds) may be able to move away quickly and easily, but other less mobile species, or those with high fidelity with their home range, may be slower to move away or may not relocate at all, potentially resulting in injury or mortality of the individual.

During construction at the Rozelle Rail Yards (including demolition of the Victoria Road bridge), there is potential for the Eastern Bentwing-bat to be injured or stressed due to disturbances associated with noise, dust or light while roosting in the cavities of the bridge. Direct mortality or injury is unlikely to occur to the Grey-headed Flying-fox as a result of the works, as the species is highly mobile. Individuals are likely to actively avoid the area during construction.

Although there is potential for some injury or mortality of fauna species, the project is unlikely to result in a large number of fauna injury or mortality incidents, as the majority of the project would be constructed underground. Where temporary and permanent ancillary facilities and infrastructure occur, the surrounding land is highly urbanised.

Implementation of management measures outlined in **section 18.5** would reduce the chances of injury or mortality of fauna. Measures to manage potential impacts on bats would be included in the Construction Flora and Fauna Management Plan, which would include specific measures identified for the Victoria Road bridge.

### Impact on migratory species

No migratory species are expected to occur in the project footprint, given the absence of suitable habitat and the highly urbanised environment. A total of 40 migratory species are either known to occur, or have been assessed as likely to occur, within the study area, however outside of the project footprint. The project is therefore unlikely to impact migratory species (refer to **Appendix S** (Technical working paper: Biodiversity)).

### Threatened fauna and loss of habitat

There is potential for direct and indirect impacts on the Grey-headed Flying-fox, Eastern Bentwing-bat and Yellow-bellied Sheath-tail-bat as a result of the project.

#### *Grey-headed Flying-fox impact*

The Grey-headed Flying-fox is listed as 'vulnerable' under the EPBC Act and is therefore considered a MNES. This species is considered likely to forage on around 4.49 hectares of mapped urban exotic and native cover comprising feed trees around that would be removed by the project (foraging habitat). This area does not include vegetation within the Rozelle Rail Yards that will be removed as part of the site management works. This loss of foraging habitat is considered negligible in the context of similar available habitat within the foraging range for this species. A cumulative assessment of the impact on biodiversity, including the Grey-headed Flying-fox, is included in **Chapter 26** (Cumulative impacts).

While the species was not sighted during targeted field surveys for other species, known records exist close to the study area. The project would not impact roosting sites or known breeding camps located at the Royal Botanic Gardens in Sydney, around three kilometres east of the Rozelle interchange and at Turrella, around four kilometres southeast of the St Peters interchange.

Indirect impacts of the project also have the potential to affect the Grey-headed Flying-fox. Construction noise and vibration would be generated by the works, and lighting would be required during standard construction hours (to brighten dark areas such as under the Victoria Road bridge) and during out-of-hours (night) works. These types of indirect impacts are already widespread within the highly urbanised study area, and any exacerbation of these impacts would be managed by the implementation of mitigation measures outlined in **section 18.5**.

Furthermore, night construction works would likely deter Grey-headed Flying-fox individuals from foraging within or immediately adjacent to the project footprint. Construction noise, vibration and lighting impacts would be temporary and are not expected to significantly impact the Grey-headed Flying-fox.

An assessment in accordance with criteria under the *Matter of National Environmental Significance Significant Impact Guidelines* (Commonwealth of Australia 2013) for this species was undertaken and is provided in Annexure E of **Appendix S** (Technical working paper: Biodiversity). This assessment concluded that a significant impact on the Grey-headed Flying-fox is unlikely to occur as a result of the project.

#### *Impact on microbats (Eastern Bentwing-bat and Yellow-bellied Sheath-tail-bat)*

The project would require the demolition of Victoria Road bridge. The cavities of the bridge have been identified as a potential roosting site for the Eastern Bentwing-bat (non-breeding / maternal roost). No maternity colonies for the Eastern Bentwing-bat are known within the Sydney Metropolitan Catchment Management Authority area (OEH 2016a). This species breeds at maternal roosting sites within limestone caves and migrates to Sydney and other areas for winter, returning to maternal roosts in summer.

The Eastern Bentwing-bat is most at risk from indirect impacts associated with noise, vibration, light and dust during construction. The works for the Rozelle interchange would occur during standard construction hours and out-of-hours (night) works, and the impacts of noise, dust and vibration are expected to occur continuously during this time. However, separation distances from these activities to the Victoria Road bridge where potential roost sites exist (before its demolition), would minimise these impacts.

There is potential for noise, light and/ or vibration impacts on the Eastern Bentwing-bat to occur at the new Victoria Road bridge during operation as a result of additional surface road traffic and associated increases in lighting and noise impacts. These potential impacts are not expected to be significant as the Eastern Bentwing-bat is a highly mobile species and the bridge has been identified as only providing a potential non-breeding/maternal roost site.

Whites Creek bridge was also assessed for potential microbat habitat. No microbats were considered likely to occur at Whites Creek bridge. Of the 4.49 hectares of vegetation being removed for the project and comprising potential foraging habitat for the Grey-headed Flying-fox, around 3.78 hectares of vegetation has been identified as potential foraging habitat for the Eastern Bentwing-bat. This small loss of foraging habitat would have a minor impact on the Eastern Bentwing-bat.

Construction noise, vibration, light and dust are not expected to have a significant impact on the Yellow-bellied Sheath-tail-bat as it is considered likely that this species only visits this area for foraging habitat and does not rely on this area as a roosting site.

### 18.3.3 Loss of aquatic biodiversity

The surface water and flooding assessment for the project (refer to **Appendix Q** (Technical working paper: Surface water and flooding)) has determined that the project would have no adverse surface water quality impacts (including Whites Creek), based on the implementation of appropriate management measures and the fact that the residual risk to the environment is low (refer to **Chapter 15** (Soil and water quality)).

Suitable habitat for marine species is not considered present, or is unlikely to be present, within the study area. Further, impacts on aquatic habitat downstream of the project are not expected. Water quality impacts such that they would affect marine species, or their habitat, are not expected at Dobroyd Canal (Iron Cove Creek), Hawthorne Canal, Iron Cove estuary, Whites Creek, Johnstons Creek or Alexandra Canal. These receiving waterways are highly disturbed ecosystems and the

project would generally reduce the mean annual stormwater pollutant loads being discharged to receiving waterways when compared to the existing conditions. Further details regarding water quality are provided in **Chapter 15** (Soil and water quality).

The project would not directly harm marine vegetation or habitat of threatened species, communities or populations. Removal of planted riparian vegetation (non-marine) along the edges of the Whites Creek concrete channel would be required for the upgrade of the intersection of The Crescent and City West Link and the widening and improvement works to Whites Creek. Following these works, a section of the riparian corridor of Whites Creek between The Crescent and the Rozelle Bay confluence would be improved as part of the integration of the Whites Creek naturalisation works planned by Sydney Water. These naturalisation works would be carried out in consultation with Sydney Water.

The new infrastructure proposed over Whites Creek would shade the aquatic habitat within the concrete channel of Whites Creek, creating less favourable conditions for barnacles and oysters attached to the wall. This reduction in light is unlikely to change water temperature given the constant tidal movement in and out of the crossing. The increased bridge width is unlikely to act as a behavioural barrier to fish passage (as is the case with small dark culverts). The passage is considered to have adequate clearance (two to three metres above water), depth (one to two metres) and width (nine metres) to encourage fish movement.

During construction, the proposed works may temporarily obstruct fish passage during the use of a floating boom and silt curtain near the Whites Creek outlet across Rozelle Bay. A coffer dam would also be required within Rozelle Bay to facilitate piling for a pedestrian bridge and rock revetment works for the drainage outlet to Rozelle Bay. This impact would be minimal given the poor creek habitat in Whites Creek and Rozelle Bay intertidal and subtidal area. Fish passage would be restored during operation.

As part of the project, Easton Park drain would be decommissioned with flows diverted into a new channel to convey flows through the Rozelle Rail Yards. An upgraded culvert would be provided to discharge flows into Rozelle Bay. This culvert upgrade would result in the removal of around 27 metres of intertidal rock revetment wall. This intertidal habitat is in poor condition with limited aquatic value comprising few oysters and marine molluscs. A rock spillway and scour protection rock apron would replace the existing rock wall, providing a similar scale and type of intertidal habitat. There is no marine vegetation present at this location that could be affected by changes in salinity due to freshwater discharge. The nearest sensitive vegetation is Coastal Saltmarsh, located around 300 metres east of The Crescent, which is unlikely to be affected due to its distance and mixing with tidal water. The project would not result in a net loss of key fish habitat. No direct impacts would occur to Dobroyd Canal (Iron Cove Creek), Hawthorne Canal, Iron Cove estuary, Johnstons Creek or Alexandra Canal.

Indirect impacts on aquatic habitat may occur as a result of impacts on water quality. Water quality could potentially be impacted by sediment runoff and deposition, polluted road runoff, high velocity runoff/discharge, and oil and pollutant spills entering the waterway. Uncontrolled runoff or discharge can influence the water quality in waterways, such as water temperature, turbidity, pH, salinity and alkalinity. These impacts may reduce water quality, reduce light penetration through the water column, and smother benthic habitat with sediment. This could alter primary (plant) and secondary (animal) production that supports or regulates the aquatic food web.

However, the receiving waterways are highly disturbed ecosystems and the project would generally reduce the mean annual stormwater pollutant loads being discharged to receiving waterways when compared to the existing conditions. Impacts on aquatic habitat as a result of water quality impacts during construction would be short term and would be minimised through the implementation of appropriate management measures as identified in **section 18.5** and in **Chapter 15** (Soil and water quality). There would be no net loss of aquatic habitat in the medium to long term.

### 18.3.4 Impact on groundwater dependent ecosystems

No priority GDEs were identified in the study area and therefore the project is considered unlikely to have an impact on GDEs. Long term dewatering caused by tunnel drainage could lower the water table, reducing the amount of groundwater available for shallow rooted plants. The minimum depth of the water table underlying the majority of the project is around two metres below ground surface and therefore existing plants are unlikely to be completely dependent on groundwater. Further information on groundwater is provided in **Chapter 19** (Groundwater).

### 18.3.5 Introduction and spread of exotic species

#### Animal pests

Given the majority of the study area is disturbed and within a highly urbanised setting, it is likely that animal pests are present within the study area. The following species were recorded during field surveys at the Rozelle Rail Yards as part of the site management works investigations:

- European Red Fox (*Vulpes vulpes*)
- European Rabbit (*Oryctolagus cuniculus*)
- Feral Cat (*Felis catus*)
- Common Myna (*Acridotheres tristis*).

Given the highly urbanised nature of the remainder of the study area, these species are also considered likely to occur in other parts of the study area. The project is not likely to exacerbate the impacts of the European Red Fox or European Rabbit on native fauna, due to their existing presence in the study area, the highly urban context and the lack of native fauna. Further, the project is unlikely to increase the abundance of cats, introduce them into new areas (given the abundance of cats in the study area), or increase predation pressure on native fauna.

#### Pathogens

A number of pathogens of concern in NSW have the potential to impact native flora and fauna. Activities that involve movement of equipment over large areas are of particular concern, given the high potential to spread pathogens over large areas. Although no sign of pathogen infection was identified during the field surveys at the Rozelle Rail Yards as part of the site management works investigations, key pathogens of concern include:

- Myrtle rust (*Uredo rangellii*)
- Chytrid fungus (*Batrachochytrium dendrobatidis*)
- Phytophthora (*Phytophthora cinnamomi*).

Given the highly urban context and lack of existing remnant native vegetation within the study area, it is unlikely that Phytophthora is present. Myrtle rust, if present, would be limited to any landscaped or planted Eucalypts. It is considered unlikely that the Chytrid fungus (an infectious disease in amphibians) is present within the study area given the absence of frog species.

The implementation of appropriate mitigation measures listed in **section 18.5** would reduce the potential for introduction of Myrtle rust and Phytophthora to be introduced into the study area during construction of the project. Where required, these pathogens would be managed through the implementation of the management measures detailed in **section 18.5**.

### 18.3.6 Impact on matters of national environmental significance

The only MNES that was considered likely to be impacted by the project is the Grey-headed Flying-fox, listed as Vulnerable under the EPBC Act. This species was considered likely to forage on a limited number of feed trees within up to 4.49 hectares of mapped urban and exotic native cover to be removed by the project. Potential impacts of the project on this species include:

- Removal of up to 4.49 hectares of potential foraging habitat within the study area
- Disturbance from construction noise, vibration and lighting.

An assessment in accordance with criterion under the *Matter of National Environmental Significance Significant Impact Guidelines* (Commonwealth of Australia 2013) for this species was undertaken and is provided in Annexure E of **Appendix S** (Technical working paper: Biodiversity). This assessment concluded that a significant impact on the Grey-headed Flying-fox is unlikely to occur as a result of the project. No impacts on a known camp would occur as a result of the project and no species offsets are required.

As no significant impact would occur on any MNES, a referral to the Commonwealth Department of the Environment is not required and the EPBC Act assessment bilateral agreement has not been triggered for this project. Further detail is provided in **Chapter 2** (Assessment process).

### 18.3.7 Impacts on relevant key threatening processes

The project has the potential to contribute to key threatening processes as defined by the EPBC Act, TSC Act and FM Act in relation to threatened species, communities, populations and their habitats. These are summarised in **Table 18-7**. With the implementation of appropriate mitigation measures, the risk of exacerbating these key threatening processes is considered to be low.

**Table 18-7 Potential impacts of key threatening processes on biodiversity**

Key threatening process	Statutory listing	Relevance to the project	Potential or known
Infection of native plants by <i>Phytophthora cinnamomi</i>	TSC Act	Movement of vehicles, equipment and people during the construction phase carries a risk of introduction and spread of the plant pathogen <i>Phytophthora cinnamomi</i> .	Potential
Dieback caused by the root-rot fungus* <i>Phytophthora cinnamomi</i>	EPBC Act	Presence of the plant pathogen within the study area is unknown.	
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	TSC Act	Movement of vehicles, equipment and people during the construction phase carries a risk of introduction and spread of Myrtle rust.  Presence of Myrtle rust within the study area is unknown, but would likely be limited to any landscaped or planted Eucalypts.	Potential
Invasion and establishment of exotic vines and scramblers	TSC Act	Exotic vines and scramblers are present within the study area including areas along road and track edges.  Movement of vehicles, equipment and people during the construction phase carries a risk of introduction and spread of these exotic vines and scramblers.	Potential
Invasion, establishment and spread of <i>Lantana camara</i>	TSC Act	<i>L. camara</i> is present within the Rozelle Rail Yards. Movement of vehicles, equipment and people carries a risk of introduction and spread of <i>L. camara</i> into unaffected areas.	Known

Key threatening process	Statutory listing	Relevance to the project	Potential or known
Human-caused climate change	TSC Act, EPBC Act and FM Act	<p>During construction, machinery and production and transport of materials would emit carbon-dioxide into the atmosphere, which is known to increase greenhouse gases responsible for climate change.</p> <p>However, the results of the greenhouse gas assessment for the project demonstrates the benefits of road tunnel usage in urban areas, where travel along a more direct route at higher average speeds results in fewer greenhouse gas emissions being generated by road users, as reduced congestion and stop-start driving reduces the fuel used by vehicles. Further detail is provided in <b>Chapter 22</b> (Greenhouse gas).</p>	Known

Note: \*It is now understood that *P. cinnamomi* is not a fungus. This was the name of the key threatening process when it was registered under the EPBC Act.

## 18.4 Biodiversity offsets

Consistent with the SEARs, the project has been assessed using the FBA. The FBA was developed by OEH and includes a standardised methodology for the calculation of offsets. The outcome of this assessment is that no biodiversity offsets are required for this project. Details of this assessment can be found in **Appendix S** (Technical working paper: Biodiversity).

Replacement planting would be undertaken for the trees that would be removed by the project, as outlined in **section 18.3.1** and **section 18.5**.

## 18.5 Environmental management measures

Environmental management measures relating to biodiversity during construction and operation are provided in **Table 18-8**. Additional mitigation and management measures relevant to biodiversity are also described in the following sections of this EIS:

- Noise and vibration management measures in **Chapter 10** (Noise and vibration)
- Lighting management measures in **Chapter 13** (Urban design and visual amenity)
- Erosion and sediment control management measures in **Chapter 15** (Soil and water quality)
- Flooding and drainage management measures in **Chapter 17** (Flooding and drainage).

**Table 18-8 Environmental management measures – biodiversity**

Impact	No.	Environmental management measure	Timing
<b>Construction</b>			
Impact on biodiversity values	B1	<p>A Construction Flora and Fauna Management Plan (CFFMP) would be developed and implemented during construction. The CFFMP would include the following:</p> <ul style="list-style-type: none"> <li>• Identification of guidelines relevant to construction, the matters they apply to and what is required to ensure compliance</li> <li>• Pre-disturbance inspection requirements to identify features of biodiversity conservation significance and select appropriate management measures and environmental controls</li> <li>• Management measures and environmental controls to be implemented before and during construction including: <ul style="list-style-type: none"> <li>- An unexpected threatened species finds procedure</li> <li>- Section 3.3.2 Standard precautions and mitigation measures of the <i>Policy and guidelines for fish habitat</i></li> </ul> </li> </ul>	Construction

Impact	No.	Environmental management measure	Timing
		<p><i>conservation and management Update 2013</i> (DPI-Fisheries NSW 2013)</p> <ul style="list-style-type: none"> <li>- Tree assessment and management protocols consistent with AS 4970-2009 Protection of trees on development sites</li> <li>- Weed management protocols.</li> </ul>	
Disturbance of threatened microbats	B2	<p>Prior to the commencement of any works associated with the modification of the Victoria Road bridge, an inspection would be carried out by a suitably qualified and experienced ecologist to confirm the presence of roosting microbats. If roosting microbats are identified, measures to manage potential impacts would be developed in consultation with an appropriate microbat expert and included in the CFFMP prior to the commencement of any work with the potential to disturb the roosting locations (as confirmed by the microbat expert). The plan would include management measures outlined in Appendix S (Technical paper: Biodiversity assessment report) and from any additional assessments carried out during detailed design and project delivery as relevant.</p>	Construction
Aquatic impacts	B3	<p>The proposed road bridge at Whites Creek would be designed with consideration of <i>Policy and Guidelines for Fish Habitat Conservation Update 2013</i> (DPI, 2013) and <i>Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</i> (NSW Fisheries 2003).</p>	Construction
	B4	<p>Site-specific Erosion and Sediment Control Plans (ESCPs) would be prepared for each work location associated with or in the vicinity of waterways and culverts that would be modified as part of the project. The ESCPs would contain measures to stabilise all surfaces disturbed as a result of the project as soon as possible following the disturbance to prevent erosion and to minimise sedimentation in adjacent aquatic environments.</p>	Construction
Loss of trees	B5	<p>The CFFMP will include measures to manage potential impacts on trees. Measures will include:</p> <ul style="list-style-type: none"> <li>· The establishment of tree protection zones</li> <li>· Ground protection measures for trees to be retained.</li> </ul>	Construction
	B6	<p>As many trees as possible will be retained during construction. In the event that tree removal cannot be avoided, a tree replacement strategy will be prepared. Replacement trees will be included in the Urban Design and Landscape Plan to be developed and implemented for the project.</p>	Construction
	B7	<p>The CFFMP will include tree management protocols and provision for the development of tree management plans (in accordance with the requirements of AS 4970-2009) where required for specific trees. Protection of trees on development sites will be carried out in consultation with an arborist with a minimum Australian Qualifications Framework (AQF) Level 5 qualification in arboriculture for each tree proposed for retention where works associated with the project have the potential to impact on the tree root zone.</p>	Construction

Impact	No.	Environmental management measure	Timing
	B8	Tree removal, pruning and maintenance work will be carried out by an arborist with a minimum AQF Level 3 qualification in accordance with AS 4373-2007 Pruning of Amenity Trees and the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998) and advice provided by an arborist with a minimum AQF Level 5 qualification in arboriculture (or equivalent).	Construction
<b>Operation</b>			
Loss of trees	OB9	An Urban Design and Landscape Plan will be prepared and implemented to guide the compensatory planting for trees removed by the project. The plan will include: <ul style="list-style-type: none"> <li>· A tree replacement strategy</li> <li>· Species recommendations for the landscape design to consider, including foraging trees for the Grey-headed Flying-fox</li> <li>· Relevant project specific rehabilitation and revegetation measures associated with the M4 East and New M5 projects, where there is an overlap in use of project footprint.</li> </ul>	Operation
Loss of aquatic habitat	OB10	Consultation would be undertaken with Sydney Water regarding integration of naturalisation works at Whites Creek, including re-establishment of vegetation where possible following construction activities. Vegetation re-establishment will be undertaken in accordance with Guide 3: <i>Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and management biodiversity on RTA project</i> (NSW Roads and Traffic Authority 2011).	Operation