

## **22 Biodiversity - Stage 1**

# 22 Biodiversity – Stage 1

This chapter provides an assessment of the potential impact of Stage 1 on biodiversity and identifies mitigation measures to minimise these impacts. This chapter is based on information in Technical Paper 10 (Biodiversity development assessment report).

## 22.1 Secretary’s Environmental Assessment Requirements

The Secretary’s Environmental Assessment Requirements relating to biodiversity, and where these requirements are addressed in this Environmental Impact Statement, are outlined in Table 22-1.

**Table 22-1: Secretary’s Environmental Assessment Requirements – Biodiversity Stage 1**

Reference	Requirement	Where addressed
<b>11. Biodiversity</b>		
11.1	Biodiversity impacts in accordance with section 7.9 of the <i>Biodiversity Conservation Act 2016</i> (BC Act), the Biodiversity Assessment Method (BAM), and be documented in a Biodiversity Development Assessment Report (BDAR).	Section 22.6
11.2	Impacts on biodiversity values not covered by the BAM. This includes a threatened aquatic species assessment (Part 7A of the <i>Fisheries Management Act 1994</i> ) to address whether there are likely to be any significant impact on listed threatened species, populations or ecological communities listed under the <i>Fisheries Management Act 1994</i> (FM Act).	Section 22.6.5
11.3	If the project, or any component of the project, would be classified as a KTP in accordance with the listings in the BC Act, FM Act and the <i>Environment Protection and the Biodiversity Conservation Act 1999</i> (EPBC Act).	Section 22.6.9

## 22.2 Legislative and policy context

A Biodiversity Development Assessment Report has been prepared for Stage 1 as required under the *Biodiversity Conservation Act 2016* and a requirement of the Biodiversity Assessment Method.

Stage 1 has been assessed in relation to key biodiversity legislation and policy including:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
- *Biodiversity Conservation Act 2016*
- *Biosecurity Act 2015*
- *Environmental Planning and Assessment Act 1979*
- *Fisheries Management Act 1994*
- NSW Biodiversity Assessment Method (Office of Environment and Heritage, 2017).

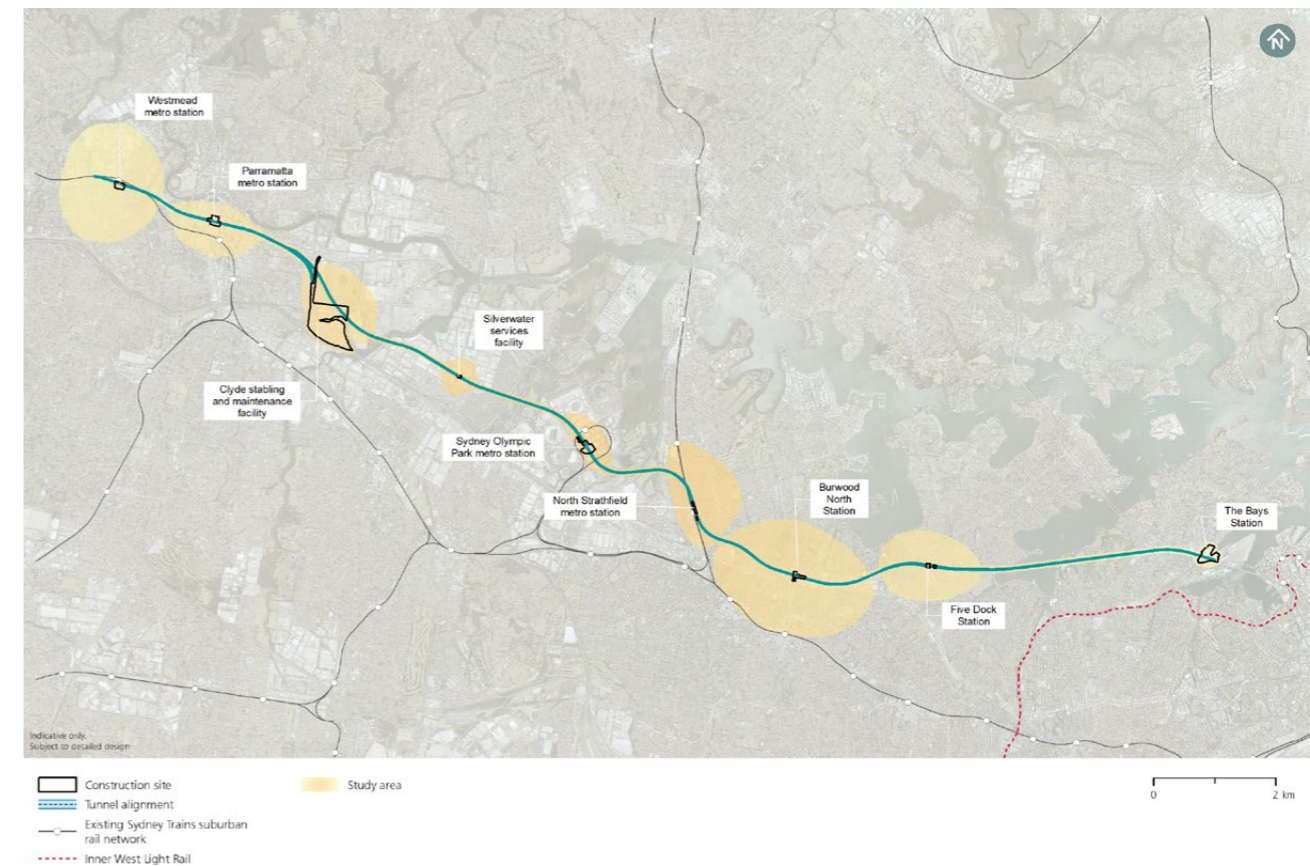
## 22.3 Assessment approach

The biodiversity assessment for Stage 1 involved:

- Definition of the study area for Stage 1 (refer to Section 22.3.1)
- A desktop assessment to describe the existing environment and landscape features, and to identify threatened flora and fauna that may be potentially affected
- Field surveys to identify the biodiversity values within the study area and to determine the likelihood of threatened species and their habitats occurring in the construction footprint or being affected
- Identification and assessment of likely direct and indirect impacts to biodiversity
- Identification of mitigation measures for avoiding, managing or reducing impacts on biodiversity values
- Identification of any residual impacts that cannot be avoided, minimised or mitigated which must be offset
- Consultation with the Environment, Energy and Science Group (part of the Department of Planning, Industry and Environment) to discuss the approach to the biodiversity assessment.

## 22.3.1 Study area

The study area for the biodiversity assessment (refer to Figure 22-1) considered all areas where biodiversity values are potentially affected by Stage 1 and includes each construction site footprint (the area which would be directly impacted by construction activities) with a 50 metre buffer applied to capture areas that may be subject to indirect impacts, the surface area above and adjacent to the tunnel alignment and a 1,500 metre landscape buffer around each of the construction site footprints.



**Figure 22-1: Biodiversity assessment study area**

## 22.3.2 Assessment method

The existing environment and likely biodiversity impacts of Stage 1 were assessed using the Biodiversity Assessment Method. The impact assessment included an assessment of likely impacts to the aquatic environment and impacts on biodiversity related Matters of National Environmental Significance in accordance with the *Environment Protection and Biodiversity Conservation Act 1999*, including nationally listed threatened and migratory species and ecological communities.

The Biodiversity Assessment Method also requires assessment of species credit species and ecosystem credit species. Species credit species are species where the likelihood of occurrence of a species or elements of suitable habitat for that species cannot be confidently predicted by vegetation surrogates and landscape features. Ecosystem credit species are those threatened species where the likelihood of occurrence of a species or elements of the species habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection. Species credit and ecosystem credit species within the Stage 1 construction footprint are discussed in Section 22.4.7.

### 22.3.3 Desktop research

A review of publicly available information was carried out to identify the existing biodiversity and natural environment features, such as landscape features, plant community types, threatened species, populations and communities as well as important habitat for migratory species, within 10 kilometres of the study area ('the locality'). The review focused on database searches, relevant ecological reports and relevant GIS layers.

#### Database searches

The following databases were searched:

- BioNet – the website for the Atlas of NSW Wildlife and Threatened Species Data Collection (NSW Department of Planning, Industry and Environment, 2019b) (searched April 2019)
- Biodiversity Assessment Calculator (NSW Department of Planning, Industry and Environment, 2019a) (viewed December 2019)
- NSW Department of Primary Industries freshwater threatened species distribution maps (NSW Department of Primary Industries, 2019b) (viewed December 2019)
- The federal Department of Agriculture, Water and the Environment's Protected Matters Search Tool (Australian Government Department of the Environment and Energy, 2019b) (searched December 2019)
- BioNet NSW Vegetation Classification database (NSW Department of Planning, Industry and Environment, 2019c) (viewed December 2019)
- Atlas of Living Australia (Atlas of Living Australia website, 2019) (viewed December 2019)
- Atlas of Groundwater Dependent Ecosystems (Bureau of Meteorology, 2017) (viewed December 2019)
- Fisheries Spatial Data Portal (NSW Department of Primary Industries, 2019a) (viewed December 2019)
- Australian Wetlands Database and directory of important wetlands (Australian Government Department of the Environment and Energy, 2019a) (viewed December 2019).

#### Literature review

Reports, regional vegetation maps, geology and soil maps and literature were reviewed to provide an understanding of ecological values occurring or potentially occurring in the study area and wider region. Reviewed information included:

- The Native Vegetation of the Sydney Metropolitan Area – Version 3 (State Government of NSW Office of Environment and Heritage, 2016)
- Southeast NSW Native Vegetation Classification and Mapping – SCIVI (NSW and Office of Environment and Heritage, 2010)
- Penrith 1:100 000 Geological Sheet 9030 (Clarke and Jones, 1991)
- Soil landscapes of the Penrith 1:100,000 Sheet 9030 (Hazelton et al., 1989)
- Sydney 1:100 000 Geological Sheet 9130 (Herbert, 1983)
- Soil landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy, 1989)
- Risk Assessment Guidelines for Groundwater Dependant Ecosystems (Kuginis et al., 2012)
- Australian Soil Classification Soil Type map of NSW (NSW Office of Environment and Heritage, 2012)
- Preliminary and provisional determinations of threatened species and ecological communities listed under the *Biodiversity Conservation Act 2016* from the NSW Threatened Species Scientific Committee web resources (NSW Threatened Species Scientific Committee, 2019)
- Clyde Terminal Conversion Environmental Impact Statement (AECOM Australia Pty Ltd, 2013)
- Biodiversity Development Assessment Report – Viva Energy Clyde Western Area Remediation Project (Biosis, 2018)
- Biodiversity Development Assessment Report – Parramatta Light Rail (WSP, 2017).

### 22.3.4 Habitat suitability for threatened species

The Biodiversity Assessment Calculator was used to derive the list of candidate species for this assessment. The results were also supplemented with database searches, including a review of the Threatened Biodiversity Data Collection, to identify the threatened species that have been previously recorded or are considered likely to occur in the broader study area and Stage 1 construction footprints.

Once the initial list of predicted species was generated, an on-site habitat assessment was undertaken to determine the habitat quality and presence of any habitat constraints or microhabitats for the threatened species predicted to occur in the Stage 1 construction footprints.

### 22.3.5 Field survey

Field surveys to identify terrestrial flora and fauna within the study area were undertaken in January, March and June 2019.

The site inspections involved:

- Establishing the extent of native vegetation within the Stage 1 construction footprints
- Identifying and mapping the type and distribution of plant community types
- Establishing vegetation zones (an area of native vegetation that is the same plant community type and has a similar broad condition state) within each plant community type
- Undertaking plot based floristic vegetation surveys within each vegetation zone to identify the condition and integrity of native vegetation
- Assessment of potential habitat for threatened flora and fauna species previously recorded within the locality
- Targeted threatened flora surveys.

Targeted threatened fauna surveys were not undertaken as the habitat assessment identified that limited habitat was present for most threatened fauna species. However, where suitable habitat for a threatened species was present, the species was assumed to be present.

### 22.3.6 Biodiversity offsets

An offset, in the form of a biodiversity credit, is required for impacts to plant community types and threatened (species credit) species. The biodiversity credit obligation has been calculated using the Biodiversity Assessment Method Calculator. Areas of the study area that do not possess plant community types have not been assessed and offset credits are not required.

For marine vegetation such as mangroves, the offsetting rules of the NSW Department of Primary Industries Policy and Guidelines for Fish Habitat Conservation and Management (NSW Department of Primary Industries, 2013) are applicable as these guidelines are intended to feed into the assessment of State significant infrastructure projects to ensure the sustainable management, and 'no net loss', of key fish habitats in NSW.

## 22.4 Existing environment

### 22.4.1 General landscape features

Table 22-2 summarises the general landscape features of the study area.

**Table 22-2: Landscape features of the study area**

Landscape features	Description
<b>Bioregion and sub-regions</b>	The study area is located in the Sydney Basin bioregion (as defined by the Interim Biogeographic Regionalisation for Australia, Thackway and Creswell 1995), with most of the study area located within the Cumberland subregion. The study area east of William Street, Five Dock to The Bays is located in the Pittwater subregion.
<b>BioNet NSW landscapes</b>	The study area contains the following two landscapes (as mapped by NSW National Parks and Wildlife Service 2002 and described by the NSW Department of Environment and Climate Change (2001)): <ul style="list-style-type: none"> <li>• Ashfield Plains – Undulating hills and valleys on horizontal Triassic shale and siltstone, occasional quartz sandstones especially near the margin of the Port Jackson landscape. General elevation 0 to 45 m and a local relief of less than 20 m</li> <li>• Port Jackson Basin – Deep elongated harbour with steep cliffed margins on horizontal Triassic quartz sandstone. Small pocket beaches and more extensive Quaternary estuary fill of muddy sand at the head of most tributary streams. General elevation 0 to 80 m and local relief between 10 m to 50 m.</li> </ul>
<b>Rivers, streams and estuaries</b>	Stage 1 is located entirely within the Parramatta River/Port Jackson subcatchment of the Sydney Metro catchment (Department of Primary Industries, 2019c). The tunnel alignment would pass at depth beneath Domain Creek, Clay Cliff Creek, Duck River, Haslams Creek, Saleyards Creek, Powells Creek and Iron Cove. As part of Stage 1, structures would be built within and over A'Becketts Creek and Duck Creek.

Landscape features	Description
<b>Wetlands</b>	Mapped areas of wetland listed under State Environmental Planning Policy (Coastal Management) 2018 are present within 200 metres of Stage 1, which includes vegetation along the Duck River and Mason Park wetlands. Several other wetlands are located within 1,500 metres of Stage 1 including Bicentennial Park wetlands, Newington Nature Reserve wetlands, the Brickpit at Sydney Olympic Park, Haslams Creek, and wetlands associated with Duck River including the Clyde Wetland.
<b>Habitat connectivity</b>	The habitat within the construction footprint has a low degree of connectivity to other areas of habitat due to impacts of urbanisation. Habitat within the study area generally occurs as small isolated fragments within the largely urban environment of residential, commercial and industrial land uses. At the north-western corner of the study area, there is a broken corridor of habitat that connects Coopers Creek and Toongabbie Creek to Darling Mills Creek and eventually the Parramatta River. The corridor then follows Duck River to the south. This corridor does not interact with Stage 1. The wide tidal channel of Duck River is a barrier to connectivity for some species. A corridor begins at Haslams Creek which provides a north south corridor from the Parramatta River to the vegetation along the M4 Motorway. Haslams Creek is also linked to Powells Creek forming a wetland corridor which would likely be used by birds and bats. The Stage 1 tunnels would pass beneath Haslams Creek (at about 30 metres below ground level). Planted trees and gardens surrounding Stage 1 also provide some connectivity for mobile species such as the Grey-headed Flying-fox and birds that can use the resources available in urban areas.
<b>Areas of outstanding biodiversity value</b>	Stage 1 does not contain any areas of outstanding biodiversity value as declared by the Minister for Energy and Environment.
<b>Native vegetation extent</b>	Within the 1,500 m landscape buffer, there is approximately 160 ha of native vegetation present, which is about 2.5 per cent of the landscape buffer. Native vegetation cover in the landscape is very low and in the 0 - 10 per cent cover class. The purpose of the percentage vegetation cover calculation is to apply a figure of native vegetation cover in the Biodiversity Assessment Calculator, to predict threatened species likely to occur or use habitat in the study area.

#### 22.4.2 Vegetation characteristics

A general description of the vegetation at each of the construction sites is provided in Table 22-3.

**Table 22-3: Vegetation characteristics**

Construction site	Description
<b>Westmead metro station</b>	There are limited areas of naturally occurring native vegetation present at the construction site and most of the vegetation is exotic. Street trees and residential garden plantings include some native species found in NSW. There is a small area of vegetation within the existing T1 rail corridor north of Alexandra Avenue at the existing Westmead Station that contains regrowth native plant species which are typical of the Grey Box-Forest Red Gum grassy woodland on flats of the Cumberland Plain and Sydney Basin Bioregion (Plant Community Type 849) which would have once occurred at the location. This corresponds with the Cumberland Plain Woodland in the Sydney Basin Bioregion listed under the Biodiversity Conservation Act 2016.
<b>Parramatta metro station</b>	There is no naturally occurring native vegetation present at the construction site. Isolated street trees and garden plantings are present along Horwood Place, which include native species however these are not naturally occurring. The remainder of the vegetation consists of exotic trees and opportunistic weeds occurring in garden beds and alongside buildings and the roadside.

Construction site	Description
<b>Clyde stabling and maintenance facility</b>	The Clyde stabling and maintenance facility construction site is mostly occupied by commercial and industrial development that lacks natural vegetation. Planted native vegetation occurs along Wentworth Street and along Unwin Street, towards the north-west corner of the site. The riparian zone of A'Becketts Creek in the construction footprint is weed dominated, however a few planted native species occur along the creek bank. The vegetation surveyed along Duck Creek is dominated by weeds with some native species present on the banks. Patches of mangrove vegetation at A'Becketts and Duck Creeks correspond to the Plant Community Type: Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (Plant Community Type 920). It is not classified as a threatened ecological community however, it is considered protected marine vegetation under the <i>Fisheries Management Act 1994</i> .
<b>Silverwater services facility</b>	There is no naturally occurring native vegetation present at the construction site. Woody vegetation (including <i>Corymbia citriodora</i> , saplings of <i>Casuarina glauca</i> , and a mature specimen of the introduced shrub <i>Acacia saligna</i> ) and street trees are present at the site. The ground is largely bare, with some patches of groundcover vegetation dominated by introduced grasses and herbaceous weeds.
<b>Sydney Olympic Park metro station</b>	There is no naturally occurring native vegetation present at the construction site. Street trees and garden plantings occur at this site, which include some native species.
<b>North Strathfield metro station</b>	There is no naturally occurring native vegetation present at the construction site. The plantings adjacent to Queen Street are a mix of species including some native species.
<b>Burwood North Station</b>	There is no naturally occurring native vegetation present at the construction site. The vegetation at this site consists of residential plantings with some native species.
<b>Five Dock Station</b>	There is no naturally occurring native vegetation present at the construction site. Some planted trees and shrubs are present, consisting of exotic and native species.
<b>The Bays Station</b>	There is no naturally occurring native vegetation present at the construction site. This site is almost devoid of vegetation except for opportunistic weed species. The land directly adjacent (to the south, west and north) contains a mix of planted vegetation and weeds.

#### 22.4.3 Native vegetation

Most of Stage 1 contains residential, commercial and industrial development, with limited areas of existing naturally occurring native vegetation. There are two plant community types present within the study area as follows:

- Small area of regrowth within the rail corridor in the footprint of the Westmead metro station construction site (0.03 hectares)
- Small areas of mangrove forest along A'Becketts Creek and Duck Creek at Clyde stabling and maintenance facility construction site (0.15 hectares).

Table 22-4 describes the plant community types within the Stage 1 footprint as defined in the BioNet Vegetation Classification database. The location of this vegetation is shown in Figure 22-2.

Table 22-4: Plant Community Types within the Stage 1 footprint

Plant community type ID No.	Plant Community Type name	Broad condition class	Vegetation zone area in Stage 1 construction footprint (ha)	Stage 1 component	Corresponding Threatened Ecological Community
849	Grey Box-Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Poor (vegetation integrity score 11.4)	0.03	Westmead metro station construction site	Cumberland Plain Woodland in the Sydney Basin Bioregion listed as critically endangered under <i>Biodiversity Conservation Act 2016</i>
920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Poor (vegetation integrity score 34.6)	0.15	Clyde stabling and maintenance facility and downstream	None

**22.4.4 Threatened ecological communities**

There is one threatened ecological community (Cumberland Plain Woodland in the Sydney Basin Bioregion) listed under the *Biodiversity Conservation Act 2016* that occurs in the Stage 1 construction footprint, in the existing rail corridor at the Westmead metro station construction site. This corresponds to Plant Community Type 849 and the threatened ecological community is in poor condition represented by regrowth native species amongst plantings and weed growth.

There are also two threatened ecological communities downstream of the development site along Duck River including:

- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

None of the plant community types within the Stage 1 construction footprint correspond to *Environment Protection and Biodiversity Conservation Act 1999* listed threatened ecological communities. The patch of Plant Community Type 849 at Westmead metro station construction site is too small and degraded to be part of the listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

No other threatened ecological communities listed under the *Biodiversity Conservation Act 2016* or *Environment Protection Biodiversity Conservation Act 1999* were recorded within the Stage 1 construction footprint.

A patch of the *Environment Protection and Biodiversity Conservation Act 1999* listed ‘Subtropical and Temperate Coastal Saltmarsh’ community occurs about 1.2 kilometres downstream of the Clyde stabling and maintenance facility construction site. Indirect impacts to this threatened ecological community are discussed in Section 22.6.

**22.4.5 Groundwater dependent ecosystems**

There are no mapped aquatic groundwater dependent ecosystems within the Stage 1 study area. However, the Atlas of Groundwater Dependant Ecosystems (Bureau of Meteorology, 2017) identifies portions of the locality as containing some areas of high potential terrestrial groundwater dependent ecosystems including areas of saltmarsh and mangrove forest.

Based on the results of the field surveys, there is high potential for terrestrial groundwater dependent ecosystems known to be present, including:

- Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion Plant Community Type (849)
- Forest Red Gum - Rough-barked Apple grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion Plant Community Type (835)
- Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley Plant Community Type (1800)
- Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion Plant Community Type (1281).

These plant community types have a moderate to high likelihood to be terrestrial groundwater dependant ecosystems but are not entirely dependent on groundwater. These plant community types may depend on the subsurface presence of groundwater in some locations but not in others.

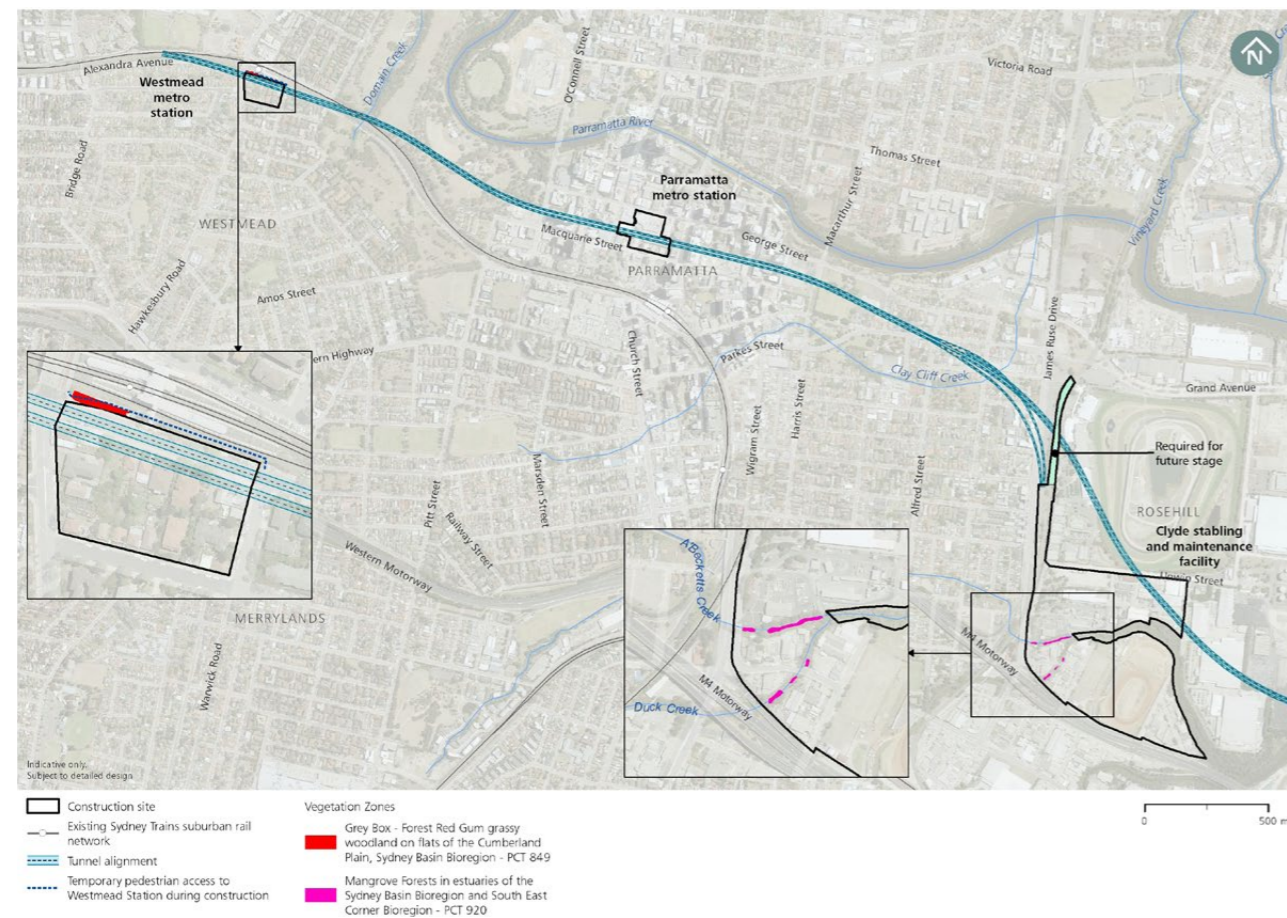


Figure 22-2: Location of plant community types within the Stage 1 footprint

### 22.4.6 Threatened flora species

Based on the assessment of habitat in the Stage 1 construction footprints, and a review of databases and published information, the following species credit plant species were considered 'candidate species' for assessment (see Table 22-5). The full assessment for threatened plant species is provided in Technical Paper 10 (Biodiversity development assessment report).

**Table 22-5: Candidate threatened flora species identified for assessment**

Species name	Common name	Biodiversity Conservation Act 2016 status	Environment Protection and Biodiversity Conservation Act 1999 status
<i>Acacia pubescens</i>	Downy Wattle	Vulnerable	Vulnerable
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Endangered	Endangered
<i>Dillwynia tenuifolia</i>	Dillwynia tenuifolia	Vulnerable	Not listed
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	Vulnerable	Not listed
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Square Raspwort	Vulnerable	Vulnerable
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Endangered Population	Not listed
<i>Pultenaea pedunculata</i>	Matted Bush-pea	Vulnerable	Not listed
<i>Wilsonia backhousei</i>	Narrow-leafed Wilsonia	Vulnerable	Not listed

Note: V = Vulnerable, E = Endangered, EP = Endangered population

No threatened flora species were recorded during field surveys. A small sub-population of *Wilsonia backhousei* (listed as Vulnerable under the *Biodiversity Conservation Act 2016*) was recorded about 1.2 kilometres downstream of the Clyde stabling and maintenance facility construction site.

### 22.4.7 Threatened fauna species

Targeted surveys for threatened fauna were not undertaken during the surveys. The assessment of threatened fauna species was based on suitable habitat present and the findings of previous surveys.

One species credit fauna species, the Southern Myotis (listed as vulnerable under the *Biodiversity Conservation Act 2016*) is considered likely to occur based on the presence of suitable habitat. Foraging habitat is present but no potential roosting or breeding habitat is present. The Southern Myotis is known to occur around the Port Jackson estuary and its tributaries.

Based on the assessment of habitat in the Stage 1 construction footprints, and a review of databases and published information, the ecosystem credit fauna species in Table 22-6 were assumed to be present based on the presence of suitable habitat. The full assessment for threatened fauna species is provided in Technical Paper 10 (Biodiversity development assessment report).

The Stage 1 construction footprint also provides some limited foraging habitat for the *Environment Biodiversity Conservation Act 1999* listed species Grey-headed Flying-fox and Swift Parrot.

A number of threatened and migratory shorebirds and other estuarine birds listed under the *Biodiversity Conservation Act 2016* and/or the *Environment Protection and Biodiversity Conservation Act 1999* have the potential to occur downstream of the Stage 1 construction footprint. This is discussed in the following section.

**Table 22-6: Threatened ecosystem credit fauna species assumed to be present**

Common name	Scientific name	Biodiversity Conservation Act 2016 status	Environment Biodiversity Conservation Act 1999 status	Commentary
<b>Within the Stage 1 construction site footprint (does not include landscape buffer)</b>				
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	Vulnerable	Not listed	Commonly seen near the Parramatta River and may forage in or over the mangroves in and adjacent to the Stage 1 construction footprint.
Little Bent-winged Bat	<i>Miniopterus australis</i>	Vulnerable	Not listed	May forage in and around the mangrove vegetation.
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	Vulnerable	Not listed	May forage in and around the mangrove vegetation.
Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	Vulnerable	Not listed	Foraging habitat is present and potential roosting habitat is present in the mangrove vegetation.
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Vulnerable	Vulnerable	Known to occur in the Sydney urban area. Some foraging habitat may be impacted (street trees, garden plantings and mangroves).
Little Lorikeet	<i>Glossopsitta pusilla</i>	Vulnerable	Not listed	May forage in street trees within the construction footprint on occasion.
Swift Parrot	<i>Lathamus discolor</i>	Endangered	Critically Endangered	Vagrant birds are known to occasionally visit the street trees around the Sydney urban area but the likelihood of birds using the trees within the footprint as a continual source of habitat is low.
<b>Above the tunnel alignment (does not include the Stage 1 construction site surface footprint and does not include the landscape buffer)</b>				
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Endangered	Endangered	Habitat present in saltmarsh downstream of the Clyde stabling and maintenance facility construction site and in Mason Park wetlands located above the tunnels.
Green and Golden Bell Frog	<i>Litoria aurea</i>	Endangered	Vulnerable	Habitat present in wetlands of Haslams Creek that are located above the tunnels.

### 22.4.8 Migratory species

Based on the desktop assessment, the following species are considered moderately likely to occur within the study area in habitats which include mangrove, wetlands and saltmarsh:

- Migratory marine birds – Fork-tailed Swift
- Migratory terrestrial species – White-throated Needletail
- Migratory wetland species – Common Sandpiper, Ruddy Turnstone, Sharp-tailed Sandpiper, Curlew Sandpiper, Pectoral Sandpiper, Red-necked Stint, Great Knot, Double-banded Plover, Greater Sand Plover, Lesser Sand Plover, Latham’s Snipe, Bar-tailed Godwit, Black-tailed Godwit, Eastern Curlew, Whimbrel, Osprey, Ruff, Pacific Golden Plover, Grey-tailed Tattler, Common Greenshank and Marsh Sandpiper.

These birds are also listed as marine species under the *Environment Protection and Biodiversity Conservation Act 1999*. Other listed marine species including the Great Egret, Cattle Egret, Red-capped Plover, White-bellied Sea-Eagle, Black-winged Stilt, Swift Parrot, and Red-necked Avocet may occur in the mangrove, wetlands and saltmarsh habitats on occasion.

While some migratory bird species are likely to use the study area, the Stage 1 construction footprint would not be classed as an ‘important habitat’ according to the guidance provided in the *Environment Protection and Biodiversity Conservation Act 1999* Policy Statement 3.21 – Industry guidelines for avoiding, assessing and mitigating impacts on *Environment Protection and Biodiversity Conservation Act 1999* listed migratory shorebird species (Department of the Environment, 2015).

### 22.4.9 Aquatic ecology

#### Key watercourses

The Stage 1 construction footprint is located entirely within the Sydney Metro catchment (Parramatta River/ Port Jackson subcatchment). The tunnel alignment would pass at depth under a number of waterways. Duck Creek and A’Becketts Creek would be traversed with culverts over the creeks as part of works at the Clyde stabling and maintenance facility construction site. A description of each of the key watercourses in the study area (which includes the 1,500 metre landscape buffer) is provided in Table 22-7

**Table 22-7: Key watercourses within the study area (including the 1,500 metre landscape buffer)**

Watercourse	Description	Mapped as key fish habitat? <sup>1</sup>	Waterway class <sup>2</sup>	Habitat for threatened fish species? <sup>3</sup>	SEPP (Coastal Management) wetland? <sup>4</sup>
<b>Coopers Creek</b>	<ul style="list-style-type: none"> <li>Heavily urbanised, first order stream</li> <li>Approximately 1.5 km north-west of the Westmead metro station construction site</li> <li>Unlikely to be impacted by Stage 1.</li> </ul>	No	Class 2 (moderate key fish habitat)	No	No
<b>Toongabbie Creek</b>	<ul style="list-style-type: none"> <li>Third order stream</li> <li>Major tributary of Parramatta River</li> <li>Approximately 1.2 km north-west of Westmead metro station construction site</li> <li>Unlikely to be impacted by Stage 1.</li> </ul>	Yes	Class 1 (major key fish habitat)	No	No
<b>Finlaysons Creek</b>	<ul style="list-style-type: none"> <li>A freshwater, first order creek</li> <li>Located approximately 1 km west of the Westmead metro station construction site</li> <li>Majority of the creek is a modified concrete lined channel with no instream aquatic habitat</li> <li>Unlikely to be impacted by Stage 1.</li> </ul>	No	Class 4 (unlikely key fish habitat)	No	No
<b>Darling Mills Creek</b>	<ul style="list-style-type: none"> <li>A freshwater, fourth order creek</li> <li>Located approximately 1.5 metres north-east of Westmead metro station construction site.</li> <li>Unlikely to be impacted by Stage 1.</li> </ul>	Yes	Class 2 (moderate key fish habitat)	No	No
<b>Domain Creek</b>	<ul style="list-style-type: none"> <li>A freshwater, first order creek</li> <li>The tunnels pass about 25 m beneath the creek and are located about 300 m east of the Westmead metro station construction site</li> <li>Within the vicinity of the tunnels, the creek is a modified waterway with sections of naturalised channel, and sections that are concrete-lined</li> <li>The instream habitat includes aquatic macrophytes and limited overhanging riparian vegetation.</li> </ul>	No	Class 1 (major key fish habitat)	No	No

Watercourse	Description	Mapped as key fish habitat? <sup>1</sup>	Waterway class <sup>2</sup>	Habitat for threatened fish species? <sup>3</sup>	SEPP (Coastal Management) wetland? <sup>4</sup>
<b>Parramatta River</b>	<ul style="list-style-type: none"> <li>Main tributary of Sydney Harbour (a large fourth order waterway)</li> <li>The Parramatta metro station construction site is located about 300 m south of the river</li> <li>The tunnels would not pass beneath Parramatta River</li> <li>The river is freshwater upstream of Charles Street weir, downstream it is saline</li> </ul>	Yes	Class 1 (major key fish habitat)	No	Yes. Large sections of the Parramatta River estuary are mapped.
<b>Clay Cliff Creek</b>	<ul style="list-style-type: none"> <li>Highly modified second order creek</li> <li>The tunnels pass about 35 m beneath the creek and about 820 m upstream of the confluence with the Parramatta River</li> <li>The creek is a concrete lined channel, with underground sections, and contains no instream habitat.</li> </ul>	No	Class 4 (unlikely key fish habitat)	No	Yes. Located downstream along the banks of the Parramatta River at the confluence with Clay Cliff Creek.
<b>Vineyard Creek</b>	<ul style="list-style-type: none"> <li>Freshwater, second order watercourse</li> <li>Located around 1.4 km north of the Clyde stabling and maintenance facility</li> <li>Unlikely to be impacted by Stage 1.</li> </ul>	No	Class 2 (moderate key fish habitat)	No	No
<b>Subiaco Creek</b>	<ul style="list-style-type: none"> <li>Freshwater, second order watercourse</li> <li>Located around 1.4 km north of the Clyde stabling and maintenance facility</li> <li>Unlikely to be impacted by Stage 1.</li> </ul>	Yes	Class 2 (moderate key fish habitat)	No	No
<b>Duck River</b>	<ul style="list-style-type: none"> <li>Within the study area, the river is a third order estuarine stream</li> <li>The tunnels pass about 30 m beneath the Duck River at about 1.7 km upstream of the confluence with the Parramatta River, and east of the Clyde stabling and maintenance facility construction site</li> <li>The banks of the channel are densely vegetated by mangroves.</li> </ul>	Yes	Class 1 (major key fish habitat) as it is a permanently flowing river.	No	Yes. The banks of the channel are mapped.

Watercourse	Description	Mapped as key fish habitat? <sup>1</sup>	Waterway class <sup>2</sup>	Habitat for threatened fish species? <sup>3</sup>	SEPP (Coastal Management) wetland? <sup>4</sup>
<b>Duck Creek</b>	<ul style="list-style-type: none"> <li>Highly modified second order stream</li> <li>The creek is located within and adjacent to the Clyde stabling and maintenance facility construction site</li> <li>Within the study area, the creek is estuarine but becomes less saline and eventually freshwater in its upper reaches</li> <li>The creek contains mangrove vegetation, but the banks are dominated by exotic species with occasional planted native trees.</li> </ul>	Yes	Class 1 (major key fish habitat)	No	Yes Area mapped along Duck Creek in the footprint of the Clyde stabling and maintenance facility construction site.
<b>A'Becketts Creek</b>	<ul style="list-style-type: none"> <li>Highly modified first order stream</li> <li>The creek is located upstream and within the Clyde stabling and maintenance facility construction site</li> <li>Within the study area, the creek is estuarine but becomes less saline and eventually freshwater in its upper reaches</li> <li>The creek contains mangrove vegetation, but the banks are dominated by exotic species with occasional planted native trees.</li> </ul>	No	Class 1 (major key fish habitat)	No	Yes Area mapped along A'Becketts Creek in the footprint of the Clyde stabling and maintenance facility construction site
<b>Haslams Creek</b>	<ul style="list-style-type: none"> <li>Highly modified second order stream</li> <li>Within the study area, the creek is estuarine</li> <li>The tunnels pass about 30 m beneath the creek at about 2 km upstream of the confluence with Homebush Bay</li> </ul>	Yes	Class 1 (major key fish habitat)	No	Yes Present along the creek
<b>Saleyards Creek</b>	<ul style="list-style-type: none"> <li>Highly modified first order stream</li> <li>The tunnels pass about 25 m beneath the creek at about 130 m upstream of the confluence with Powells Creek</li> <li>The creek is a concrete lined channel and contains minimal instream habitat.</li> </ul>	Yes However following inspection, it is not considered key fish habitat in accordance with relevant guidelines	Class 3 (minimal key fish habitat)	No	Yes Mason Park Wetlands are in close proximity to the creek.

Watercourse	Description	Mapped as key fish habitat? <sup>1</sup>	Waterway class <sup>2</sup>	Habitat for threatened fish species? <sup>3</sup>	SEPP (Coastal Management) wetland? <sup>4</sup>
<b>Powells Creek</b>	<ul style="list-style-type: none"> <li>A semi-naturalised concrete lined first order drainage channel</li> <li>Within the study area, the creek is estuarine</li> <li>The tunnels pass about 25 m beneath the creek at about 1.4 km upstream of the confluence with Homebush Bay,</li> <li>located about 320 m west of North Strathfield metro station construction site</li> <li>Dense mangroves occur in areas along the banks</li> </ul>	Yes	Class 1 (major key fish habitat)	No	Yes Mason Park wetland and Homebush Bay wetlands are in close proximity to the creek.
<b>St Lukes Park Canal</b>	<ul style="list-style-type: none"> <li>Highly modified first order channel</li> <li>The channel is predominantly concrete lined and contains no instream aquatic habitat</li> <li>Within the study area, the canal is estuarine but is also influenced by stormwater runoff from its predominantly urban catchment</li> <li>The tunnels pass about 20 metres underground immediately to the south of the canal, at about 90 m east of the Burwood North station construction site</li> </ul>	No	Class 4 (unlikely key fish habitat)	No	No

Note 1: Mapped as key fish habitat (NSW Department of Primary Industries, 2013)

Note 2: Waterway classification (Fairfull and Witheridge, 2003)

Note 3: Habitat for threatened aquatic species listed under the Fisheries Management Act 1994 and Environment Protection and Biodiversity Conservation Act 1999

Note 4: Proximity to coastal wetlands listed in the State Environment Planning Policy (Coastal Management) 2018

### Other watercourses

There are a number of other watercourses located near Stage 1, including:

- Saltwater Creek, a concrete lined canal located approximately 1.7 kilometres north of the Burwood North Station construction site that discharges to Exile Bay at Concord
- Barnwell Park Canal, which discharges in Hen and Chicken Bay. The tunnels pass about 30 metres beneath the upstream extents of canal
- Iron Cove Creek (also known as Dobroyd Canal), which discharges into Iron Cove. The tunnels pass around 130 metres to the north of the creek at about 35 metres below ground, and Five Dock Station construction site is located about 600 metres to the north
- Hawthorne Canal, which discharges into Iron Cove. The tunnels pass around 180 metres to the north of the creek at around 40 metres below ground
- Whites Creek, a concrete lined canal that discharges to Rozelle Bay at Annandale approximately 600 metres south-west of The Bays Station construction site
- Johnstons Creek, a concrete lined canal that discharges to Rozelle Bay at Glebe approximately 1.3 kilometres south of The Bays Station construction site.

These waterways are concrete lined and contain no instream aquatic habitat. While some are mapped as key fish habitat, these waterways are not considered to be key fish habitat in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management ((NSW Department of Primary Industries, 2013) and are classified as Class 4 (unlikely key fish habitat).



No threatened species listed under the *Fisheries Management Act 1994* have potential habitat within these watercourses. Coastal wetlands as defined by the Coastal Management SEPP are greater than 500 metres downstream.

### Sydney Harbour

The tunnels are located south of Sydney Harbour and pass about 35 to 45 metres beneath Iron Cove which is mapped as key fish habitat. The Bays Station construction site is located on the foreshore of White Bay.

The entire Sydney Harbour and all major tributaries linked to the harbour are mapped as key fish habitat (Type 1 key fish habitat) and Class 1 (major key fish habitat). However, White Bay has been heavily modified for port purposes and is unlikely to contain significant aquatic habitat and is therefore not considered key fish habitat in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (NSW Department of Primary Industries, 2013).

No threatened species listed under the *Fisheries Management Act 1994* have potential habitat within White Bay. Coastal wetlands as defined by the Coastal Management SEPP are present greater than 500 metres away.

### Sensitive receiving environments

Parramatta River/Sydney Harbour, Duck River, Duck Creek, Haslams Creek, Powells Creek, Iron Cove Creek/Dobroyd Canal and Hawthorne Canal have been identified as high sensitive receiving environments predominantly due to the key fish habitat classifications and/or proximity to SEPP Coastal Wetlands. Table 22-8 summarises the sensitive receiving environments that may be impacted by Stage 1:

**Table 22-8: Sensitive receiving environments**

Stage 1 component	Watercourse / waterbody name	Conditions	Sensitivity
<ul style="list-style-type: none"> <li>Westmead metro station construction site</li> <li>Parramatta metro station construction site</li> <li>The Bays Station construction site</li> <li>Tunnels</li> </ul>	Parramatta River / Sydney Harbour	Moderately disturbed	High
<ul style="list-style-type: none"> <li>Westmead metro station construction site</li> <li>Tunnels</li> </ul>	Domain Creek	Highly disturbed	Low
<ul style="list-style-type: none"> <li>Westmead metro station construction site</li> </ul>	Toongabbie Creek	Moderately disturbed	Moderate
<ul style="list-style-type: none"> <li>Tunnels</li> </ul>	Clay Cliff Creek	Highly disturbed	Moderate
<ul style="list-style-type: none"> <li>Clyde stabling and maintenance facility construction site</li> <li>Tunnels</li> </ul>	Duck River	Moderately disturbed	High
	Duck Creek	Moderately disturbed	High
	A'Becketts Creek	Highly disturbed	Moderate
<ul style="list-style-type: none"> <li>Sydney Olympic Park metro station construction site</li> <li>Tunnels</li> </ul>	Haslams Creek	Moderately disturbed	High
<ul style="list-style-type: none"> <li>North Strathfield metro station construction site</li> <li>Tunnels</li> </ul>	Saleyards Creek	Highly disturbed	Moderate
	Powells Creek	Moderately disturbed	High
	Mason Park Wetland	Moderately disturbed	High
<ul style="list-style-type: none"> <li>Burwood North Station construction site</li> <li>Tunnels</li> </ul>	St Lukes Park Canal	Highly disturbed	Moderate
	Barnwell Park Canal	Highly disturbed	Moderate
<ul style="list-style-type: none"> <li>Five Dock Station construction site</li> </ul>	Iron Cove Creek / Dobroyd Canal	Moderately disturbed	High
<ul style="list-style-type: none"> <li>Tunnels</li> </ul>	Iron Cove	Moderately disturbed	High
<ul style="list-style-type: none"> <li>The Bays Station construction site</li> </ul>	White Bay	Highly disturbed	Low

### Marine vegetation

Mangroves are present within and adjacent to the Clyde stabling and maintenance facility construction site along Duck River and A'Becketts Creek.

Expansive seagrass meadows are not known within the study area, however small isolated and fragmented patches of seagrass (*Zostera capricorni* and *Halophila ovalis*) have been identified within Iron Cove.

### Aquatic fauna

Previous fish surveys within the Parramatta River at Charles Street Weir, Homebush Bay and Kendall Bay have not recorded threatened aquatic fauna species.

The desktop searches identified sixteen threatened aquatic fauna species that have the potential to occur within the locality. Of these, three are regarded as having a moderate to high likelihood of occurrence (Table 22-9).

**Table 22-9: Aquatic species with moderate to high likelihood to occur within the locality**

Common name	Scientific name	Biodiversity Conservation Act 2016 status	Environment Biodiversity Conservation Act 1999 status	Commentary
<b>Black Rockcod</b>	<i>Epinephelus daemeli</i>	Vulnerable	Vulnerable	Inhabit caves, gutters, beneath bommies in near shore environments to depths of 50 metres. Potential occurrence around near shore environments, particularly in the vicinity of The Bays station construction sites.
<b>White Shark</b>	<i>Carcharodon carcharias</i>	Vulnerable	Vulnerable	If in the unlikely event White Sharks were within the waterways at Pyrmont and Iron Cove, it is not expected that any sharks would remain long enough to be vulnerable to any potential impacts.
<b>Grey Nurse Shark</b>	<i>Carcharias taurus</i>	Critically Endangered	Critically Endangered	Parramatta River and Duck River are considered marginal habitat for the Grey Nurse Shark.

Stage 1 is not expected to directly impact suitable habitat for the Black Rockcod, and the nearshore environments, particularly within the vicinity of The Bays station construction site as this is considered unsuitable for this species. The Black Rockcod has a low likelihood of occurrence in any habitats that may be impacted by Stage 1.

The threatened shark species (White Shark, Grey Nurse Shark) are large and conspicuous. While desktop assessment indicated that the habitat in the lower Parramatta River Estuary is suitable or potentially suitable for these species to occupy, they have not been recorded in the study area. If in the unlikely event White Sharks were within the waterways at Pyrmont and Iron Cove, it is unlikely that any sharks would remain long enough to be vulnerable to any potential impacts. Parramatta River and Duck River are considered marginal habitat for the White Shark. Given the distance from known aggregation areas, the proposed works within the study area would not directly affect Grey Nurse Shark habitat. Parramatta River and Duck River are considered marginal habitat for the Grey Nurse Shark.

## 22.5 Avoidance and minimisation of impacts

The design development of Stage 1 focussed on avoiding or minimising potential biodiversity impacts. Stage 1 is largely within a highly urbanised area that does not possess large expanses of intact native vegetation with high biodiversity value. As the majority of Stage 1 would be underground or in pre-existing developed areas, direct impacts to terrestrial biodiversity has been largely avoided and/or minimised.

## 22.6 Potential impacts

The Stage 1 construction footprint is predominantly set in areas with existing development. The limited amount of native vegetation to be disturbed by Stage 1 is of poor to moderate quality and threatened species habitats are very limited. Biodiversity impacts that would occur are described below.

### 22.6.1 Loss of native vegetation

No areas of land that the Minister for Energy and Environment has declared as an area of outstanding biodiversity value in accordance with Section 3.1 of the *Biodiversity Conservation Act 2016* would be impacted.

No threatened flora species would be directly impacted as a result of Stage 1.

Stage 1 would involve the direct removal of 0.18 hectares of native vegetation that corresponds with the following Plant Community Types:

- Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Plant Community Type 849) – 0.03 hectares located within the Westmead metro station construction site
- Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (Plant Community Type 920) – 0.15 hectares located within the Clyde stabling and maintenance facility construction site.

### 22.6.2 Loss of fauna habitat

The following seven threatened fauna species may use other vegetation, including both native and exotic planted trees and shrubs, and are found within the Stage 1 construction footprint:

- Large Bent-winged Bat (*Miniopterus orianea oceanensis*)
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Little Bent-winged Bat (*Miniopterus australis*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Southern Myotis (*Myotis macropus*)
- Swift Parrot (*Lathamus discolor*).

The Grey-headed Flying-fox, Swift Parrot and Little Lorikeet are considered likely to forage on the flowers and/or fruit of both planted and exotic trees within the Stage 1 construction footprint. The Large Bent-winged Bat, Eastern Coastal Free-tailed Bat and Little Bent-winged Bat may forage in the air spaces around areas of non-native vegetation, feeding on the insects attracted to the vegetation. Potential roosting habitat in the form of small tree hollows may also be present in some of the larger trees for the Eastern Coastal Free-tailed Bat and Southern Myotis. In the case of the Southern Myotis, only tree hollows within 200 metres of water bodies are likely to be used.

Due to the marginal, unnatural structure of the vegetation present, it is unlikely that vegetation within the Stage 1 footprint would be used as breeding habitat by any threatened species. Therefore, it is unlikely that Stage 1 would detrimentally affect these species if they were present.

### 22.6.3 Assessments of significance

No threatened species are likely to be significantly impacted by Stage 1. The findings of *Environment Protection and Biodiversity Conservation Act 1999* assessments of significance are summarised in Table 22-10 and further details are provided in Appendix D of Technical Paper 10 – Biodiversity development assessment report.

**Table 22-10: Assessment of significance – Environment Protection and Biodiversity Conservation Act 1999**

Threatened species	Impacts on important population?	Likely significant impact?
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	No	No
Swift Parrot ( <i>Lathamus discolor</i> )	No	No

### 22.6.4 Impacts to habitat connectivity

The Stage 1 construction footprint is located within a highly disturbed landscape where the majority of habitats have been cleared. The habitats that do remain are fragmented and highly isolated.

The vegetated riparian zones of Duck Creek and A'Becketts Creek potentially provide movement corridors that would be temporarily impacted by the Stage 1 construction footprint, but these corridors are only likely used by flying species or local common mammals, reptiles and amphibians. There is a low chance that the threatened Green and Golden Bell Frog would utilise the riparian zones of Duck Creek and A'Becketts Creek as these two waterways are tidal (not still water), have permanent water, are polluted, lack emergent aquatic plant species (i.e. no Typha, Phragmites, etc.), and contain predatory fish including Gambusia and Carp. Additionally, the planted urban vegetation within the construction footprint also plays a small role in facilitating the movement of threatened species across the landscape.

Many mobile species, particularly birds and bats, and to a more limited extent amphibians, mammals and reptiles may potentially use these vegetated riparian corridors. Flying animals such as birds and bats use the airspace to move between natural habitats and the planted vegetation potentially within the construction sites and are could be used as a foraging or perching resource as part of daily movements.

### 22.6.5 Impacts on aquatic habitats and groundwater dependent ecosystems

Potential Stage 1 activities that could impact aquatic habitats and water quality include:

- Direct removal of 0.15 hectares of mangrove habitat
- Realignment of short sections of A'Becketts Creek and Duck Creek
- New crossings of A'Becketts Creek and Duck Creek
- Discharge of treated groundwater from water treatment plants (collected from tunnelling activities)
- General construction activities.

The above construction activities would have the following potential impacts:

- Disruption to fish passage
- Direct loss of mangrove habitat
- Reduced water quality due to increased turbidity associated with instream earthworks.

Indirect impacts such as those from groundwater drawdown are not expected to impact the habitat of threatened species based on groundwater modelling as detailed in Chapter 18 (Groundwater and ground movement – Stage 1). Impacts to threatened ecological communities are expected to be minimal as the threatened ecological communities are likely to be opportunistic facultative groundwater dependent ecosystems that depend on the subsurface presence of groundwater in some locations but not in others, particularly where an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function.

Impacts of groundwater drawdown relating to soils, water quality and hydrology are discussed in Chapter 19 (Soils and surface water quality – Stage 1) and Chapter 21 (Hydrology and flooding – Stage 1) respectively.

### 22.6.6 Marine fauna species

As discussed in Section 22.4.9 and Table 22-9, three aquatic fauna species have a moderate to high likelihood to occur within the locality.

Suitable habitat for the Black Rockcod, particularly within the vicinity of The Bays Station construction sites would not be directly impacted however it may be impacted by changes to water quality during construction.

In the unlikely event White Sharks were within the waterways at Pyrmont and Iron Cove, it is unlikely that any sharks would remain long enough to be vulnerable to any potential impacts. Similarly, no aggregation sites for Grey Nurse Sharks are located within Sydney Harbour, therefore Stage 1 would not directly affect suitable habitat.

### 22.6.7 Fauna injury or mortality

There is a chance of fauna mortality during construction through vehicle collision (i.e. roadkill). Mammals, reptiles, amphibians and birds are all at risk of vehicle strike, particularly those common species (e.g. birds) that are tolerant of disturbance and would remain within the construction footprint. The risk of increased vehicle strike due to Stage 1 is low and would generally be limited to movement of vehicles to and from sites. Vehicle strike associated with Stage 1 is unlikely to affect any threatened species of animals.

### 22.6.8 Assessment against the Biodiversity Assessment Method

An offset is required for the impacts to plant community types and threatened (species credit) species. The biodiversity credit obligation has been calculated using the Biodiversity Assessment Method Calculator. Only areas of the Stage 1 construction footprint that contain plant community types were assessed and the offset credits that are required were determined.

A summary of the biodiversity credit requirements for Stage 1 is:

- Ecosystem credits required:
  - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (Plant Community Type 920) – three credits
- Species credits required:
  - Southern Myotis (*Myotis macropus*) – three credits.

An offset is not required for impacts on native vegetation where the vegetation integrity score is below 15. The vegetation integrity score for the Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion Plant Community Type (849) is 11.4 and therefore an offset is not required for impacts to this Plant Community Type.

For marine vegetation such as mangroves, the offsetting rules of the NSW Department of Primary Industries Policy and Guidelines for Fish Habitat Conservation and Management (NSW Department of Primary Industries, 2013) are applicable as the guidelines are intended to feed into the assessment of State Significant Infrastructure projects to ensure the sustainable management, and ‘no net loss’, of key fish habitats in NSW.

Offsets for impacts to marine vegetation would need to be made at a 10:1 ratio due to impacts on a mapped coastal wetland area and the mangrove community (refer to Table 22-11).

An alternative to the provision of offsets is the making of a payment to the Biodiversity Conservation Trust Fund.

**Table 22-11: Impact to marine vegetation and likely offset ratio**

Plant community type	Area in Stage 1 footprint	Offset ration	Likely offset required
Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	0.15 ha	10:1	1.5 ha

### 22.6.9 Key threatening process

A key threatening process is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Stage 1 may directly or indirectly contribute to the following key threatening processes as outlined in Table 22-12.

**Table 22-12: Summary of key threatening processes that Stage 1 may directly or indirectly contribute to**

Key threatening process	Act designated under <sup>1</sup>	Likelihood of Stage 1 directly or indirectly contributing to the key threatening process
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	BC Act	High – some sections of Duck Creek and A’Becketts Creek would be modified.
Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams	FM Act	High – permanent instream structures would be built in A’Becketts Creek and Duck Creek but they would be designed where practicable to allow for fish passage.
Clearing of native vegetation	BC Act	High – clearing of native vegetation will occur. However, the magnitude of clearing is small (0.18 hectares).
Land clearance	EPBC Act	High – clearing of native vegetation will occur. However, the magnitude of clearing is small (0.18 hectares).
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	BC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of amphibian chytrid fungus.
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	EPBC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of amphibian chytrid fungus.
Infection of native plants by <i>Phytophthora cinnamomi</i>	BC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of <i>Phytophthora cinnamomi</i> .
Dieback caused by the root-rot fungus ( <i>Phytophthora cinnamomi</i> )	EPBC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of <i>Phytophthora cinnamomi</i> .
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	BC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scrambler	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Invasion of native plant communities by African Olive <i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif.	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Invasion of native plant communities by <i>Chrysanthemoides monilifera</i>	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Invasion of native plant communities by exotic perennial grasses	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Invasion, establishment and spread of Lantana ( <i>Lantana camara</i> L. sens. Lat)	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Degradation of native riparian vegetation along New South Wales water courses	FM Act	High – sections of Duck Creek and A’Becketts Creek and associated native riparian vegetation would be modified and cleared.

Note 1: BC Act: NSW Biodiversity Conservation Act 2016, FM Act: Fisheries Management Act 1994, EPBC Act: Environmental Protection and Biodiversity Conservation Act 1999

### 22.6.10 Cumulative impacts

Potential cumulative impacts were considered for assessment based on the likely interactions of Stage 1 with other projects and plans that met the adopted screening criteria. The approach to assessment and the other projects considered are described further in Appendix G (Cumulative impacts assessment methodology – Stage 1).

The cumulative impacts of historic vegetation clearing for agriculture, urban development, and development and maintenance of infrastructure would likely include continued loss of biodiversity on the Cumberland Plain. The Cumberland Plain is an over cleared landscape and due to the expansion of western Sydney and creation of housing and associated infrastructure, further impacts to biodiversity are likely to result in this region.

Available information on recent projects with biodiversity impacts is as follows:

- Parramatta Light Rail (Stage 1): Direct impact to 0.62 hectares of native vegetation. Removal of approximately 300 individual trees that are mostly horticultural plantings
- Clyde Terminal Conversion Project: No impacts to native vegetation. Impact to tank farm habitat for the Green and Golden Bell Frog
- WestConnex M4 Widening: Direct impact on up to 8.86 hectares of planted and remnant vegetation.

When the impacts of Stage 1 are considered together with the impacts of the above projects the contribution of Stage 1 to cumulative biodiversity impacts in the Cumberland Plain region is low. While there would be some limited biodiversity impacts from Stage 1, no significant increase to cumulative impacts would occur.

All potential biodiversity impacts during construction would be managed to acceptable levels through the implementation of the mitigation measures in Section 22.7.2.

## 22.7 Mitigation and management

### 22.7.1 Management approach

Stage 1 biodiversity impacts would be managed in accordance with the Construction Environmental Management Framework. Of relevance, the Construction Environmental Management Framework (Appendix D) includes biodiversity management objectives to maximise workers' awareness of biodiversity values and avoid or minimise potential impacts to biodiversity.

The Construction Environmental Management Framework also requires the preparation and implementation of a Flora and Fauna Management Plan, including as a minimum:

- Procedures for the demarcation and protection of retained vegetation, including all vegetation outside and adjacent to the construction footprint
- Measures to reduce disturbance to sensitive fauna
- Procedures for the clearing of vegetation and the relocation of flora and fauna
- Procedures for dealing with unexpected Endangered Ecological Communities or threatened species identified during construction
- Weed management measures in accordance with the *Biosecurity Act 2015*
- Pathogen management measures to prevent introduction and spread of amphibian chytrid fungus *Phytophthora cinnamomi* and exotic rust fungi
- Inspection and monitoring requirements.

### 22.7.2 Mitigation measures

The mitigation measures in Table 22-13 would be implemented to further reduce the potential biodiversity impacts of Stage 1.

**Table 22-13: Mitigation measures – Biodiversity Stage 1**

Reference	Impact/issue	Mitigation measure	Applicable location(s) <sup>1</sup>
B1	Impacts to fish passage	During construction, sufficient flow and fish passage would be maintained similar to current conditions during in-stream works where feasible and reasonable.	CSMF
B2	Impacts of proposed creek crossings	The A'Becketts Creek and Duck Creek crossings would be designed to: <ul style="list-style-type: none"> <li>• Provide sufficient fish passage in accordance with Policy and guidelines for fish habitat conservation and management Update 2013 (DPI (Fisheries NSW) 2013)</li> <li>• Incorporate suitable scour protection</li> <li>• Avoid worsening existing flow velocities downstream from the crossing locations</li> <li>• Incorporate a vegetated riparian zone within the realigned open channel sections where feasible and reasonable.</li> </ul>	CSMF
B3	Impacts to groundwater dependent ecosystems	Additional investigations and assessment would be completed to confirm the potential for impacts to groundwater dependant ecosystems due to groundwater drawdown, and to identify any required mitigation through design.	WMS, CSMF, NSMS, BNS, FDS.

*Note 1: WMS: Westmead metro station; PMS: Parramatta metro station; CSMF: Clyde stabling and maintenance facility; SSF: Silverwater services facility; SOPMS: Sydney Olympic Park metro station; NSMS: North Strathfield metro station; BNS: Burwood North Station; FDS: Five Dock Station; TBS: The Bays Station; Metro rail tunnels: Metro rail tunnels not related to other sites (e.g. tunnel boring machine works); PSR: Power supply routes.*

### 22.7.3 Interactions between mitigation measures

Mitigation measures in other chapters that are relevant to the management of biodiversity include:

- Chapter 18 (Groundwater and ground movement – Stage 1), specifically measures which address modelling changes to groundwater levels and measures requiring further investigations to confirm the existing groundwater baseflow contribution to the streamflow.
- Chapter 19 (Soil and surface water – Stage 1), specifically measures which address water quality impacts.

There are no mitigation measures identified in the assessment of other environmental aspects that are likely to affect the assessment of biodiversity.

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