Chapter 19

# Biodiversity

January 2020

# 19 Biodiversity

This chapter provides an assessment of the potential impacts of the project on terrestrial, aquatic and marine biodiversity and identifies measures to address these impacts.

A detailed assessment of terrestrial and aquatic biodiversity has been carried out for the project and is included in Appendix S (Technical working paper: Biodiversity development assessment report). A detailed assessment of marine biodiversity has been carried out for the project and is included in Appendix T (Technical working paper: Marine ecology).

The Secretary's environmental assessment requirements as they relate to biodiversity, and where in the environmental impact statement these have been addressed, are detailed in Table 19-1.

The proposed environmental management measures relevant to biodiversity are included in Section 19.5.

**Table 19-1 Secretary's environmental assessment requirements – biodiversity**

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Biodiversity** | |
| 1. Biodiversity impacts related to the proposal are to be assessed in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). | Biodiversity impacts related to project are outlined in **Section 19.4** and documented in **Appendix S** (Technical working paper: Biodiversity Development Assessment Report). |
| 2. The BDAR must include information in the form detailed in the Biodiversity Conservation Act 2016 (s. 6.12), Biodiversity Conservation Regulation 2017 (s 6.8) and Biodiversity Assessment Method (BAM) including details of the measures proposed to address the offset obligation as follows:<br>a. the total number and classes of biodiversity credits required to be retired for the developments/project;<br>b. the number of classes of like-for-like biodiversity credits proposed to be retired;<br>c. the number and classes of biodiversity credits proposed to be retired in accordance with the variation rules;<br>d. any proposal to fund a biodiversity conservation action; and<br>e. any proposal to make a payment to the Biodiversity Conservation Fund. | The Biodiversity Development Assessment Report is provided in **Appendix S** (Technical working paper: Biodiversity Development Assessment Report). |
| 3. If requesting the application of the variation rules, the BDAR must contain details of what reasonable steps have been taken to attempt to obtain the required like-for-like biodiversity credits. | Not applicable. |
| 4. The BDAR must be prepared by a person accredited in accordance with the Accreditation scheme for the Application of the | Accreditation in accordance with the Accreditation scheme for the Application of the Biodiversity Assessment Method Order |

| Secretary's requirement | Where addressed in EIS |
|---|---|
| Biodiversity Assessment Method Order 2017 under *s. 6.10 of the Biodiversity Conservation Act 2016*. | 2017 is provided in **Appendix S** (Technical working paper: Biodiversity Development Assessment Report). |
| 5. In accordance with section 9.1 and 9.2 of the BAM the BDAR must assess all direct and indirect impacts of the proposal on native vegetation, threatened ecological communities and threatened species habitat. | **Section 19.4** provides an assessment of biodiversity impacts related to the project with further details provided in **Appendix S** (Technical working paper: Biodiversity Development Assessment Report). |
| 6. Impacts on biodiversity values that cannot be assessed using the BAM must also be otherwise assessed. The values include:<br>a. marine mammals;<br>b. wandering seabirds; and<br>c. matters of national significance listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. | **Section 19.4** provides an assessment of biodiversity impacts related to the project with further details provided in **Appendix S** (Technical working paper: Biodiversity Development Assessment Report). |
| 7. Species declared as threatened under the *Biodiversity Conservation Act 2016* and recorded recently (since 1990) within approximately 1.5 kilometres of the project's development corridor should be considered as likely to be affected by the proposal. | **Section 19.4** provides an assessment of the impacts to threatened species. Consideration of species recently recorded within 1.5 kilometres of the construction footprint are documented in **Appendix S** (Technical working paper: Biodiversity Development Assessment Report). |

## 19.1 Legislative and policy framework

Chapter 2 (Assessment process) describes the environmental impact assessment and approval process for the project, including relevant NSW and Commonwealth legislation applicable to the project. The key legislative requirements and assessment guidelines specific to biodiversity are outlined below.

### 19.1.1 NSW Biodiversity Conservation Act 2016

The NSW *Biodiversity Conservation Act 2016* (BC Act) replaced the *Threatened Species Conservation Act 1995* (TSC Act) on 25 August 2017. The BC Act aims to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. It establishes a framework for assessment, and offsetting of, biodiversity impacts as well as investment in biodiversity conservation.

The Biodiversity Assessment Method is established under section 6.7 of the BC Act. The purpose of the Biodiversity Assessment Method is to assess impacts on threatened species and threatened ecological communities, and their habitats, and the impact on biodiversity values, where required under the BC Act.

### 19.1.2 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) includes provisions to protect and manage matters of national environmental significance, including nationally and internationally important flora, fauna, ecological communities and migratory species, defined in the EPBC Act as matters of national environmental significance.

In accordance with sections 67 and 67A of the EPBC Act, any action that has a potential to result in an impact on any matters of national environmental significance or on Commonwealth land are considered 'controlled actions' and require a referral to the Commonwealth Minister for the Environment for approval. The significance of impacts on matters of national environmental significance is determined in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (Department of the Environment, 2013).

### 19.1.3 Fisheries Management Act 1994

The NSW *Fisheries Management Act 1994* (FM Act) contains provisions for the conservation of fish stocks, key fish habitat, biodiversity, threatened species, populations and ecological communities. The FM Act regulates the conservation of fish, marine vegetation and some aquatic macroinvertebrates and the development and sharing of fishery resources of NSW for present and future generations. Part 7 of the FM Act identifies requirements for the protection of aquatic habitats while Part 7A of the FM Act lists threatened species, populations and ecological communities and key threatening processes for species, populations and ecological communities in NSW waters. Section 220ZZ of the FM Act outlines significant impact considerations to threatened species, populations and ecological communities listed under the FM Act.

### 19.1.4 Assessment guidelines

A number of assessment guidelines were used to inform the biodiversity assessment, the most relevant of which were:

- *Biodiversity Assessment Method* (Office of Environment and Heritage (OEH), 2017) – for the assessment of impacts on threatened species, threatened ecological communities, and their habitats, and the impact on biodiversity values, where required under the BC Act
- *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (Department of the Environment, 2013) – for the assessment of significance of impacts on matters of national environmental significance under the EPBC Act
- *Policy and Guidelines for Fish Habitat Conservation and Management – Update 2013* (NSW DPI, 2013) – for the assessment of freshwater and marine biodiversity matters.

A list of all of the assessment guidelines that were used to inform the biodiversity assessment is provided in Appendix S (Technical working paper: Biodiversity development assessment report) and Appendix T (Technical working paper: Marine ecology) of this environmental impact statement.

## 19.2 Assessment methodology

The assessment of biodiversity impacts included consideration of:

- Potential impacts on terrestrial biodiversity, consistent with the Biodiversity Assessment Method (Section 19.2.1)
- Potential impacts on aquatic biodiversity (Section 19.2.2)

- Potential impacts on marine biodiversity (Section 19.2.3).

The key terminology adopted for the terrestrial, marine and aquatic assessments with regard to extent of assessments and identification of impacts is summarised in Table 19-2 below.

**Table 19-2 Biodiversity assessment extent terminology**

| Term | Definition |
|---|---|
| **Terrestrial biodiversity** | |
| Construction footprint | The above ground area to be directly impacted by the project. |
| Terrestrial biodiversity locality | An area within 10 kilometres of the construction footprint. |
| **Marine biodiversity** | |
| Project area | The area to be directly impacted by the project. |
| Marine biodiversity study area | Estuarine areas from the highest astronomical tide encompassing the project area, and areas next to Gladesville Bridge and the open water area just to the east of Garden Island and Robertsons Point. |
| Marine biodiversity Study locality | An area within 10 kilometres of the project area (for the purpose of the desktop review). |
| **Aquatic biodiversity** | |
| Construction footprint | The above ground area to be directly impacted by the project. |
| Aquatic biodiversity study area | An area encompassing the construction footprint and areas immediately adjacent (about 500 metres around the project alignment). |

## 19.2.1 Terrestrial biodiversity

The assessment of potential impacts on terrestrial biodiversity has been carried out in accordance with the Biodiversity Assessment Method (Office of Environment and Heritage, 2017). The assessment methodology is summarised below, with further detail provided in Appendix S (Technical working paper: Biodiversity development assessment report).

### *Desktop assessment*

A desktop assessment was carried out for the project, including review of information from relevant databases, vegetation maps, topographic maps, aerial photography, reports and published literature.

The following databases were searched in June 2016, May 2017, December 2017 and then again in April 2019:

- Bionet Atlas of NSW Wildlife
- EPBC Act Protected Matters Search Tool
- Threatened biodiversity profile search.

The database searches were carried out for an area of 10 kilometres around the construction footprint.

The desktop assessment was used to identify threatened species, populations, communities and their habitats with a likelihood of occurrence in areas that may be impacted by the project.

#### *Field surveys*

Field surveys were carried out between May 2016 and November 2017, and again in February, May and June 2018, and March 2019 and included:

- Random meander surveys to verify vegetation communities and the condition of vegetation across accessible land within the construction footprint
- Targeted flora and fauna surveys for species identified as having a high or moderate likelihood of occurrence in areas that may be impacted by the project, as identified through the desktop assessment.

No vegetation integrity plot surveys were carried out for the project since none of the vegetation that would be directly impacted by the project would fall within the description of any plant community types listed in the BioNet Vegetation Classification (Office of Environment and Heritage, 2018, formerly known as the Vegetation Information System (VIS) Classification).

#### *Opportunities to avoid and minimise impacts*

Based on the outcomes of the desktop assessment and field surveys, opportunities to avoid or minimise biodiversity impacts were considered as part of the project design development process. Further details of the avoidance and minimisation of potential impacts through design is provided in Chapter 4 (Project development and alternatives).

#### *Assessment of potential impacts*

The potential impacts of the project were assessed against the relevant matters in the Biodiversity Assessment Method, including:

- Removal of native vegetation and habitat, including direct and indirect impacts on native vegetation and threatened flora
- The potential for serious and irreversible impacts on identified threatened species and ecological communities
- The prescribed biodiversity impacts under the Biodiversity Assessment Method
- The potential for impacts on relevant matters of national environmental significance under the EPBC Act.

### 19.2.2 Aquatic biodiversity

The freshwater aquatic habitat assessment was informed by the results of inspections carried out at seven locations across the four waterways (or their catchments) that fall within the aquatic biodiversity study area:

- Whites Creek
- Willoughby Creek
- Flat Rock Creek
- Quarry Creek.

The extent and condition of freshwater habitats within the aquatic biodiversity study area was recorded during the site inspections, based on a 100 metre reach of waterway centred at each inspection location.

No fish or macroinvertebrate sampling was carried out during the inspections. The likelihood of occurrence of aquatic species has been assessed based on the availability of suitable habitat. Further details of the inspection locations are provided in Chapter 17 (Hydrodynamics and water quality).

In summary, the aquatic assessment involved the following:

- Identification of the location, extent and condition of waterways potentially impacted by the project
- Assessment of potential impacts to freshwater ecology, including threatened species and ecological communities, and associated geomorphology due to construction and operation of the project
- Identification of environmental management measures and offsets required to manage potential impacts to aquatic ecology.

### 19.2.3 Marine biodiversity

The assessment methodology for marine biodiversity is summarised below, with further details provided in Appendix T (Technical working paper: Marine ecology).

#### *Desktop assessment*

A desktop assessment was carried out for the project, including review of information from relevant databases, aerial photography, reports and published literature.

The following databases were searched:

- Bionet Atlas of NSW Wildlife
- EPBC Act Protected Matters Search Tool
- Threatened biodiversity profile search
- NSW DPI Fish Communities and Threatened Species Distribution of NSW
- NSW DPI Listed Protected Fish Species website
- NSW DPI Listed Threatened Species, Populations and Ecological Communities website
- National System for the Prevention and Management of Marine Pest Incursions website
- Atlas of Living Australia.

The database searches were carried out for an area of 10 kilometres around the marine components of the project.

The desktop assessment was used to identify threatened species, populations, communities and their habitats with a likelihood of occurrence in areas to be impacted by the project.

#### *Field surveys*

Preliminary sampling and predictive habitat mapping from aerial photography captured in May 2017 was used to identify areas for field surveys. Sites for field surveys also took into account the outcomes of the desktop assessment, including consideration of relevant species, communities, populations and habitats, and their likelihood of occurrence in areas that may be impacted by the project.

Field surveys were carried out within Sydney Harbour in November and December 2017, between the Gladesville Bridge to the west and Garden Island, Potts Point and Robertsons Point. The field surveys included mapping and confirmation of seagrass, subtidal rocky reef, intertidal rocky reef and deep water soft sediment habitats. Surveys of macroalgae and sessile invertebrate coverage, fish numbers and epibiota coverage were also carried out in relevant habitats.

### *Assessment of potential impacts*

A risk based approach was applied to the assessment of potential direct and indirect impacts of the project on marine biodiversity, including impacts associated with:

- Removal of habitat
- Turbidity
- Sedimentation
- Mobilisation of contaminants
- Introduction/spread of marine pests
- Altered hydrodynamics
- Underwater noise
- Boat strike to marine mammals and reptiles
- Spill of contaminants.

The assessment took into account the sensitivity of key fish habitat types, including Type 1 (highly sensitive), Type 2 (moderately sensitive) and Type 3 (minimally sensitive) habitats.

The likelihood and consequence of direct and indirect impacts on each key fish habitat were evaluated to determine an anticipated level of risk. The levels of risk applied to the assessment are summarised in Table 19-3.

**Table 19-3 Risk levels applied to the assessment of potential marine biodiversity impacts**

| Level of risk | Description |
|---|---|
| Extreme | The risk is unmanageable and unjustified. Measures to reduce the risk to a lower level are required. |
| High | The risk is significant and requires substantial measures for risk reduction and/or management. |
| Medium | The risk may be acceptable and requires routine management measures. |
| Low | The risk is acceptable and requires either routine management measures or no further measures. |

## 19.3 Existing environment

This section summarises the existing key biodiversity values along and around the project alignment, including:

- Terrestrial flora (Section 19.3.1)
- Terrestrial fauna (Section 19.3.2)
- Aquatic biodiversity (Section 19.3.3)

- Marine biodiversity (Section 19.3.6).

## 19.3.1 Terrestrial flora

### *Vegetation communities*

Vegetation communities within the construction footprint are summarised in Table 19-4 and shown on Figure 19-1 to Figure 19-5.

The following construction support sites have not been considered further with regards to impacts to terrestrial flora:

- The Rozelle Rail Yards construction support site (WHT1), as any vegetation at this location has been assumed to be removed by the approved M4-M5 Link project
- The White Bay construction support site (WHT3), given there is no vegetation within or next to the construction support site.

Field surveys carried out for the project identified one native vegetation community within the construction footprint. This community is consistent with plant community type 1778: Smooth-barked Apple - Coast Banksia/Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney and covers around 0.13 hectares in the north-west corner of the Berrys Bay construction support site (WHT7).

Other vegetation within the construction footprint is also described in Table 19-4 and shown in Figure 19-1 to Figure 19-5 and includes:

- Native plantings
- Native plantings (planted medians)
- Urban exotic/native
- Weeds and exotics.

This vegetation covers around 7.6 hectares within the construction footprint.

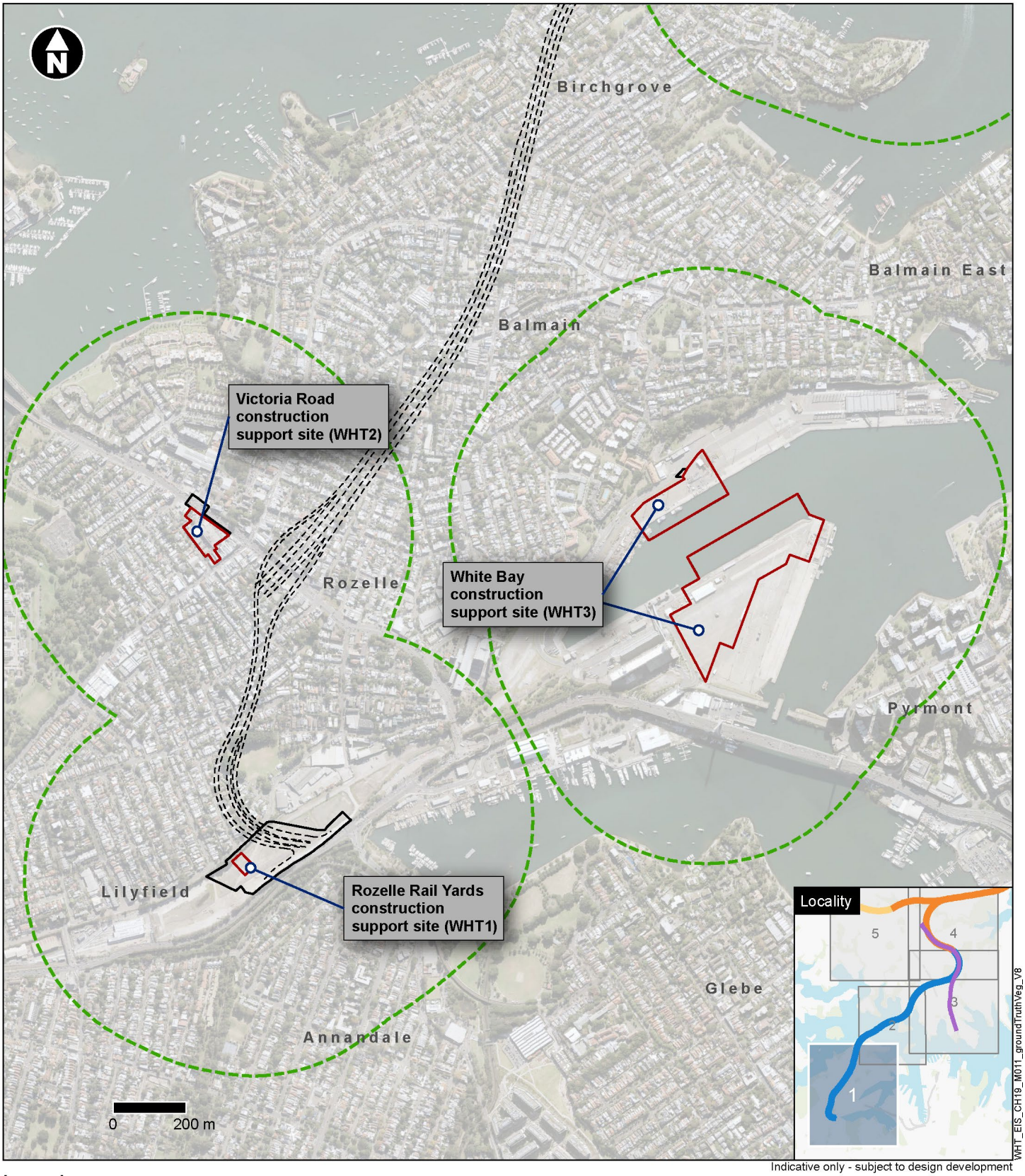
### *Threatened ecological communities*

No threatened ecological communities were identified as likely to occur within the construction footprint.

**Table 19-4 Vegetation communities within the construction footprint**

| Mapped vegetation[1] | Corresponding plant community type | Location within the construction footprint | Area within the construction footprint (ha) |
|---|---|---|---|
| Native vegetation community | Plant community type 1778: Smooth-barked Apple - Coast Banksia/Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney | In the south-western corner of the Berrys Bay construction support site (WHT7), forming part of a larger patch of native vegetation extending southwards across Balls Head. | 0.13 |
| Native plantings | Not consistent with the definition of any plant community type | Planted trees along road verges and within parklands to the north-east of The Crescent, Annandale, within the Yurulbin Point construction support site (WHT4) and next to the existing Warringah Freeway. | 3.30 |
| Native plantings (planted medians) | Not consistent with the definition of any plant community type | Planted vegetation on the median strips between carriageways on the Warringah Freeway, as well as between the carriageways and ramps. | 2.84 |
| Urban exotic/native | Not consistent with the definition of any plant community type | Highly modified landscaped vegetation in gardens, parks and road verges including an area within the Berrys Bay construction support site (WHT7), and areas next to the existing Warringah Freeway. | 1.11 |
| Weeds and exotics | Not consistent with the definition of any plant community type | Planted exotic trees and grassy weeds within a cleared area to the east of the Warringah Freeway, at the southbound on ramp from High Street. | 0.35 |
| **Total vegetation area within construction footprint (including native vegetation communities)** | | | **7.73** |

Note 1: Vegetation mapped by project ecologists as part of field surveys carried out for the biodiversity assessment

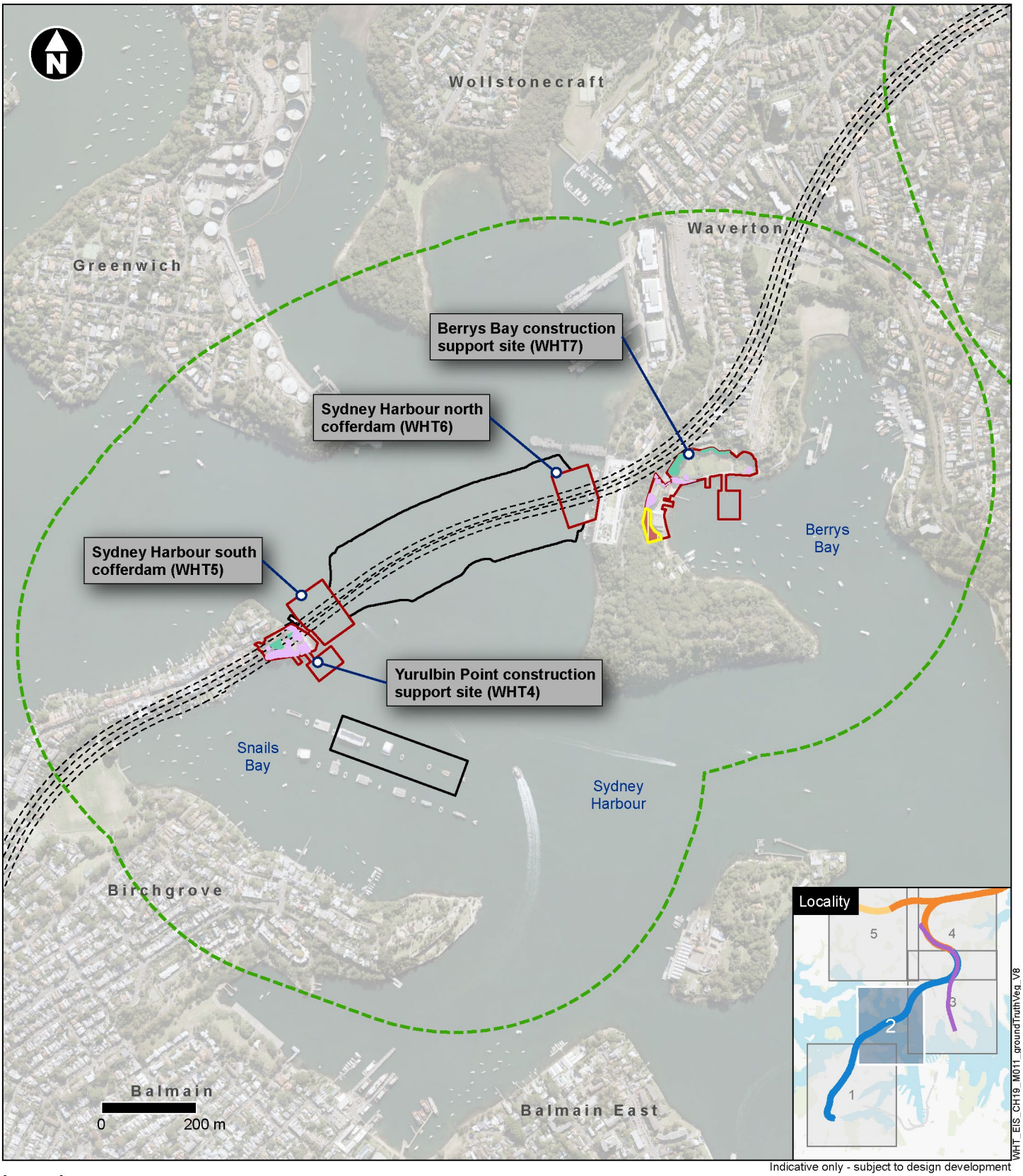



**Legend**

**Construction features**

- Construction footprint
- Assessment area
- Construction support site
- Tunnel section

**Figure 19-1 Distribution of plant community types and other vegetation (map 1)**




**Legend**

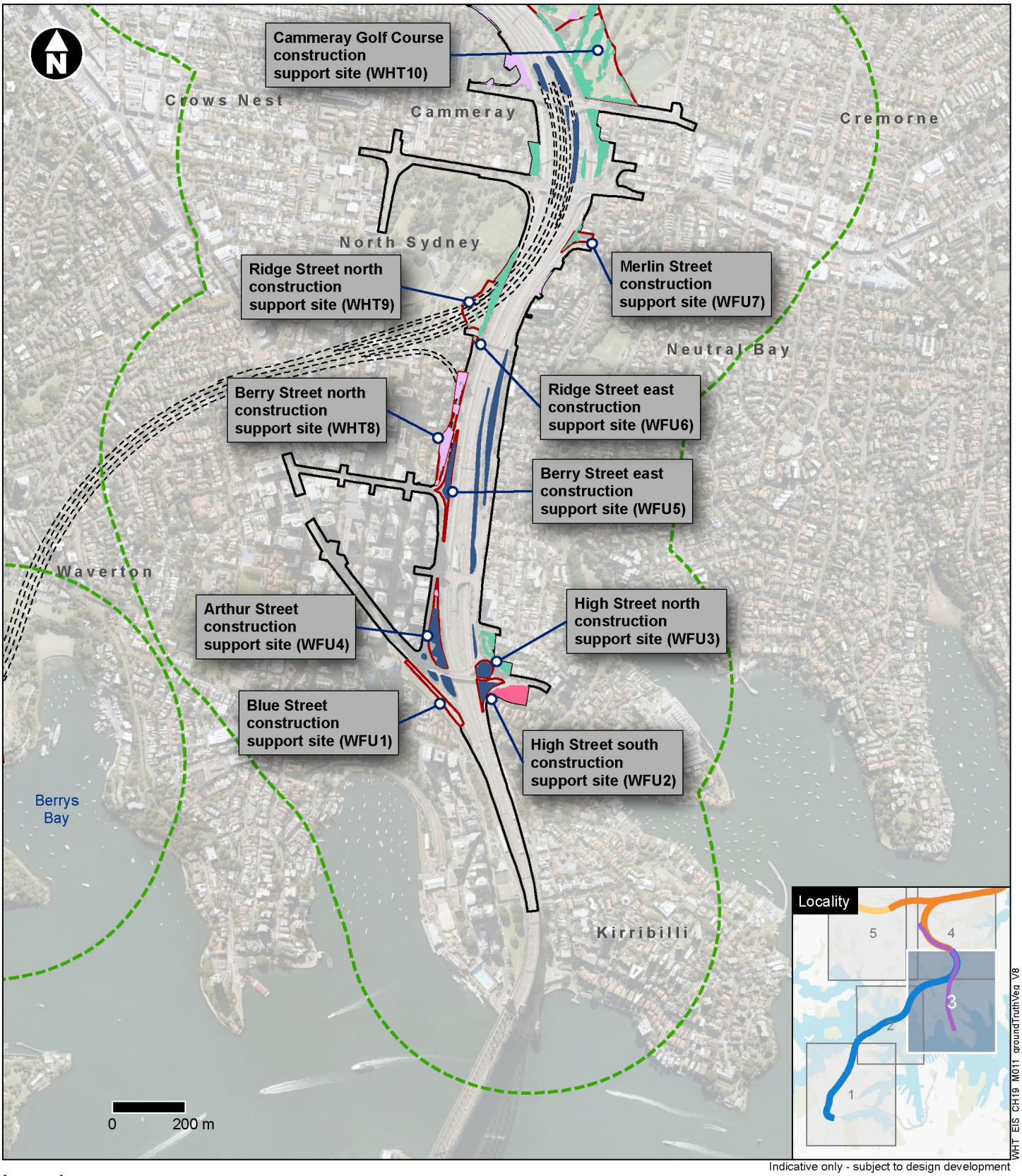
**Construction features**

- Construction footprint
- Construction support site
- Tunnel section
- Exclusion zone
- Assessment area

**Plant community types and other vegetation**

- Native Plantings
- PCT 1778 / BVT ME65 - Coastal Sandstone Foreshores Forest
- Urban Exotic/Native

**Figure 19-2 Distribution of plant community types and other vegetation (map 2)**




**Legend**

**Construction features**

- Construction footprint
- Construction support site
- Tunnel section
- Assessment area

**Plant community types and other vegetation**

- Exotic Plantings
- Native Plantings
- Plantation (median)
- Urban Exotic/Native

**Figure 19-3 Distribution of plant community types and other vegetation (map 3)**

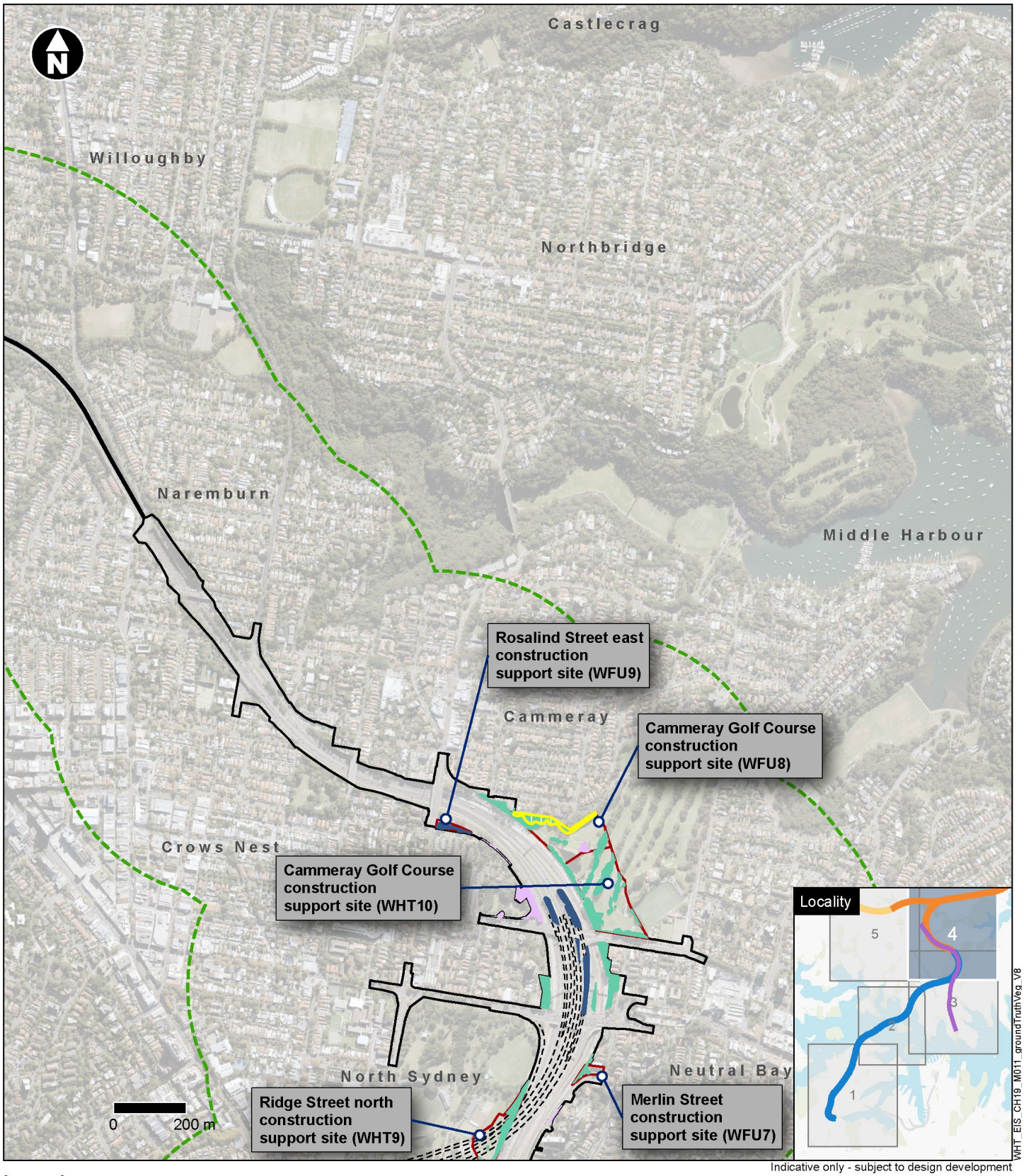
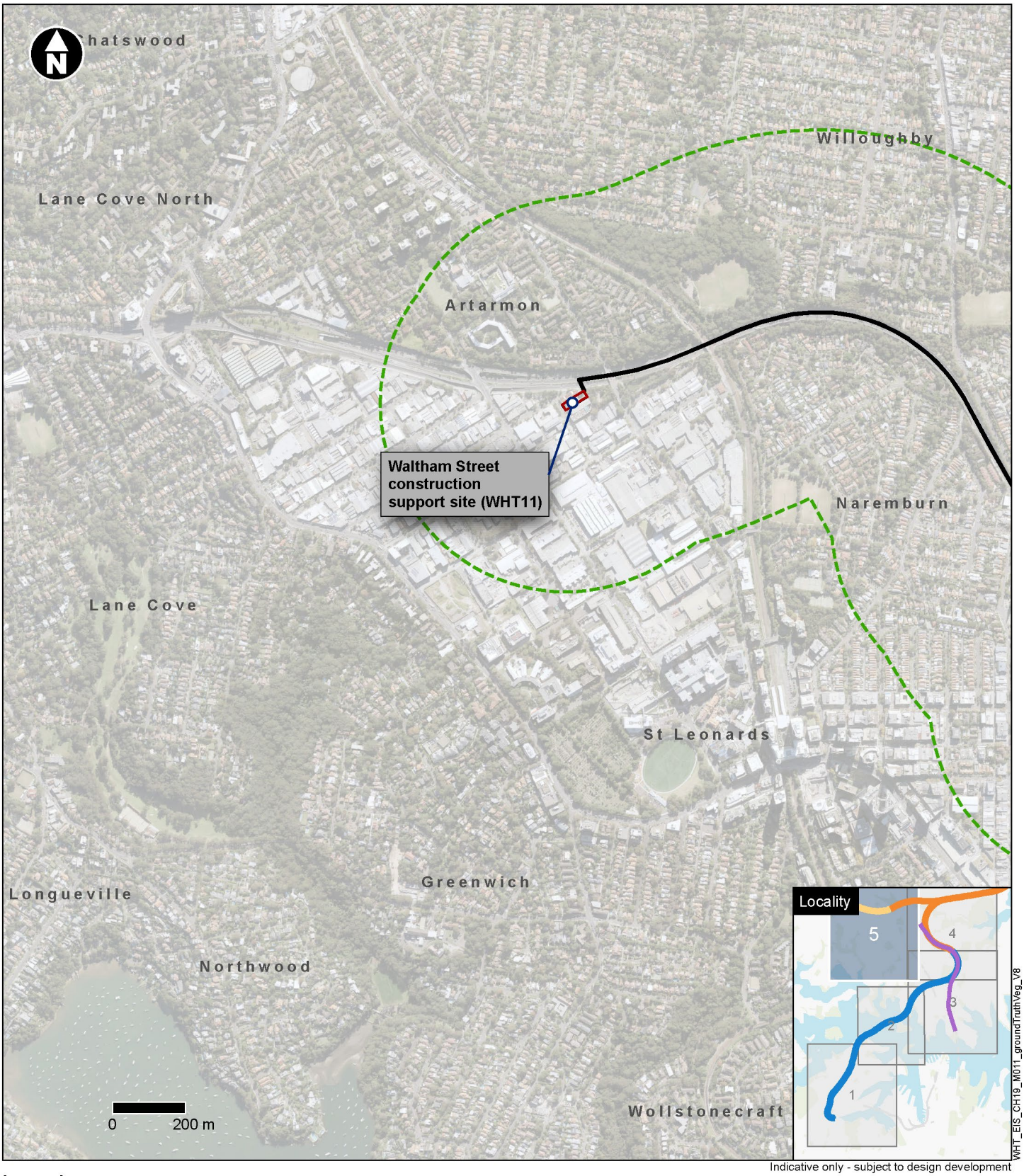



**Figure 19-4 Distribution of plant community types and other vegetation (map 4)**




**Legend**

**Construction features**

Construction footprint

Assessment area

Construction support site

**Figure 19-5 Distribution of plant community types and other vegetation (map 5)**

### Threatened flora

Field surveys carried out for the project identified four listed threatened flora species within or next to the construction footprint:

- Magenta Lilly Pilly (*Syzygium paniculatum*)
- Narrow-leaved Black Peppermint (*Eucalyptus nicholii*)
- Wallangarra White Gum (*Eucalyptus scoparia*)
- Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*).

The *Acacia terminalis* subsp. *terminalis* is possibly natural regrowth. The remaining three species are well outside their known geographic range and/or known habitat. As these species occur as individual trees, it is assumed that these species have been planted.

No listed threatened species were identified as having a moderate or high likelihood of occurrence within the construction footprint.

Details of these four species are provided in Table 19-5, with the locations of species recorded during field surveys for the project shown in Figure 19-7.

**Table 19-5 Threatened flora species known or to occur in the construction footprint**

| Species | Conservation significance | Occurrence in the construction footprint |
|---|---|---|
| Magenta Lilly Pilly (*Syzygium paniculatum*) | Endangered (BC Act) Vulnerable (EPBC Act) | Recorded next to the construction footprint. Planted specimens were recorded within the Warringah Freeway corridor just outside the construction footprint. Unlikely to occur naturally as the construction footprint does not represent suitable habitat for the species. |
| Narrow-leaved Black Peppermint (*Eucalyptus nicholii*) | Vulnerable (BC Act and EPBC Act) | Recorded within the construction footprint. Planted specimens were recorded within the Warringah Freeway corridor. Unlikely to occur naturally as the construction footprint is outside the known naturally occurring distribution of the species. |
| Wallangarra White Gum (*Eucalyptus scoparia*) | Endangered (BC Act) Vulnerable (EPBC Act) | Recorded within the construction footprint. Planted specimens were recorded in the Warringah Freeway corridor. Unlikely to occur naturally as the construction footprint is outside the known naturally occurring distribution of the species. |
| Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) | Endangered (BC Act and EPBC Act) | Recorded within the construction footprint. One individual specimen in disturbed vegetation adjoining the Warringah Freeway. There are records of the species in bushland adjoining Sydney Harbour, including near the construction footprint. However, most of the vegetation within and adjoining the construction footprint does not represent suitable habitat for the species. |

## 19.3.2 Terrestrial fauna

### *Terrestrial fauna habitat*

Table 19-6 provides a summary of the terrestrial fauna habitat types within and next to the construction footprint, and the known or potential fauna species occurring within those habitats.

The key terrestrial fauna habitat types identified for the project include:

- Vegetated habitats
- Man-made structures and built environments (including existing buildings, jetties and wharves)
- Marine and intertidal habitats. The assessment of marine and intertidal habitats in relation to marine species is discussed in Section 19.3.6.

**Table 19-6 Terrestrial fauna habitats**

| Habitat type | Location | Known or potential fauna species |
|---|---|---|
| Vegetated habitats | Vegetated habitats (ie landscaped parks, private gardens and street verges) within or next to the following:<br>• Yurulbin Point construction support site (WHT4)<br>• Berrys Bay construction support site (WHT7)<br>• Cammeray Golf Course construction support sites (WHT10 and WFU8)<br>• Warringah Freeway Upgrade component<br>• Jeaffreson Jackson reserve. | • Flowering and fruiting trees and shrubs throughout the construction footprint may offer foraging, nesting and roosting habitat to bats, birds and arboreal mammals, such as: Grey-headed Flying-fox (*Pteropus poliocephalus*); Australian Magpie (*Cracticus tibicen*); Noisy Miner (*Manorina melanocephala*); Rainbow Lorikeet (*Trichoglossus moluccanus*); Grey Butcherbird (*Cracticus torquatus*); Common Brushtail Possum (*Trichosurus vulpecula*); and Common Ringtail Possum (*Pseudocheirus peregrinus*)<br>• Landscaped areas and garden beds may offer marginal foraging habitat for birds, small mammals and reptiles<br>• The area of native vegetation within and next to the Berrys Bay construction support site (WHT7) is contiguous with a larger tract of bushland at Balls Head Reserve and offers potential foraging habitat to the Powerful Owl (*Ninox strenua*)<br>• The following threatened fauna species have also been previously recorded in Balls Head Reserve, next to the construction footprint: White-bellied Sea Eagle (*Haliaeetus leucogaster*); Eastern Bentwing-bat (*Miniopterus schreibersii*); and Grey-headed Flying-fox (*Pteropus poliocephalus*)<br>• One potential hollow-bearing tree was identified (*Eucalyptus saligna*) in Jeaffreson Jackson Reserve. Hollow entrances were not visible from the ground, but if present, may support common urban fauna such as Brushtail Possum (*Trichosurus vulpecula*) and Sulphur-crested Cockatoo (*Cacatua galerita*). |
| Man-made structures and built environments | Within the coal loader tunnels on the western side of Waverton peninsula, near the Sydney Harbour north cofferdam (WHT6). | • A roost habitat known to be occupied during autumn and winter by hibernating Eastern Bentwing-bats (*Miniopterus schreibersii*) is located within one of the four coal loader tunnels. The number of Eastern Bentwing-bats occupying this winter roost in recent years has fluctuated between zero and about 500 individuals. |
| | Buildings and sheds at Berrys Bay construction support site (WHT7). | • Potential roosting habitat for microbats within small wall and ceiling cavities in buildings and sheds. However, no evidence of microbat occupation or threatened microbat recordings were identified in the area. |

| Habitat type | Location | Known or potential fauna species |
|---|---|---|
| | Within built structures, including warehouses, buildings, wharves, jetties at:<br>• White Bay construction support site (WHT3)<br>• Yurulbin Point construction support site (WHT4)<br>• Berrys Bay construction support site (WHT7). | • Limited and marginal potential roosting habitat for microbats, including Southern Myotis (*Myotis macropus*), which is known to roost in jetties and wharves in Sydney Harbour. |
| Marine and intertidal habitats* | Intertidal sand and mudflats below rock and sandstone retaining walls at:<br>• The western and south-western shore of Rozelle Bay (next to Federal Park), near the Rozelle Rail Yards construction support site (WHT1)<br>• A small foreshore area of Yurulbin Point near the Yurulbin Point construction support site (WHT4)<br>• The western shore of Snails Bay (next to Birchgrove Park)<br>• The southern shore of Berrys Bay, in proximity to Berrys Bay construction support site (WHT7). | • Provides marginal foraging habitat to threatened shorebird species, where worms, bivalves, crustaceans and other invertebrates occur within soft substrate tidal areas that are exposed during low tide. However, no threatened shorebird species were identified during database searches as having a high likelihood of occurrence within the construction footprint<br>• No nesting or roosting habitat provided as these areas are inundated at high tide. |
| | Intertidal rocky shores and artificial seawalls along bays including: Rozelle Bay; White Bay; Snails Bay; Balls Head Bay; and Berrys Bay. | • Supports a high abundance of Sydney Rock Oysters (*Saccostrea glomerata*), which comprise limited foraging resources for threatened shorebirds. However, no threatened shorebird species were identified during database searches as having a high likelihood of occurrence within the construction footprint<br>• No nesting or roosting opportunities for threatened shorebird species, as these areas are inundated at high tide. |

| Habitat type | Location | Known or potential fauna species |
|---|---|---|
| | Open water within Sydney Harbour | Foraging habitat for a number of threatened bird species that forage for fish or other marine prey species, including:<br>• Little Penguin (*Eudyptula minor*) which has been previously recorded at several locations within the construction footprint, including Snails Bay, Berrys Bay, Balls Head Bay, and in the main channel of the harbour<br>• White-bellied Sea Eagle (*Haliaeetus leucogaster*) which has been recorded flying over Sydney Harbour near the construction footprint next to Balls Head and flying above Goat Island, due to the presence of preferred prey species (ie fish, turtles and sea snakes), as well as potential perching habitat in trees along the harbour foreshore at Balls Head, Birchgrove and Waverton<br>• Southern Myotis (*Myotis macropus*) due to the presence of preferred prey species (ie fish), particularly within Balls Head Bay<br>• Eastern Osprey (*Pandion cristatus*) due to the presence of preferred prey species (ie fish)<br>• Not a preferred habitat for wandering seabirds with no wandering seabird species identified as having a high likelihood of occurrence within the construction footprint. |

### *Threatened fauna species and endangered populations*

Field surveys carried out for the project identified three listed threatened fauna species within or next to the construction footprint:

- Eastern Bentwing-Bat (*Miniopterus schreibersii oceanensis*) recorded within one of the coal loader tunnels near the construction footprint at Waverton
- Grey-headed Flying-fox (*Pteropus poliocephalus*) recorded flying over the construction footprint at Berrys Bay
- White-bellied Sea Eagle (*Haliaeetus leucogaster*) flying over Sydney Harbour near the construction footprint next to Balls Head and flying above Goat Island.

Another four listed threatened species were identified as having a high likelihood of occurrence within the construction footprint, despite not being identified during field surveys. These species were:

- Eastern Freetail-bat (Mormopterus norfolkensis)
- Little Bentwing-Bat (*Miniopterus australis*)
- Southern Myotis (*Myotis macropus*)
- Powerful Owl (*Ninox strenua*).

In addition, the Eastern Osprey (*Pandion cristatus*) was identified as having a moderate likelihood of occurrence, despite not being identified during field surveys.

One threatened population is known to occur in the construction footprint on occasion, being the population of Little Penguins in the Manly Point Area, about 10 kilometres north-east of the project.

Details of these nine threatened species and one endangered population are provided in Table 19-7 with the locations of species recorded during field surveys for the project shown in Figure 19-6 to Figure 19-9.

### *Migratory bird species*

As identified above, one migratory bird species listed under the EPBC Act, the White-bellied Sea Eagle (*Haliaeetus leucogaster*), was recorded flying over Sydney Harbour near the construction footprint next to Balls Head and flying above Goat Island.

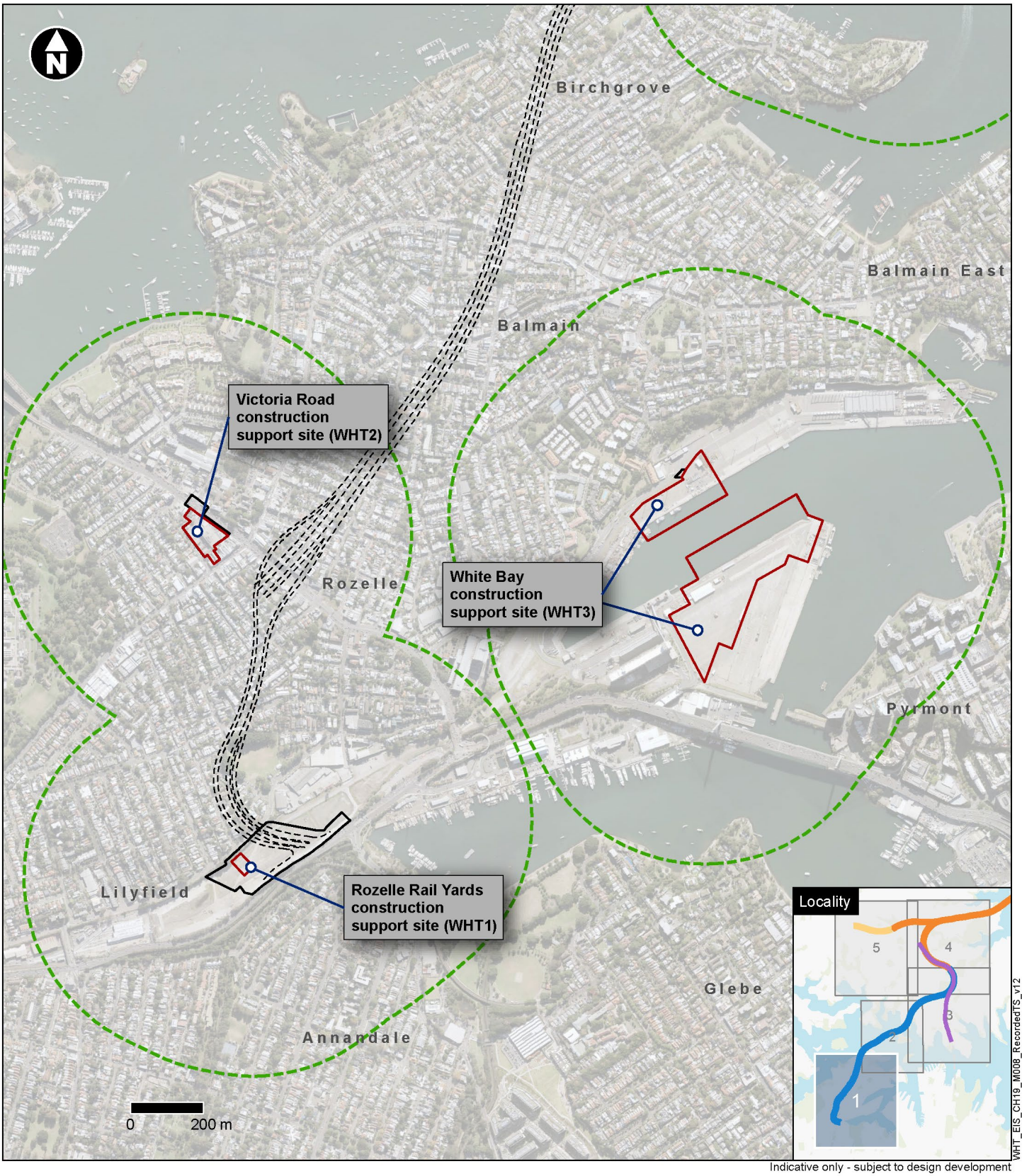
Migratory marine and freshwater species such as whales, turtles and fish are discussed in Section 19.3.3 and Section 19.3.6.

**Table 19-7 Threatened fauna species known or likely to occur in the construction footprint**

| Species | Conservation significance | Likelihood of occurrence in the construction footprint |
|---|---|---|
| **Threatened species** | | |
| Eastern Bentwing-Bat (*Miniopterus schreibersii oceanensis*) | Vulnerable (BC Act) | Recorded.<br>This species is known to roost in one of the four coal loader tunnels near the construction footprint at Waverton (during autumn and winter), and was identified during field surveys for the project. Other potential roosting habitat includes in built structures throughout the construction footprint. There is also potential foraging habitat for the species within and next to the construction footprint in well-vegetated areas such as Balls Head Reserve. Recorded in Sydney Harbour in close proximity to the construction footprint. |
| Grey-headed Flying-fox (*Pteropus poliocephalus*) | Vulnerable (BC Act and EPBC Act) | Recorded.<br>This species was observed flying over a number of locations within the construction footprint at Berrys Bay during field surveys for the project. Potential foraging habitat for the species is present within vegetated areas throughout the construction footprint. |
| White-bellied Sea Eagle (*Haliaeetus leucogaster*) | Vulnerable (BC Act)<br>Migratory (EPBC Act) | Recorded.<br>This species was observed flying over Sydney Harbour near the construction footprint next to Balls Head and flying above Goat Island.<br>Potential foraging habitat occurs within the construction footprint due to the presence of preferred prey species that inhabit Sydney Harbour.<br>Potential perching habitat also occurs within and next to the construction footprint due to the presence of trees along the harbour foreshore at Balls Head, Birchgrove and Waverton.<br>The construction footprint is not known to support nesting habitat for the species. |

| Species | Conservation significance | Likelihood of occurrence in the construction footprint |
|---|---|---|
| Eastern Freetail-bat (*Mormopterus norfolkensis*) | Vulnerable (BC Act) | High.<br>This species has been previously recorded within the construction footprint. Potential roosting habitat for the species is present in built structures within the construction footprint, such as existing buildings at the Berrys Bay construction support site (WHT7). Potential foraging habitat is also present in well-vegetated areas such as Balls Head Reserve in proximity to the construction footprint. |
| Little Bentwing-Bat (*Miniopterus australis*) | Vulnerable (BC Act) | High.<br>Potential roosting habitat for this species is present in built structures throughout the construction footprint including stormwater drains, culverts and buildings, such as those located at the Berrys Bay construction support site (WHT7). Potential foraging habitat is also present in well-vegetated areas within and next to the construction footprint such as Balls Head Reserve. |
| Powerful Owl (*Ninox strenua*) | Vulnerable (BC Act) | High.<br>This species has been previously recorded within the construction footprint and surrounding areas. A small area of native vegetation within the Berrys Bay construction support site (WHT7), contiguous with a larger tract of bushland at Balls Head Reserve, provides potential foraging habitat for the species. No nesting or roosting/breeding habitat is available within the construction support site. |
| Southern Myotis (*Myotis macropus*) | Vulnerable (BC Act) | High.<br>This species has been previously recorded within and next to the construction footprint at Berrys Bay and Balls Head. The species is known to roost in a jetty structure in a sheltered bay in Sydney Harbour. The construction footprint supports potential roosting habitat for the species, due to the presence of jetties, wharves and other man-made structures along the harbour foreshore, including the large Coal Loader wharf at Waverton, and smaller wharves and jetties at Berrys Bay, Snail Bay and Birchgrove.<br>Sydney Harbour, particularly sheltered bays, also provides potential foraging habitat for the species, particularly Balls Head Bay. |

| Species | Conservation significance | Likelihood of occurrence in the construction footprint |
|---|---|---|
| Eastern Osprey (*Pandion cristatus*) | Vulnerable (BC Act)<br>Migratory (EPBC Act) | Moderate.<br>Relatively recent records of this species exist in the vicinity of the construction footprint. Potential foraging habitat for the species is present in Sydney Harbour. |
| **Endangered population** | | |
| Little Penguin (*Eudyptula minor*) | Endangered population (BC Act)<br>Marine (EPBC Act) | High.<br>This species has been previously recorded at several locations including Snails Bay, Berrys Bay, Balls Head Bay, and in the main channel of the harbour. Potential foraging habitat for the species is present within the construction footprint. No nesting habitat is present within the construction footprint, with nesting limited to the Manly area. |




**Legend**

**Construction features**

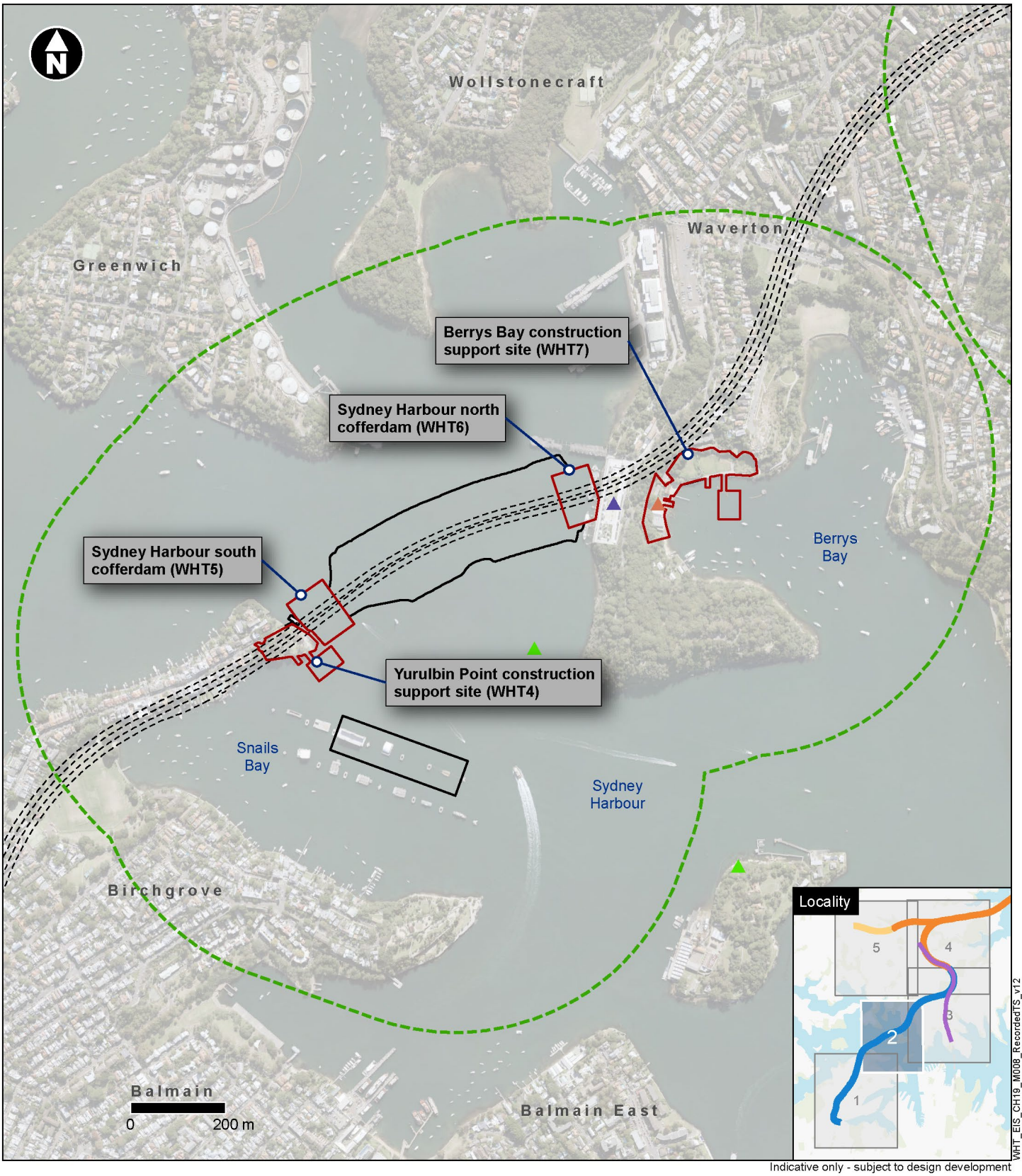
Assessment area

Construction footprint

Construction support site

Tunnel section

**Figure 19-6 Recorded threatened species (map 1)**




**Legend**

**Construction features**

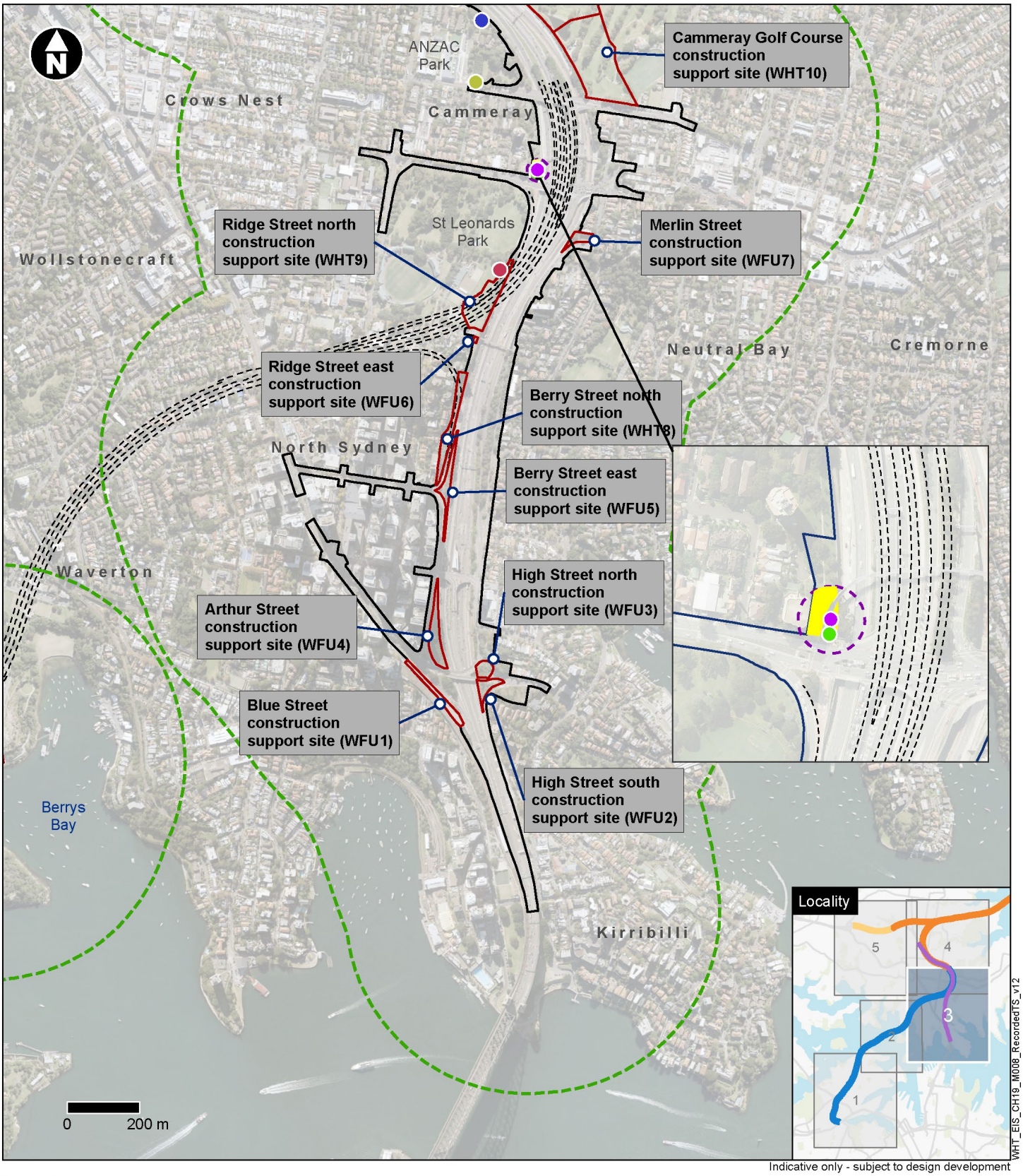
- Construction footprint
- Construction support site
- Tunnel section

**Threatened fauna species**

- Eastern Bentwing-bat
- Grey-headed Flying-fox
- White-bellied Sea Eagle

- Assessment area

**Figure 19-7 Recorded threatened species (map 2)**




**Legend**

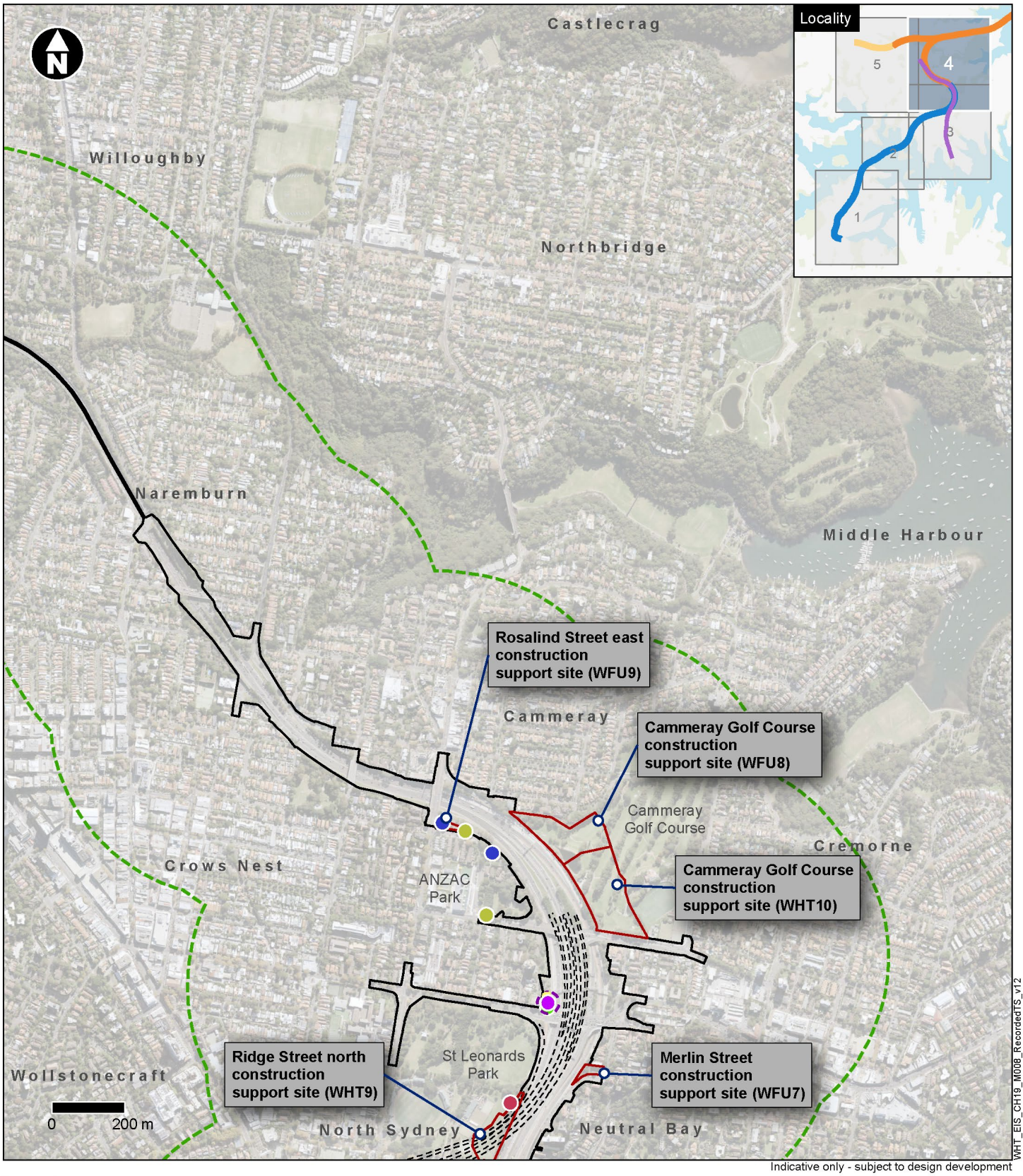
**Construction features**

- Construction footprint
- Construction support site
- Tunnel section

**Threatened flora species**

- *Eucalyptus nicholii*
- *Eucalyptus scoparia*
- *Syzygium paniculatum*
- *Acacia terminalis subsp terminalis*
- *Acacia terminalis subsp terminalis 30 m buffer*
- *Acacia terminalis subsp terminalis species polygon*
- Potential hollow-bearing tree
- Assessment area

**Figure 19-8 Recorded threatened species (map 3)**




**Legend**

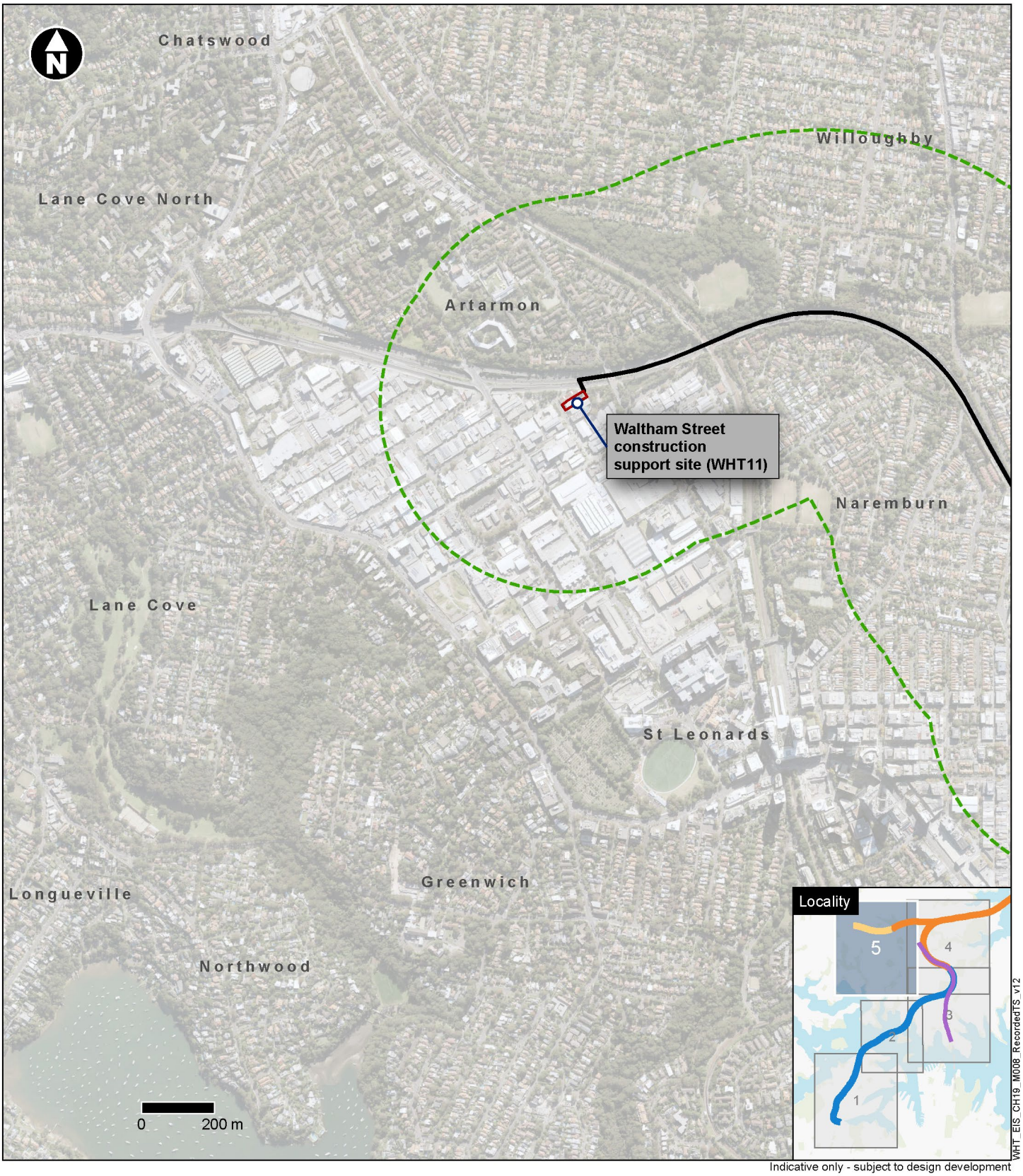
**Construction features**

- Construction footprint
- Construction support site
- Tunnel section

**Threatened flora species**

- *Eucalyptus nicholii*
- *Eucalyptus scoparia*
- *Syzygium paniculatum*
- *Acacia terminalis subsp terminalis*
- *Acacia terminalis subsp terminalis 30 m buffer*
- *Acacia terminalis subsp terminalis species polygon*
- Assessment area

**Figure 19-9 Recorded threatened species (map 4)**




**Legend**

**Construction features**

Assessment area

Construction footprint

Construction support site

Tunnel section

**Figure 19-10 Recorded threatened species (map 5)**

## 19.3.3 Aquatic biodiversity

### *Aquatic habitat*

Table 19-8 provides a summary of the aquatic freshwater habitats associated with the waterways within and downstream of the construction footprint.

Quarry Creek and the natural reaches of Flat Rock Creek have been identified as Type 1 highly sensitive key fish habitat and sensitive receiving environments. The classification of waterways regarding their status as sensitive receiving environments is discussed in detail in Chapter 17 (Hydrodynamics and water quality), and summarised in Table 19-8.

The quality of these waterways was also assessed as part of the surface water assessment, the results of which are provided in Chapter 17 (Hydrodynamics and water quality). In general, the waterways potentially impacted by the project are largely influenced by surrounding urban development with occurrences of contaminants such as suspended sediments, heavy metals and persistent organic pollutants including from stormwater, wastewater overflows and leachate from contaminated lands. Some of these waterways have also undergone significant change from natural channels to artificial, concrete-lined channels to accommodate higher volume and velocity flows from an increase in urban, impervious surfaces.

Although no fish or macroinvertebrate sampling was carried out as part of the aquatic assessment, the waterways in the aquatic biodiversity study area are considered suitable for the majority of common and exotic fish species typically found in waterways in the Sydney region. The most suitable habitat are the natural reaches of these waterways (Willoughby Creek, Quarry Creek and some reaches of Flat Rock Creek).

Common native fish species typically found in waterways in the Sydney region include short-finned and long-finned eels (*Anguilla australis* and *A. reinhardtii*), common jollytails (*Galaxias brevipinnis*), Australian bass (*Macquaria novemaculeata*) and a number of gudgeon species. Exotic fish species are also widespread across the Sydney region.

The waterways are also likely to support an array of macroinvertebrates including the Sydney crayfish (*Euastacus australasiensis*) and the freshwater shrimp (*Paratya australiensis*) as well as smaller insects and freshwater mussels. These species depend on healthy waterways and access to diverse habitats including swamps, floodplains, wetland, streams and rivers of which only streams occur within the aquatic biodiversity study area.

### *Threatened ecological communities, species and endangered populations*

No threatened freshwater fauna, flora species or ecological communities or endangered populations listed under the FM Act and/or the EPBC Act have been identified as likely to occur within the construction footprint.

### *Freshwater migratory species*

No freshwater migratory species listed under the EPBC Act are considered likely to occur within the construction footprint.

**Table 19-8 Aquatic freshwater habitats**

| Location | Habitat features | Key fish habitat classification | Sensitive receiving environment |
|---|---|---|---|
| Whites Creek at Rozelle, located about 40 metres south-east of the Rozelle Rail Yards construction support site (WHT1) | • The creek at the location of the inspections at Lilyfield is heavily modified, with concrete lined channel and banks<br>• The riparian corridor is also highly modified with low condition riparian vegetation consisting of planted native trees and shrubs in landscaped areas (eg within Buruwan Park, next to The Crescent), with no remnant native vegetation present. In other areas, weeds are common<br>• No instream fish habitat is present, due to the concrete channel structure. No logs, aquatic vegetation, emergent vegetation or rocks are present. | Not a key fish habitat | No |
| Willoughby Creek at Cammeray, located about 60 metres east of the Cammeray Golf Course construction support site (WHT10 and WFU8) | • The area of the creek next to Primrose Park Tennis Courts was identified as a semi-natural waterway, partially modified to accept stormwater discharge. Around 10 metres downstream of the survey location, the creek contains entrenched bedrock and a concrete-lined channel. A natural bedrock/boulder waterfall and a shallow plunge pool is located around 50 metres upstream of the survey location<br>• Banks in the upstream section of the creek are vegetated by dense tree cover and shrubs with a groundcover consisting primarily of ferns. Walking tracks and tennis courts are present on the south-east bank and on the opposite bank the riparian vegetation corridor is around 70 metres wide and continuous. Further downstream, the riparian corridor includes Primrose Park sporting fields<br>• Moderate condition riparian vegetation including commonly occurring native tree species are present within remnant riparian vegetation, such as Black Wattle (*Callicoma serratifolia*), Coachwood (*Ceratopetalum apetalum*), Blueberry Ash (*Elaeocarpus reticulatus*), Cheese Tree (*Glochidion ferdinandi*)<br>• Localised infestations of Large Leaf Privet (*Ligustrum lucidum*) and Lantana (*Lantana camara*) are also known to occur | • Type 3 minimally sensitive key fish habitat<br>• Class 3 minimal key fish habitat for fish passage. | No |

| Location | Habitat features | Key fish habitat classification | Sensitive receiving environment |
|---|---|---|---|
| | • This riparian vegetation provides shade and potentially, other ecological functions (eg a source of food and habitat, in the form of wood debris, for aquatic biota). No instream vegetation or woody debris were identified within the section of the creek inspected. Some rocky features are present. | | |
| Flat Rock Creek at Naremburn, located about one kilometre north of the Cammeray Golf Course construction support site (WHT10 and WFU8) | • The creek was identified as freshwater upstream of its confluence with Quarry Creek and estuarine downstream of the confluence<br>• Along Artarmon Reserve the channel is concrete-lined and does not support any instream aquatic vegetation and limited landscaped riparian vegetation. This section of the creek is not considered to be key fish habitat and is not considered a sensitive receiving environment<br>• Upstream of Quarry Creek, the channel consists of a steep gorge with natural bedrock and large boulders. Dense riparian vegetation encroached on the channel is likely attributed to frequent low flow conditions in the main channel. Riparian vegetation consists of native, tall, woody trees, dense shrubs and groundcover<br>• Downstream of Quarry Creek, the channel appeared be subjected to stormwater discharge with evidence of channel and bank erosion a likely result of high flow events. The south bank had dense native and exotic, overhanging riparian vegetation<br>• Upstream of Quarry Creek, the channel consists of a steep gorge with natural bedrock and large boulders. Dense riparian vegetation encroached on the channel is likely attributed to frequent low flow conditions in the main channel. Riparian vegetation consists of native, tall, woody trees, dense shrubs and groundcover<br>• Downstream of Quarry Creek, the channel is subjected to stormwater discharge with evidence of channel and bank erosion a likely result of high flow events. The south bank consists of dense native and exotic, overhanging riparian vegetation | • Type 1 highly sensitive key fish habitat<br>• Class 2 moderate key fish habitat for fish passage (upstream of Quarry Creek)<br>• Class 1 major key fish habitat for fish passage (downstream of Quarry Creek). | Yes |

| Location | Habitat features | Key fish habitat classification | Sensitive receiving environment |
|---|---|---|---|
| | • In the upper reaches, instream woody debris (less than three metres long) provides aquatic habitat along its upper reaches, albeit some were emergent at the time of survey. Downstream, fish habitat includes woody debris and some undercut banks with potential to provide refuge as well as large woody debris (greater than three metres long) and dense instream common reed (*Phragmites australis*) present in some sections. | | |
| Quarry Creek at Cammeray, located about 800 metres north of the Cammeray Golf Course construction support site (WHT10 and WFU8) | • At the location of the inspection, the channel flowed through a steep rocky gorge. Upstream of this it appeared freshwater and ephemeral with bedrock steps, rocky riffles and runs with low to moderate flow during dry conditions. Quarry Creek becomes estuarine near the Flat Rock Creek confluence with a silt/clay substratum<br>• Dense exotic riparian vegetation is present within the areas of the creek inspected. | • Type 1 highly sensitive key fish habitat<br>• Class 2 moderate key fish habitat for fish passage. | Yes |

## 19.3.4 Groundwater dependent ecosystems

No groundwater dependent ecosystems were identified within the construction footprint.

The northern extent of the construction footprint would be located upstream of mapped groundwater dependent ecosystems that rely on groundwater associated with Flat Rock Creek as outlined in Table 19-9 and shown on Figure 19-11.

**Table 19-9 Groundwater dependent ecosystems in proximity to the project**

| Location of mapped groundwater dependent ecosystem | Distance from the project | Mapped ecosystems |
|---|---|---|
| Upper reaches of Flat Rock Creek at Munro Park – moderate to high potential for terrestrial groundwater dependent ecosystem | About 300 metres north-east of the construction footprint associated with the Warringah Freeway Upgrade | • Coastal Sandstone Gully Forest<br>• Sandstone Riparian Scrub<br>• Coastal Sand Forest. |

This groundwater dependent ecosystem is located outside the range of potential impact, and therefore has not been included for further assessment.

## 19.3.5 Wetlands and conservation areas

Six coastal wetlands listed under the *State Environmental Planning Policy (Coastal Management) 2018* are located within the aquatic biodiversity study area. However, none of these would be located within the construction footprint. There are no wetlands of international importance within the construction footprint. Therefore, impacts to wetlands and conservation areas are not assessed further.


**Legend**

**Operational features**

- Western Harbour Tunnel
- Warringah Freeway Upgrade

**Construction features**

- Construction footprint

**Connecting prjects**

- Beaches Link
- Gore Hill Freeway Connection

**Groundwater dependent ecosystems**

- Ecosystem that relies on subsurface presence of groundwater

**Figure 19-11 Distribution of groundwater dependent ecosystems**

## 19.3.6 Marine biodiversity

### *Marine habitats*

Seven marine habitat types were identified within the marine biodiversity study area and are shown in Figure 19-12. The habitats and relevant key fish habitat classifications as defined in the *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW DPI, 2013) are identified in Table 19-10.

No critical habitats listed on State or Commonwealth registers of critical habitat occur within the marine biodiversity study area.

**Table 19-10 Marine habitats within the marine biodiversity study area**

| Key fish habitat classification | Marine habitat |
|---|---|
| Highly sensitive key fish habitat (Type 1) | Seagrass |
| | Subtidal rocky reef |
| Moderately sensitive key fish habitat (Type 2) | Intertidal rocky shore |
| | Mangrove |
| | Intertidal sand and mudflat |
| Minimally sensitive key fish habitat (Type 3) | Deep water soft sediment |
| | Open water |

### *Threatened marine ecological communities, species and endangered populations*

No threatened marine ecological communities listed under the FM Act or the EPBC Act have been identified in the marine biodiversity study area. One endangered population listed under the FM Act has a high likelihood of occurrence within the marine biodiversity study area. The *Posidonia australis* seagrass population is considered to have a high likelihood of occurrence within the marine biodiversity study area due to the presence of populations in the surrounding area.

Two listed marine species were identified as having a high likelihood of occurrence within the construction footprint; the Black Rockcod (*Epinephelus daemelii*) and the New Zealand Fur-Seal (*Arctocephalus forsteri*). These species have a high likelihood of occurrence due to the presence of suitable habitat within the construction footprint. In addition, 10 species were identified as having a moderate likelihood of occurrence within the construction footprint.

In addition to these 10 species, White's Seahorse (*Hippocampus whitei*), which is currently listed as protected under the FM Act and EPBC Act, has been nominated for threat-listing under the FM Act. A preliminary assessment under the FM Act threatened species protection has been carried out for completeness. White's Seahorse was identified as having a high likelihood of occurrence within the construction footprint, based on the presence of suitable habitat within the construction footprint.

Details of the 13 listed marine species likely to occur within the construction footprint are provided in Table 19-11.

### *Migratory marine species*

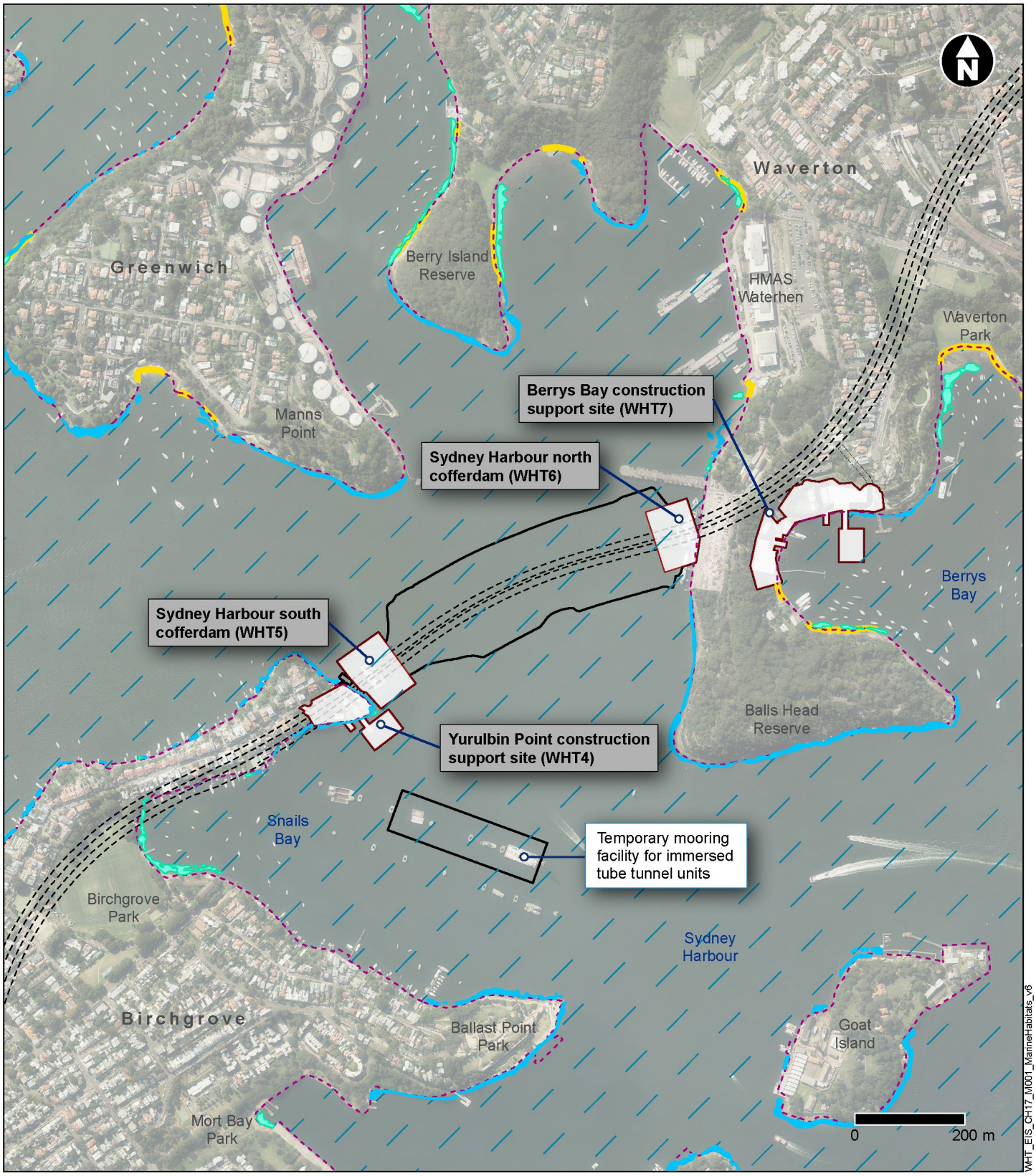
No migratory marine species listed under the EPBC Act have a high or moderate likelihood of occurrence in the construction footprint.

**Table 19-11 Threatened marine species known or likely to occur in the construction footprint**

| Species | Conservation significance | Likelihood of occurrence in the construction footprint |
|---|---|---|
| Black Rockcod (*Epinephelus daemelii*) | Vulnerable (FM Act)<br>Vulnerable (EPBC Act) | High.<br>Suitable habitat for this species is present throughout the marine areas of the construction footprint. Suitable habitat for this species within the construction footprint includes both subtidal, and medium to high relief rocky reef areas, which are present along the shorelines of Sydney Harbour. |
| White's Seahorse (*Hippocampus whitei*) | Nominated for threat listing | High<br>Suitable habitat for this species is present within the marine areas of the construction footprint, including subtidal, low, medium and high relief, rocky reef areas and in *Halophila*, *Zostera* and *Posidonia* seagrasses. |
| New Zealand Fur-seal (*Arctocephalus forsteri*) | Vulnerable (BC Act) | High.<br>Foraging habitat and suitable rest areas are present throughout the marine areas of the construction footprint. One individual has returned annually to the Sydney Opera House steps since 2014 and is likely to forage in Sydney Harbour. |
| Australian Fur-seal (*Arctocephalus pusillus doriferus*) | Vulnerable (BC Act) | Moderate.<br>Foraging habitat and suitable rest areas are present throughout the marine areas of the construction footprint. |
| Southern Right Whale (*Eubalaena australis*) | Endangered (BC Act)<br>Endangered, migratory (EPBC Act) | Moderate.<br>This species is one of the most commonly sighted species in Sydney Harbour. Suitable habitat for use during annual migration is present throughout the marine areas of the construction footprint. |
| Humpback Whale (*Megaptera novaeangliae*) | Vulnerable (BC Act)<br>Vulnerable, migratory (EPBC Act) | Moderate.<br>This species is one of the most commonly sighted species in Sydney Harbour. Suitable habitat for use during annual migration is present throughout the marine areas of the construction footprint. |

| Species | Conservation significance | Likelihood of occurrence in the construction footprint |
|---|---|---|
| Loggerhead Turtle (*Caretta caretta*) | Endangered (BC Act)<br>Endangered, migratory, marine (EPBC Act) | Moderate.<br>This species has been anecdotally recorded within the marine biodiversity study area, however high-quality preferred habitat for this species is not present within the marine areas of the construction footprint. |
| Green Turtle (*Chelonia mydas*) | Vulnerable (BC Act)<br>Vulnerable, migratory, marine (EPBC Act) | Moderate.<br>This species has been anecdotally recorded within the marine biodiversity study area, however high-quality preferred habitat for this species is not present within the marine areas of the construction footprint. |
| Leatherback Turtle (*Dermochelys coriacea*) | Endangered (BC Act)<br>Endangered, migratory, marine (EPBC Act) | Moderate.<br>This species has been anecdotally recorded within the marine biodiversity study area, however high-quality preferred habitat for this species is not present within the marine areas of the construction footprint. |
| Hawksbill Turtle (*Eretmochelys imbricata*) | Vulnerable, migratory, marine (EPBC Act) | Moderate.<br>This species has been anecdotally recorded within the marine biodiversity study area, however high-quality preferred habitat for this species is not present within the marine areas of the construction footprint. |
| Flatback Turtle (*Natator depressus*) | Vulnerable, migratory, marine (EPBC Act) | Moderate.<br>This species has been anecdotally recorded within the marine biodiversity study area, however high-quality preferred habitat for this species is not present within the marine areas of the construction footprint. |
| Grey Nurse Shark (*Carcharias taurus*) | Critically endangered (FM Act)<br>Critically endangered (EPBC Act) | Moderate.<br>Foraging habitat for this species is present throughout the marine areas of the construction footprint. |

| Species | Conservation significance | Likelihood of occurrence in the construction footprint |
|---|---|---|
| White Shark (*Carcharodon carcharias*) | Vulnerable (FM Act)<br>Vulnerable, migratory (EPBC Act) | Moderate.<br>Foraging habitat for this species is present throughout the marine areas of the construction footprint. |




**Legend**

**Construction features**
- Construction footprint
- Construction support site
- Tunnel section

**Highly sensitive key fish habitat (Type 1)**
- Seagrass
- Subtidal rocky reef

**Moderately sensitive key fish habitat (Type 2)**
- Intertidal rocky shore
- Intertidal sand and mudflat

**Minimally sensitive key fish habitat (Type 3)**
- Shallow and deep soft sediment habitat

**Figure 19-12 Marine habitats within the marine biodiversity study area**

## 19.4 Assessment of potential impacts

This section assesses the potential impacts during construction and operation of the project on:

- Terrestrial flora, including removal of vegetation and loss of threatened flora species, edge effects, spread of weeds and pathogens (Section 19.4.1)
- Terrestrial fauna, including potential removal or degradation of fauna habitat, fauna injury and mortality, noise, vibration, dust and light spill impacts (Section 19.4.2)
- Aquatic biodiversity, including potential loss of aquatic habitat and water quality impacts (Section 19.4.3)
- Marine biodiversity, including potential loss of marine habitat, marine water quality impacts, and underwater noise impacts (Section 19.4.4).

### 19.4.1 Assessment of potential impacts to terrestrial flora

#### *Removal of vegetation*

Construction of the project would require removal of about 7.29 hectares of vegetation (refer to Table 19-12), which comprises native plantings, planted medians, non-native species or weeds. Most of the vegetation to be removed would be located within the Warringah Freeway road reserve and the Cammeray Golf Course construction support sites (WHT10 and WFU8). Additionally, a small area of vegetation would be removed from the Yurulbin Point construction support site (WHT4).

No native vegetation (vegetation consistent with any plant community types or threatened ecological communities) would be removed as part of the project. This includes the small area of native vegetation consistent with plant community type 1778 Smooth-barked Apple - Coast Banksia/Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney that was identified within the Berrys Bay construction support site (WHT7), which would be protected and retained during construction of the project through the implementation of an exclusion zone.

No biodiversity offsets would be required for the removal of the vegetation types listed below.

The removal of a potential hollow-bearing tree would be required in Jeaffreson Jackson Reserve; potential impacts on fauna species, as a result of this removal are discussed in Section 19.4.2.

**Table 19-12 Vegetation to be removed as part of the project**

| Vegetation type | Area removed (ha) |
|---|---|
| Native plantings | 2.99 |
| Native plantings (planted median) | 2.84 |
| Urban exotic/native | 1.11 |
| Weeds and exotics | 0.35 |
| **Total area of vegetation to be removed** | **7.29** |

#### *Removal of threatened flora species*

Potential impacts to threatened flora species as a result of the project are summarised in Table 19-13, including impacts to planted individuals of Sunshine Wattle (*Acacia terminalis* subsp.

*terminalis*), Narrow-leaved Black Peppermint (*Eucalyptus nicholii*) and Wallangarra White Gum (*Eucalyptus scoparia*). These impacts are indicative based on the current level of design development and would be confirmed during further design development.

**Table 19-13 Summary of threatened flora species impacts**

| Species | Conservation significance | Habitat or individuals to be impacted |
|---|---|---|
| Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*) | Endangered (BC Act and EPBC Act) | One remnant individual |
| Narrow-leaved Black Peppermint *(Eucalyptus nicholii)* | Vulnerable (BC Act and EPBC Act) | Up to seven planted individuals |
| Wallangarra White Gum *(Eucalyptus scoparia)* | Endangered (BC Act)<br>Vulnerable (EPBC Act) | Up to two planted individuals |

The project would not have a significant impact on any of these threatened flora species based on the very low numbers of remnant individuals to be removed, and the fact that other individuals are planted. Biodiversity offsets would be provided for impacts to the single individual of *Acacia terminalis* subsp. *terminalis* recorded in the construction footprint, as outlined in Section 19.5. Offsets are not required for impacts to the Narrow-leaved Black Peppermint (*Eucalyptus nicholii*) and Wallangarra White Gum (*Eucalyptus scoparia*).

### *Edge effects on native vegetation*

Native vegetation in Balls Head Reserve is next to the Berrys Bay construction support site (WHT7) at Waverton. The plant community type 1778: Smooth-barked Apple – Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney is located on elevated rocky slopes, above buildings that would be used as site offices.

Native vegetation within the construction footprint would be retained and protected within an exclusion zone, to ensure no clearance of this vegetation would occur. No native vegetation would be cleared for the project, and as such no new 'edges' would be created. Given this, with the implementation of the exclusion zone, indirect impacts to native vegetation as a consequence of edge effects are considered unlikely to occur as a result of the project.

### *Invasion and spread of weeds, pathogens and disease*

An increase in the movement of people, vehicles, machinery, vegetation waste and soil during and following construction activities may facilitate the introduction or spread of exotic grasses and other weeds that currently occur. Disturbed areas, such as those in which earthworks are to be carried out, would be particularly susceptible to weed establishment. The construction footprint is highly urbanised, with little to no native vegetation, reducing the threat of weeds to biodiversity. Even so, environmental management measures would be implemented to minimise the risk of introduction and spread of weeds.

In addition, the project has the potential to increase the spread of pathogens that threaten native biodiversity values, such as the soil-borne pathogen *Phytophthora cinnamomi* (Phytophthora). This pathogen is associated with damage and death to native plants. Construction of the project has the potential to increase the spread of this pathogen which could be dispersed by vehicles, animals, walkers and the movement of soil, or over large distances in flowing water, such as storm runoff. Management measures would be implemented to minimise the spread of weeds and pathogens during construction of the project (refer to Section 19.5).

## 19.4.2 Assessment of potential impacts to terrestrial fauna

### *Removal of fauna habitat*

Table 19-14 provides a summary of the potential impacts to terrestrial fauna habitats and associated threatened species for the following habitat types:

- Vegetated habitats
- Man-made structures and built environments (including existing buildings, jetties and wharves)
- Marine and intertidal habitats. The assessment of potential impacts to marine species habitat is discussed in Section 19.4.4.

Construction of the project would require removal of about 7.29 hectares of vegetation (refer to Table 19-12), which comprises native plantings, non-native species or weeds. Most of the vegetation to be removed would be located within the Warringah Freeway road reserve and the Cammeray Golf Course construction support sites (WHT10 and WFU8). Additionally, a small area of vegetation would be removed from the Yurulbin Point construction support site (WHT4). The removal of flowering and fruiting trees, shrubs and ground layer vegetation would result in the loss of potential foraging and sheltering habitat to a number of threatened fauna species known or considered likely to occur in the construction footprint. However, these impacts would be negligible since the habitat to be removed does not comprise a significant proportion of habitat available to species in the surrounding terrestrial biodiversity locality or wider bioregion.

Further to this, the limited extent of vegetated fauna habitat within the construction footprint occurs as small, isolated patches that do not maintain habitat connectivity with any large areas of native vegetation in the wider locality. Much of the vegetation which would be removed is currently subject to regular and on-going disturbance and maintenance (ie pruning and mowing).

Direct impacts to man-made structures and the built environment would be limited to some structures at Yurulbin Park and Berrys Bay, which offer limited and marginal potential roosting habitat for some bat species including the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Little Bentwing-Bat (*Miniopterus australis*), and Southern Myotis (*Myotis macropus*). These works would be unlikely to adversely impact such species. Pre-clearing surveys for bat roosts would be carried on structures prior to them being demolished. If microbats are identified as roosting in these structures, individuals would be appropriately managed and excluded from these areas prior to works commencing (refer to Section 19.5). Therefore, the project is unlikely to adversely impact any threatened bat species.

The removal of a potential hollow-bearing tree in Jeaffreson Jackson Reserve would result in the loss of nesting, roosting and/or sheltering habitat for locally occurring hollow-dependent fauna species, such as Brushtail Possum and Sulphur-crested Cockatoo. Its removal is unlikely to impact any threatened fauna species.

No marine or intertidal habitats that provide potential habitat for terrestrial fauna would be directly impacted by the project.

**Table 19-14 Potential impacts to threatened fauna habitats and associated fauna species**

| Habitat type | Known or likely threatened fauna species | Potential impacts |
|---|---|---|
| Vegetated habitats | • Grey-headed Flying-fox (*Pteropus poliocephalus*)<br>• Eastern Bentwing-bat (Miniopterus schreibersii oceanensis)<br>• Eastern Freetail-bat (Mormopterus norfolkensis)<br>• Little Bentwing-Bat (*Miniopterus australis*)<br>• Powerful Owl (*Ninox strenua*)<br>• White-bellied Sea Eagle. | • Negligible impacts due to the loss of potential foraging and sheltering habitat associated with vegetation to be removed<br>• The removal of a small area of vegetation would not substantially contribute to an increase in habitat fragmentation<br>• The proposed construction site offices within the Berrys Bay construction support site (WHT7) would be established in existing buildings, minimising potential edge effects to nearby vegetated habitat and associated species during site establishment<br>• Potential noise, vibration, dust and light spill impacts are not expected to be significant given that most construction areas would occur in already highly urbanised areas. This includes works next to Balls Head Reserve. |
| Man-made structures and built environments | • Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)<br>• Eastern Freetail-bat (*Mormopterus norfolkensis*)<br>• Little Bentwing-Bat (*Miniopterus australis*)<br>• Southern Myotis (*Myotis macropus*). | • Direct impacts would be limited to some structures at Yurulbin Park and at Berrys Bay which offer limited and marginal potential roosting habitat. With the implementation of appropriate management measures including pre-clearing surveys prior to demolition of these structures, the project is unlikely to adversely impact any roosting habitat for threatened bat species<br>• Potential noise, vibration, dust and light spill impacts on other potential roosting and nesting habitat associated with wharves, jetties and buildings within and next to the construction footprint are expected to be minor, with adverse impacts on threatened bat species unlikely<br>• Potential noise and vibration impacts to roosting Eastern Bentwing-bats (*Miniopterus schreibersii oceanensis*) within the coal loader tunnels at Waverton, particularly during autumn and winter when this roost is known to be occupied. Adaptive management strategies would be developed in consultation with the Department of Planning, Industry and Environment (Environment, Energy and Science), Department of Planning, Industry and Environment (Regions, Industry, Agriculture and Resources), North Sydney Council and/or an appropriately qualified expert in microbat biology and behaviour and implemented to minimise potential adverse impacts as required. |

### *Fauna injury and mortality*

The majority of fauna species recorded within the construction footprint are highly mobile bird and mammal species that are likely to be able to move away from these types of activities quite readily. No threatened fauna species typically at risk of fauna strike (ie slow-moving fauna species) have been recorded in the construction footprint. Therefore, impacts on locally occurring fauna species during construction are considered unlikely. However, there is potential that terrestrial fauna injury or mortality would occur as a result of construction activities such as vegetation clearing (particularly during the felling of trees), or may result from collisions with work vehicles or plant, or accidental entrapment in plant, trenches or other works.

The threatened Little Penguin (*Eudyptula minor*) could be susceptible to collisions with watercraft or barges carrying out construction within Sydney Harbour. However, this species typically forages in shallow waters at the shoreline, which the project largely avoids. Sydney Harbour is subject to high levels of water traffic and the species may be adapted to avoiding water vessels.

Impacts during operation are unlikely to occur since no threatened fauna species typically at risk of fauna strike have been recorded in the area, and most of the project would be located underground. Surface connections would be located in highly urbanised areas and within existing road corridors absent of native vegetation and intact fauna habitat.

### *Noise, vibration, dust and light spill impacts*

Potential noise, vibration, dust and light spill impacts are not expected to be significant given that most construction areas would occur in already highly urbanised areas.

Construction activities would result in localised and temporary noise and vibration impacts; however, as construction areas occur in highly urbanised areas that are subject to high levels of ambient noise, any increase in noise and vibration is not expected to have a significant impact on terrestrial fauna.

Noise and vibration would potentially impact the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) known to roost within one of the coal loader tunnels at Waverton during autumn and winter. This would include potential impacts during construction of the tunnels for the project, including locations around 10 metres below the coal loader tunnels, and construction activities associated with the Sydney Harbour north cofferdam (WHT6). Adverse impacts during summer and spring are unlikely, given that the roost has not been known to be occupied during these seasons. Potential noise and vibration impacts to the Eastern Bentwing-bat would be appropriately managed through measures outlined in Section 19.5.

Construction activities in Sydney Harbour resulting in impulsive or continuous underwater noise may lead to altered behaviour of the Little Penguin (*Eudyptula minor*). The species may avoid foraging in areas subjected to continuous or high levels of sound. Sudden or high levels of sound may have the potential to result in hearing loss or damage to auditory tissues in the Little Penguin. The potential for an impact to occur and the scale or nature of impact would depend on an individual penguin's proximity to construction activities, lessening as distance from construction activities increases. Given the level of construction activity proposed in the harbour, it is expected that individuals of the species would avoid the area reducing the risk of hearing loss and/or auditory damage occurring.

### *Water quality impacts*

Construction works within Sydney Harbour have the potential to result in water quality impacts (eg during piling and dredging activities) which could result in potential adverse impacts to foraging habitat for threatened fauna species such as the Little Penguin (*Eudyptula minor*) and White-bellied Sea Eagle (*Haliaeetus leucogaster*). However, the selected methodology for the project has considered dredging methods and controls to limit the potential for turbidity impacts and mobilisation of sediment, in order to minimise the impact on the surrounding marine environment.

This includes, but is not limited to, the installation of floating silt curtains and other management measures. Accordingly, any potential increase in turbidity and sedimentation of marine waters near construction activities would be minimal, localised and temporary.

## 19.4.3 Assessment of potential impacts to aquatic biodiversity

### *Loss of aquatic habitat and hydrological impacts*

No riparian vegetation would be removed as part of the project and no instream works would be carried out in the waterways traversed by the project. Accordingly, there would be no direct impacts to these waterways.

### *Water quality impacts*

One highly modified waterway occurs within the construction footprint: Whites Creek. The lower reach of Whites Creek is located near Rozelle Rail Yards construction support site (WHT1). No instream works are proposed in this waterway as part of this project.

The catchments of three other waterways fall within the construction footprint: Willoughby Creek, Flat Rock Creek and Quarry Creek. No instream works are proposed in these waterways.

No threatened fauna species were identified within freshwater habitat in or downstream of the construction footprint. Accordingly, there would be no removal, fragmentation or modification to freshwater ecology or associated geomorphology of these waterways as a result of the project.

Construction activities near Whites Creek at Rozelle Rail Yards construction support site (WHT1), and along the Warringah Freeway corridor at Cammeray and Naremburn, could result in soil erosion, siltation and off-site movement of eroded sediments by stormwater into downstream waterways. The highest risk construction activity would be earthworks. If unmanaged, construction activities could increase levels of turbidity and sediment deposition, decrease dissolved oxygen and change pH levels in downstream waterways. Accidental fuel and chemical spills and contaminated runoff from construction vehicles, plant, equipment or chemical storage areas have the potential to reach downstream waterways.

Potential impacts of construction activities on water quality and surface flows would be managed by the implementation standard environmental management measures as outlined in Chapter 17 (Hydrodynamics and water quality) including erosion and sediment controls for all work sites and surface work areas. With the implementation of appropriate measures during construction, impacts to water quality would be temporary and manageable. Water treatment devices, such as construction sediment basins, would be located where they collect a high proportion of sediment-laden runoff from disturbed areas of the construction.

During construction, treated wastewater would be discharged to Rozelle Bay, Iron Cove, Snails Bay, Berrys Bay and Willoughby Creek. During operations, treated wastewater would be discharged to Rozelle Bay. Discharges from the wastewater treatment plants during construction and operation would be designed to improve or maintain water quality in the receiving environment.

## 19.4.4 Assessment of potential impacts to marine biodiversity

### *Impacts to key fish habitat*

A risk assessment relating to the potential hazards to Type 1, 2 and 3 key fish habitats within the marine biodiversity study area is summarised in Table 19-15, including the removal of habitat, altered hydrodynamics, elevated turbidity and sedimentation from dredging, mobilisation of contaminants, introduction of marine pests and underwater noise from dredging and piling.

Removal of medium/high relief rocky reef habitat would occur during the installation of the Sydney Harbour south (WHT5) and Sydney Harbour north (WHT6) cofferdams. This has the potential to provide habitat for the Black Rockcod species and White's Seahorse. As the removal of this habitat would be limited to less than 0.01 hectares, impacts would be small relative to the extent of the habitats in Sydney Harbour so as to not compromise the functionality, long-term connectivity or viability of habitats, or ecological processes beyond the affected areas. No offsets would be required as this area of rocky reef would be reinstated after construction and there would therefore be no net loss of habitat.

Dredging for the installation of the immersed tube tunnels would also result in the removal of about 10.51 hectares of deepwater soft sediment habitat. These areas are expected to recover quickly through natural processes of recruitment, immigration of marine flora and fauna species and reinstatement of habitat after construction is completed.

There is also potential for scour from vessel movement and changes in water quality from wastewater discharge during construction of the project to result in removal of a small patch of seagrass habitat between Yurulbin Park and the Sydney Harbour south cofferdam (WHT5). With appropriate management of vessel activities and wastewater discharge, impacts to this habitat would be minimal.

Alteration of hydrodynamics associated with the construction of the Sydney Harbour south (WHT5) and Sydney Harbour north (WHT6) cofferdams would impact currents around Type 1 key fish habitats, mostly reductions. During the high and low tides, differences would be more noticeable in the surface layer when compared to bottom layers. Modelling of temporary changes to current speeds carried out for the project construction phase indicated that while the temporary changes would be relatively large in some locations at some parts of the tidal cycle, substantial impacts are not expected for the key fish habitats within the marine biodiversity study area. The alteration to hydrodynamics would be temporary and not outside of the range of current speeds found where Type 1 key fish habitat, including seagrass and rocky reef exist in other parts of the marine biodiversity study area. As the seabed at the immersed tube tunnel crossing would be restored to the existing profile after construction, there would be no permanent alterations to hydrodynamics in the operation phase of the project.

Turbidity and sedimentation caused by dredging during the construction of the project has the potential to impact on about 0.01 hectares of rocky reef habitat. It also has the potential to impact on two small patches of seagrass, totalling about 0.03 hectares. The modelled predicted sedimentation load carried out for the project indicated that the project is unlikely to substantially impact these habitats. Impacts associated with turbidity and sedimentation would be temporary and limited to the construction phase of the project, and would not adversely impact the broader ecological functioning of marine communities.

Underwater noise would be caused by dredging and piling during the construction of the project in Sydney Harbour. Construction related underwater noise may be impulsive or continuous and has the potential to impact on fish and shark species within the marine biodiversity study area, including in seagrass, rocky reef, deepwater and open water habitats. Potential impacts may include physical impacts to marine species, such as impacts to foraging behaviours and potential impacts to hearing loss or organ impacts, and changes to the behaviour of marine species to avoid underwater noise generated by the project. Modelling carried out for the project indicated that impacts would be largely limited to the immediate location of piling and dredging activities but may extend to about 0.43 kilometres of the noise source, with the potential to impact up to 0.02

hectares of seagrass habitat, 0.79 hectares of rocky reef habitat, and 121.25 hectares of deepwater and open water habitat. As different species have different tolerance thresholds to underwater noise, there would be a range of potential responses to these impacts. It is expected that any impacts to marine species would not affect the broader ecological functioning or viability of local populations due to the temporary nature of underwater noise impacts, with any changes in species assemblages recovered through natural processes of recruitment and immigration.

Overall, the impacts on key fish habitats during construction and operation of the project are not considered to be significant and would be adequately managed by the measures identified in Section 19.5.

**Table 19-15 Risk assessment for key fish habitats**

| Hazard | Highly sensitive key fish habitat (Type 1) | | Moderately sensitive key fish habitat (Type 2) | | | Minimally sensitive key fish habitat (Type 3) | |
|---|---|---|---|---|---|---|---|
| | Seagrass | Subtidal rocky reef | Intertidal rocky shore | Mangrove | Intertidal sand and mudflat | Deep water soft sediment | Open water |
| Removal of habitat | Moderate | Moderate | Moderate | Moderate | Low | Moderate | Moderate |
| Turbidity | Moderate | Moderate | Moderate | Low | Moderate | Moderate | Moderate |
| Sedimentation | Moderate | Moderate | Moderate | Low | Moderate | Moderate | N/A |
| Mobilisation of contaminants | Moderate | Moderate | Moderate | Moderate | Low | Moderate | Moderate |
| Introduction/spread of marine pests | Moderate | Moderate | Moderate | Moderate | Low | Moderate | Moderate |
| Altered hydrodynamics | Moderate | Moderate | Moderate | Low | Moderate | Moderate | Moderate |
| Underwater noise | Moderate | Moderate | N/A | Low | Low | Moderate | Moderate |
| Boat strike to marine mammals and reptiles | Moderate | Moderate | N/A | N/A | N/A | Moderate | Moderate |
| Spill of contaminants | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate |

### *Impacts to marine threatened species and ecological communities*

A risk assessment relating to potential hazards to threatened species and ecological communities within the marine biodiversity study area is summarised in Table 19-16.

Threatened or protected species, populations or endangered ecological communities listed under the FM Act, BC Act or EPBC Act that are most likely to be affected by the project are those that would reside, forage or transit through habitat that would be affected during construction activities. This includes the Black Rockcod and White's Seahorse because of their potential to reside in moderate or high relief rocky reef, although only a very few individuals of this species would occur in the small areas of this habitat where individuals would potentially be harmed.

Some marine mammals, marine turtles and elasmobranchs could also occur because of their potential to either forage on or transit through seagrass, rocky reef or deepwater soft sediment habitats but their potential for occurrence in the small parts of these habitats where species could be harmed from the project would be low given the habitat is suboptimal. As marine mammals and marine turtles can be observed above the water, impacts to marine mammals would be manageable.

As the potential for impact during the construction phase of the project would be largely limited to the temporary disturbance of individual marine species, the potential for significant impacts to any threatened species would be minor and would not affect the viability of local populations of listed species.

In summary, the project is not expected to have a significant impact on any marine threatened species, populations or endangered ecological communities (including those which are matters of national environmental significance).

**Table 19-16 Risk assessment for threatened marine species and ecological communities**

| Hazard | Threatened marine species (grouped) | | | |
|---|---|---|---|---|
| | Fish (specifically Black Rockcod and White's Seahorse) | Mammals | Reptiles | Sharks |
| Removal of habitat | Moderate | Moderate | Moderate | Moderate |
| Turbidity | Moderate | Moderate | Moderate | Moderate |
| Sedimentation | Moderate | N/A | Moderate | Moderate |
| Mobilisation of contaminants | Moderate | Low | Low | Low |
| Introduction/spread of marine pests | Moderate | N/A | Low | Low |
| Altered hydrodynamics | Moderate | Moderate | Moderate | Moderate |
| Underwater noise | Moderate | Moderate | Moderate | Moderate |
| Boat strike to marine mammals and reptiles | N/A | Moderate | Moderate | N/A |
| Spill of contaminants | Moderate | Low | Low | Low |

## 19.5 Environmental management measures

Environmental management measures relating to biodiversity impacts are outlined in Table 19-17. The required biodiversity offsets for the project are outlined in Section 19.5.1.

**Table 19-17 Environmental management measures for biodiversity impacts**

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| B1 | Construction | Removal of native vegetation and threatened species habitat | Vegetation removal will be further minimised, where feasible and reasonable. | WHT/WFU |
| B2 | Construction | Removal of native vegetation and threatened species habitat | Vegetation removal will be carried out in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011a). | WHT/WFU |
| B3 | Construction | Removal of native vegetation and threatened species habitat | The unexpected species find procedure included in *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011b) will be followed if threatened ecological communities, flora or fauna species, not assessed in the biodiversity assessment, are identified in the construction footprint. | WHT/WFU |
| B4 | Construction | Removal of native vegetation and threatened species habitat | Vegetation will be re-established, where feasible and reasonable, in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011c). | WHT/WFU |
| B5 | Construction | Removal of threatened flora species | Pre-clearing surveys for threatened flora species will be carried out in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011d). | WHT/WFU |
| B6 | Construction | Noise, vibration and light impacts | Carry out inspections of Eastern Bentwing-bat roosting sites in the surrounding locality (eg concrete box culverts, jetties) prior to construction, to determine the roosting capacity of each site at times roosting numbers are expected to be high. | WHT |
| B7 | Construction | Noise, vibration and light impacts | Monthly monitoring of Eastern Bentwing-bats in the Coal Loader tunnel will be carried out prior to construction (in the months of March to September), preferably by utilising thermal camera imaging at tunnel entrances (a less invasive method than carrying out counts within the tunnel itself). | WHT |

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| B8 | Construction | Noise, vibration and light impacts | Monthly monitoring of Eastern Bentwing-bats in the Coal Loader tunnel during construction (in the months of March to September) will be carried out, preferably by utilising thermal camera imaging at tunnel entrances (a less invasive method than carrying out counts within the tunnel itself). | WHT |
| B9 | Construction | Noise, vibration and light impacts | Adaptive management measures (supplemented by additional monitoring if required) to minimise impacts on the Eastern Bentwing-bat will be developed in consultation with Department of Planning, Industry and Environment (Environment, Energy and Science, and the Regions, Industry, Agriculture and Resources divisions), North Sydney Council and an appropriately qualified expert in microbat biology and behaviour, if monthly monitoring during construction suggests Eastern Bentwing-bat behaviour is affected by construction noise. | WHT |
| B10 | Construction | Injury and mortality of fauna | Fauna will be managed in accordance with *Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011e). | WHT/WFU |
| B11 | Construction | Injury and mortality of fauna | Pre-clearing surveys will be carried out in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011d). | WHT/WFU |
| B12 | Construction | Injury and mortality of fauna | Pre-clearing surveys for microbat roosts will be carried out on the wharf structures to be demolished at Yurulbin Point (WHT4) and Berrys Bay (WHT7) construction support sites. If microbats are identified roosting in these structures, individuals will be excluded from this roosting habitat. | WHT |
| B13 | Construction | Injury and mortality of fauna | An observer qualified to spot Little Penguins will be used during marine construction activities. A stop-work procedure would be implemented upon sighting of the species in the proximity of the works area. | WHT |
| B14 | Construction | Invasion and spread of weeds, pests, pathogens and disease | Weed species will be managed in accordance with *Guide 6: Weed management* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011f). | WHT/WFU |

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| B15 | Construction | Invasion and spread of weeds, pests, pathogens and disease | Pathogens will be managed in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011g). | WHT/WFU |
| B16 | Construction | Impacts to marine vegetation and sensitive habitat | Transit routes for vessels entering and departing from construction support sites will be marked out with consideration for propeller wash and distances to sensitive marine habitats. | WHT |
| B17 | Construction | Impacts to marine vegetation and sensitive habitat | Exclusion zones will be implemented to avoid disturbance to sensitive marine habitats not proposed to be directly impacted by the project. These include any intertidal sand and mudflats, intertidal rocky shore, subtidal rocky reef and seagrass habitats with potential to occur within or next to transit routes and vessel movements.<br>Routine inspections and maintenance of exclusion fencing would be carried out. | WHT |
| B18 | Construction | Impacts to marine vegetation and sensitive habitat | The velocity of wastewater treatment plant discharge will be minimised to avoid scour impacts on the marine environment. | WHT/WFU |
| B19 | Construction | Impacts to marine vegetation and sensitive habitat | To minimise the potential impact of turbidity (suspended sediment) on sensitive marine vegetation and habitats silt curtains will be installed around seagrass patches and subtidal rocky reef contained within the Zone of Influence. | WHT |
| B20 | Construction | Impacts to marine vegetation and sensitive habitat | Silt curtains will be monitored for effectiveness particularly following inclement weather and maintenance carried out when required, Records of monitoring and maintenance will be kept. | WHT |
| B21 | Construction | Impacts to marine vegetation and sensitive habitat | Subtidal rocky reef and intertidal rocky shore habitat removed along the shoreline at the Sydney Harbour south cofferdam (WHT5) and Sydney Harbour north cofferdam (WHT6) will be rehabilitated and restored as close as possible to pre-construction conditions where feasible and reasonable. | WHT |

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| B22 | Construction | Invasion and spread of marine pests, pathogens and disease | Locally sourced vessels and equipment will be used where feasible and reasonable. Any vessels sourced internationally will be inspected for potential marine pests prior to departing from their previous port. Construction contractors will need to demonstrate that due diligence has been taken to avoid introducing marine pests, pathogens or disease from internationally sourced vessels and/or construction equipment prior to departure. | WHT |
| B23 | Construction | Invasion and spread of marine pests, pathogens and disease | A targeted survey will be conducted of the dredge footprint to locate any areas of the marine algal pest *Caulerpa taxifolia*. If *Caulerpa taxifolia* is identified within the dredging footprint, surface sediments from these areas will be disposed of onshore rather than in the marine environment. | WHT |
| B24 | Construction | Impacts to marine species | A stop work procedure will be developed to address marine mammal or reptile activity. | WHT |
| B25 | Construction | Impacts to marine species | Salvage of live fish and other native marine organisms (eg large, mobile macroinvertebrates) will occur during cofferdam dewatering. All salvaged organisms will be immediately relocated to similar habitat nearby. | WHT |
| B26 | Construction | Underwater noise impacts to marine species | Visual monitoring from the harbour surface will be carried out to identify any underwater noise related impacts on fish. If required, additional at source protection measures will be considered. | WHT |

### 19.5.1 Biodiversity offsets

Species credits would be required as part of the biodiversity offsets for the project, as outlined below. A species credit is a class of biodiversity credit created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection (OEH, 2017 and OEH, 2019). Offsets are identified and a preliminary strategy is provided in Appendix S (Technical working paper: Biodiversity development assessment report).

Offsets required for the potential threatened species impacted by the project that require species credits are summarised in Table 19-18.

**Table 19-18 Threatened species offsets – species credits**

| Species | Individuals | Species credits |
|---|---|---|
| Sunshine Wattle (*Acacia terminalis subsp. terminalis*) | 1 | 2 |

The impacts of a development and gains in biodiversity values at biodiversity stewardship sites are measured in biodiversity credits.


RMS 19.1441
ISBN 978-1-922338-08-2