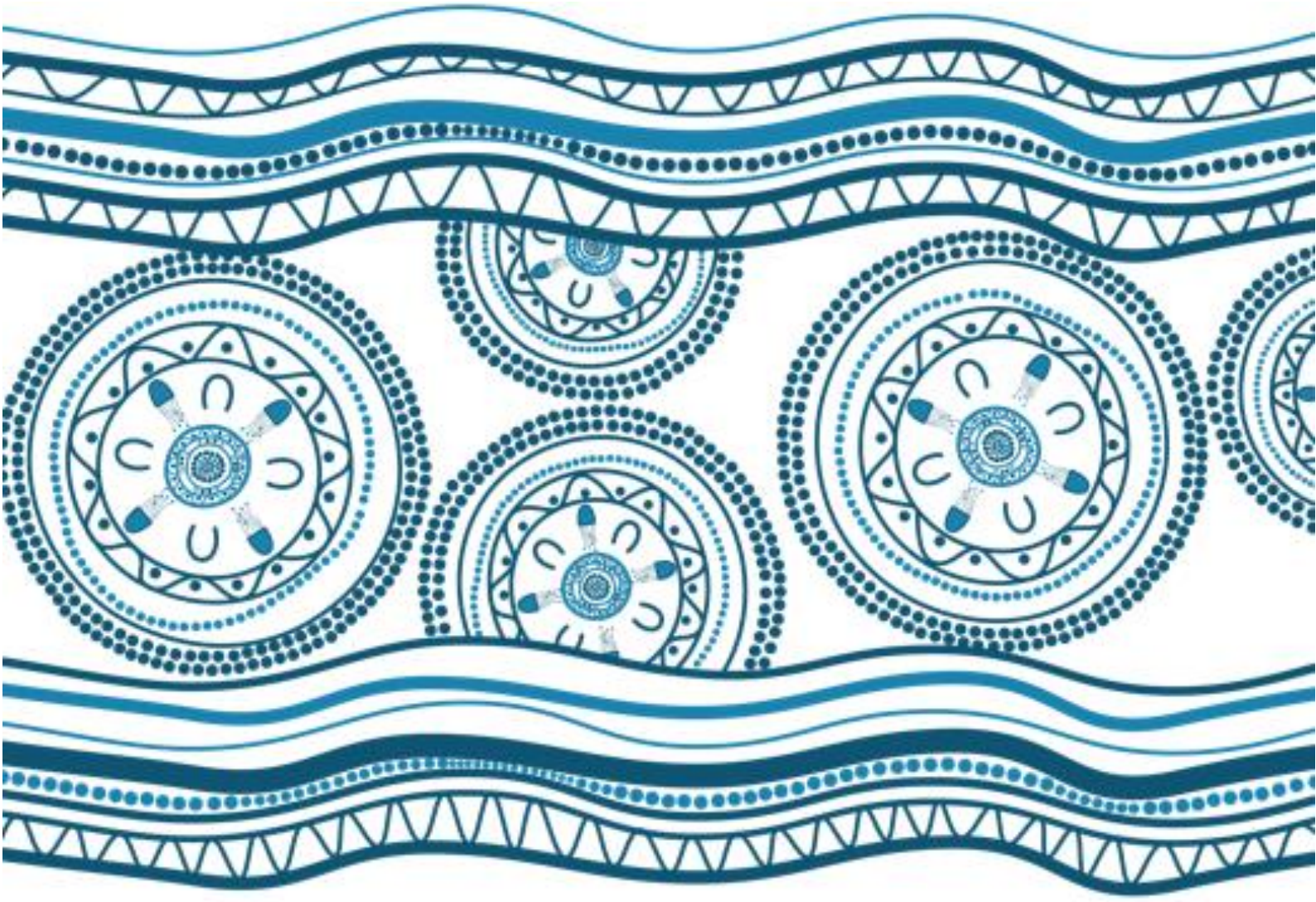
Chapter 11

Terrestrial biodiversity



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11 Terrestrial biodiversity

This chapter summarises the technical assessment of the potential impacts of the project on terrestrial biodiversity and identifies the mitigation and management measures to minimise and reduce these impacts. The assessment presented in this chapter draws on information from Appendix I (Biodiversity Development Assessment Report) (BDAR).

11.1 Assessment methodology

The method for assessing impacts on terrestrial biodiversity involved:
Establishing the study area, which included a 1500 metre buffer surrounding the construction boundary (Figure 11-1).

- Establishing the existing biodiversity values through a desktop review of published flora, fauna and habitat data, documents and site assessments to confirm suitability for threatened species and threatened ecological communities (TEC) to potentially occur in the study area.
- Carrying out targeted surveys to confirm the presence or absence of threatened species (carried out in March 2020).
- Documenting measures that would be implemented during design development and construction planning to avoid and minimise impacts.
- Assessing the potential impacts to terrestrial biodiversity as a result of the project, including any residual impacts that exist following the implementation of proposed mitigation measures.
- Developing mitigation measures to further avoid or minimise impacts, including biodiversity offsets.

Specific assessment areas are used for the BDAR in accordance with requirements under the Biodiversity Assessment Method (BAM) as described below and shown on Figure 11-2 and Figure 11-3:

- Development site: BAM specific term for the project's construction boundary**.**
- Field survey extent: an area designed to include key terrestrial biodiversity components of the development site as well as an appropriate landside buffer, that was used to undertake terrestrial field surveys within.
- Development footprint - temporary: areas of temporary impact during construction including trenching for utilities installation, site compound and storage areas, construction access roads and temporary construction platforms.
- Development footprint - permanent: areas of permanent impact.

Study area: a 1500 metre buffer surrounding the development site at La Perouse and Kurnell as shown on Figure 11-1.

11.1.1 Policy framework

The BDAR has been prepared in accordance with the following legislation, regulations and policies:

- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)
- *Biodiversity Conservation Act 2016* (NSW) (BC Act)
- NSW Biodiversity Conservation Regulation 2017 (BC Regulation)
- Biodiversity Assessment Method (BAM) (NSW Office of Environment and Heritage, 2017) (Note that this assessment was carried out using the BAM 2017, prior to the BAM 2020 being released)
- NSW Biodiversity Offset Scheme (NSW Department of Planning, Industry and Environment (DPIE), 2020i).

The BAM provides a standardised framework for ecological assessment in NSW. It was used to assess the clearing of native vegetation, impacts to threatened species and their habitats and impacts prescribed under clause 6.1 of the BC Regulation. The BDAR also assessed the potential impacts to matters of national environmental significance (MNES), as defined under the EPBC Act.

Figure 11-1: Study area

Figure 11-2: BDAR assessment areas at La Perouse

Figure 11-3: BDAR assessment areas at Kurnell

11.2 Existing environment

Existing terrestrial biodiversity values identified for the study area are presented in this section, including landscape features, native vegetation, TECs, threatened species and MNES as defined under the EPBC Act.

11.2.1 Landscape features

Landscape features within the study area are summarised in Table 11-1 and shown in Figure 11-4 and Figure 11-5.

The Kamay Botany Bay National Park occupies the northern and southern headlands at the entrance to Botany Bay. Towra Point Nature Reserve is located to the south-west of Kurnell. However, due to the distance (two kilometres) between the Towra Point Nature Reserve and the project, no impacts are anticipated.

Table 11-1: Landscape features of the study area

Landscape features	Description
Biogeographic region	Interim Biogeographic Regionalisation for Australia bioregion and sub-region: Sydney Basin IBRA bioregion and Pittwater IBRA subregion.
NSW Landscape Region (Mitchell Landscapes)	Three NSW landscape regions (Mitchell, 2002) are mapped including (1) Port Jackson Basin, (2) Sydney – Newcastle Barriers and Beaches, (3) Woronora Plateau.
Rivers and streams	The study area is located within the Botany Bay catchment, which is feed by the Georges and Cook Rivers, with lower reaches located within Botany Bay. No other rivers or streams are located within the study area, although there are several unnamed first order ephemeral streams immediately to the east of the development site at Kurnell.
Wetlands	There are two wetlands within the study area, as mapped on the NSW Wetlands database (NSW Department of Environment, Climate Change and Water, 2010d): • Towra Point Nature Reserve Ramsar site located about 2 km to the south-west of the proposed wharf at Kurnell • Botany Bay oceanic embayment. However, these are outside the development site. There are three areas mapped as Coastal Wetlands under the State Environmental Planning Policy (Coastal Management) 2018. These are two wetlands located to the south of the development site at Kurnell, being Marton Park, and vegetation adjacent to Reserve Road, and a small wetland at Henry Head which is to the east of the development site at La Perouse.
Habitat connectivity features	Vegetation at Kurnell offers connectivity for terrestrial fauna around the Kurnell Peninsula. The Marton Park Wetland is located about 500 m south-west of the development site and offers stepping-stone connectivity for highly mobile fauna to the Towra Point Nature Reserve. At La Perouse, vegetation associated with the Kamay Botany Bay National Park supports habitat connectivity around the headland with some stepping-stone connectivity to the north through the New South Wales and St Michael's Golf Courses.
Areas of geological significance	Hawkesbury sandstone cliffs occur along the La Perouse headland and the Kurnell Peninsula and extend into the construction boundary at La Perouse. These formations have the potential to offer roost habitats for a number of cave dwelling microbat species. There is also potential for sea caves in the area (refer to Chapter 10 (Marine biodiversity)).
Areas of outstanding biodiversity value under the BC Act	No mapped areas of outstanding biodiversity value occur within or adjacent to the development site.
Biodiversity values map	Within the development site, the foreshore areas at Kurnell and the sandstone slopes and cliffs at La Perouse are mapped as protected riparian lands under the Biodiversity Values Map and Threshold tool (NSW DPIE, 2020b).

Figure 11-4: Landscape features at La Perouse

Figure 11-5: Landscape features Kurnell

11.2.2 Terrestrial flora

Vegetation communities

The study area supports about 534 hectares of native vegetation, which is 28 per cent of the total study area (1639 hectares).

Vegetation surveys were undertaken in March 2020, with about 9.71 hectares of native vegetation identified. At La Perouse, the field survey extent is dominated by maintained lawns and landscaped gardens. Most of the native vegetation identified within the field survey extent occurs at Kurnell (about 8.96 hectares). The 0.75 hectares of native vegetation at La Perouse is located in small isolated patches.

Vegetation within the field survey extent at Kurnell is heavily disturbed, dominated by planted or regrowth vegetation with large areas of wet sclerophyll forest (a type of vegetation community characterised by tall open tree canopies and an understorey of rainforest species) and a small patch of littoral rainforest further to the east. Within the field survey extent, there are large areas of cleared grasslands with several planted non-endemic pines along the foreshore.

The vegetation communities identified during the surveys were aligned with plant community types (PCTs) in the BioNet Vegetation Classification database (NSW DPIE, 2020c) or discarded where relevant (ie exotic vegetation). Vegetation zones were established for each combination of vegetation types, and these were found to correspond to six PCTs with varying levels of disturbance and condition (refer to Table 11-2). Vegetation zones in the field survey extent are shown in Figure 11-6 and Figure 11-7.

Table 11-2: Vegetation zone/PCT extent in the field survey extent

Plant community type	Vegetation class/ formation	Conservation status	Vegetation zone (VZ) description	Condition	Area in field survey extent (ha)
Native vegetation					
661 Bangalay - Smooth-barked Apple - Swamp Mahogany low open forest of southern Sydney, Sydney Basin Bioregion	Wet Sclerophyll Forest, North Coast Wet Sclerophyll Forest	EPBC Act – not listed BC Act – a component of the Kurnell Dune Forest in the Sutherland Shire and City of Rockdale, listed as endangered	VZ1: Bangalay/ Tallowwood Forest	Low	0.77
			VZ3: Planted/ Remnant: Native Non-endemic	Low	1.27
			VZ4: Tuckeroo/ Coast Banksia Forest	Low	0.9
			VZ8: Bangalay Blue Gum/ Plum Pine/ Crabapple Forest	Low	0.68
			VZ10: Bangalay forest above cleared grassland	Low	0.30
			VZ11: Tallowwood Forest	Low	0.63
			VZ13: Pine/ Australian Teak/White Beech Open Forest	Low	0.34
772 Coast Banksia - Coastal Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Healthlands, Sydney Coastal Heathlands	EPBC Act – not listed BC Act – not listed	VZ7: Coastal Wattle Scrub	Low	0.06
			VZ12: Coastal Wattle Scrub - Derived	Low	0.31
			VZ14: Coast Banksia Scrub	Low	0.09
1204 Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	Grasslands, Maritime Grasslands	EPBC Act – not listed BC Act – not listed	VZ6: Spinifex Grassland	Moderate	0.12
1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	Forested Wetlands, Coastal Swamp Forests	EPBC Act – not listed BC Act – a component of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion, listed as endangered	VZ9: Swamp Oak Forest	Low	0.11

Plant community type	Vegetation class/ formation	Conservation status	Vegetation zone (VZ) description	Condition	Area in field survey extent (ha)
1778: Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	Dry Sclerophyll Forest, Sydney Coastal Dry Sclerophyll Forests	EPBC Act – not listed BC Act – not listed	VZ2: Bangalay/ Smooth-barked Apple Forest	Moderate	2.48
1823 Bracelet Honey-myrtle - Heath-leaved Banksia - Scrub She-oak coastal cliffline scrub in the Sydney basin	Healthlands, Sydney Coastal Heaths	EPBC Act – not listed BC Act – not listed	VZ15: Coastal Wattle Scrub	Low	0.62
			VZ16: Coastal Wattle Scrub (revegetation area)	Low	0.04
1832 Tuckeroo - Lilly Pilly - Cheese Tree littoral rainforest on sand dunes in the Sydney basin	Rainforest, Littoral Rainforest	EPBC Act – not listed BC Act – a component of Littoral Rainforest of the NSW North Coast, Sydney Basin and South East Corner Bioregion, listed as endangered	VZ5: Swamp Paperbark Forest	Low	0.99
Total native vegetation					*9.71*
Disturbed areas and non-native vegetation					
Not applicable	Not applicable	EPBC Act – not listed BC Act – not listed	VZ17: Cleared grassland	Not applicable	4.81
Total non-native vegetation					*4.81*
Total vegetation					**14.52**

Figure 11-6: Native vegetation at La Perouse

Figure 11-7: Native vegetation at Kurnell

Threatened ecological communities

Three TECs defined under the BC Act or EPBC Act are located within the field survey extent area at Kurnell. No TECs were recorded at La Perouse. These TECs are summarised in Table 11-3 and shown in Figure 11-8.

Table 11-3: TECs identified within the Kurnell field survey extent

Threatened ecological community (TEC)	Plant community type	Area in field survey extent (ha)	Conservation status	
			EPBC Act	BC Act
Kurnell Dune Forest in the Sutherland Shire and City of Rockdale	PCT 661	4.89	-	Endangered
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	PCT 1832	0.99	-	Endangered
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregion	PCT 1232	0.11	-	Endangered

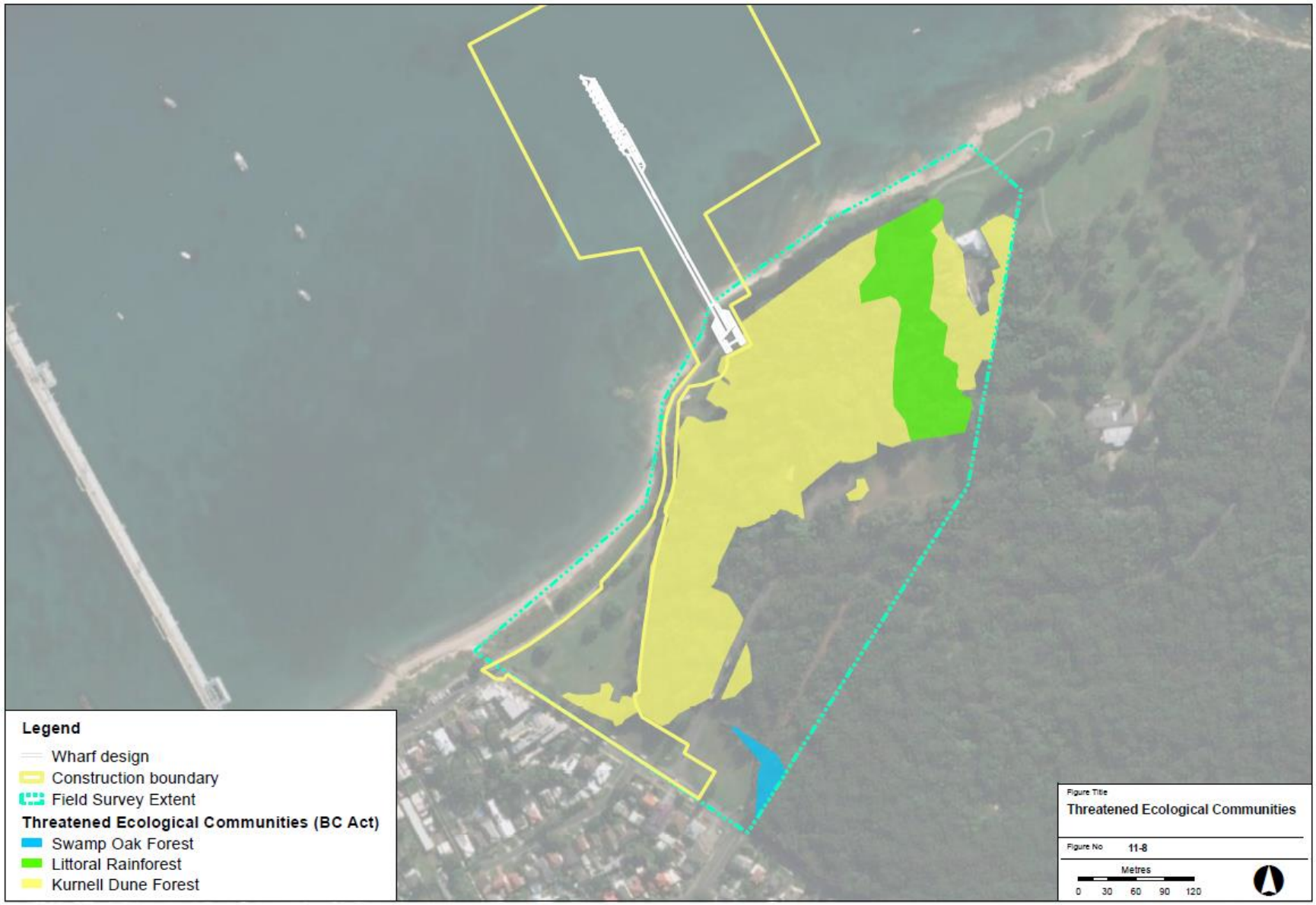

Figure 11-8: TECs at Kurnell

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDE) rely on a supply of groundwater to support the species composition and ecosystem structure and function. A review of the GDE Atlas (Australian Government, Bureau of Meteorology, 2020a) indicates that there is potential for GDEs close to the development site identified as Coastal Sand Forest. There is likely to be some vegetation reliant on groundwater within close proximity to the development site in association with Hawkesbury Sandstone, however GDE's are unlikely to occur within the development site as it is mostly cleared of this type of vegetation. As such, no impacts are expected and GDEs have not been assessed further.

Threatened flora species

Based on a desktop review, two threatened flora species were identified for targeted surveys, including:

- Leafless Tongue Orchid
- Magenta Lilly Pilly.

The surveys did not identify any threatened flora within the construction boundary. Magenta Lilly Pilly was identified next to the construction boundary at Kurnell. This species was recorded in association with the Bangalay Blue Gum/Plum Pine/Crabapple (PCT 661) and Swamp Paperbark Forest (PCT 1832) vegetation communities. About 70 individuals are estimated to occur within the field survey extent, and the spacing and pattern of these indicate that they may have been planted. Field surveys also identified suitable habitat for Leafless Tongue Orchid within Bangalay/Smooth-barked Apple forest at Kurnell (PCT 661). However, the field surveys did not coincide with flowering periods and therefore this species presence or absence could not be confirmed. The area of mapped habitat for this species is located outside the development footprint. Threatened flora at Kurnell is shown on Figure 11-9 and summarised in Table 11-4.

Table 11-4: Threatened flora within the field survey extent at Kurnell

Species	EPBC Act status	BC Act status	Survey count
Magenta Lilly Pilly	Vulnerable	Endangered	70
Leafless Tongue-orchid	Vulnerable	Vulnerable	N/A

Weeds

The surveys identified a high level of weed disturbance and invasion, including the following species:

- Asparagus Fern
- Panic Veldtgrass
- Buffalo Grass
- African Olive
- Kikuyu Grass
- Coastal Gazania
- Coastal Morning Glory
- Cobbler's Pegs
- Bitou Bush
- Paspalum
- Lantana
- Japanese Honeysuckle
- Camphor Laurel
- Moth Vine
- Ochna.

Of these, African Olive, Asparagus Fern, Bitou Bush, Camphor Laurel, Kikuyu Grass, Lantana, Moth Vine, and Panic Veldtgrass are listed as priority weeds under the *Biosecurity Act 2015* (Cth) for the Greater Sydney region.

Figure 11-9: Threatened flora at Kurnell

11.2.3 Terrestrial fauna

Terrestrial fauna habitats

At La Perouse, there is a very small area of habitat in the Coast Banksia Scrub (PCT 1778) for numerous flying species and tree and ground-dwelling mammals. However, these are likely to be species that occur commonly in disturbed environments (eg Common Brushtail Possum). At Kurnell, the native vegetation provides foraging habitat for flying species (bats and birds) as well as arboreal and ground-dwelling mammals.

Threatened fauna species

Based on the desktop review, eight candidate credit species were identified for targeted surveys:

- Gang-gang Cockatoo
- Glossy Black Cockatoo
- Pied Oystercatcher
- Large-eared Pied Bat
- Wallum Froglet
- Green and Golden Bell Frog
- Southern Myotis
- Eastern Cave Bat.

No microbat or frog habitat was identified during the surveys. A total of six threatened fauna species were recorded during field surveys, with one of these detected at La Perouse and five at Kurnell. Presence was also assumed at Kurnell for three additional fauna species that could not be discounted based on the survey methods used. These species are listed in Table 11-5.

Table 11-5: Threatened fauna identified during the survey

Species name	EPBC Act status	BC Act status	Survey observations
Mammals			
Little Bent-winged Bat	-	Vulnerable	Calls detected at Kurnell
Large Bent-winged Bat	-	Vulnerable	Calls detected at Kurnell
Eastern Coastal Free-tailed Bat	-	Vulnerable	Calls detected at Kurnell
Grey-headed Flying Fox	Vulnerable	Vulnerable	Recorded flying over and foraging within Littoral Rainforest at Kurnell
Large-eared Pied Bat	Vulnerable	Vulnerable	Species not recorded and the site does not support breeding habitat. However, species presence for foraging cannot be discounted due to presence of potential breeding habitat within two kilometres.
Eastern Cave Bat	-	Vulnerable	Species not recorded and the site does not support breeding habitat. However, species presence for foraging cannot be discounted due to presence of potential breeding habitat within two kilometres.
Birds			
Pied Oystercatcher	-	Endangered	Species observed foraging along rocky shoreline at Kurnell
Sooty Oystercatcher	-	Vulnerable	Species observed foraging along rocky shoreline at La Perouse
Gang-gang Cockatoo	-	Vulnerable	Species not recorded but could not be discounted due to presence of Eucalypt tree hollows

Pest species

While not observed on site, it is expected that pest species including European Red Fox, feral dogs and feral cats likely use both the La Perouse and Kurnell project areas.

11.2.4 Matters of national environmental significance

Published data search results

A search of the EPBC Act Protected Matters Search Tool (PMST) identified the following as having potential to occur within three kilometres of the study area:

- 11 TECs
- 18 threatened flora species
- 64 threatened fauna species
- 80 migratory species.

While the Towra Point Nature Reserve Ramsar site is considered an MNES, it is at least two kilometres from the proposed wharf at Kurnell and therefore the project is not likely to have any impact on the Ramsar site.

Project area

Following initial classification and mapping of site-based vegetation communities and habitats and targeted surveys, the MNES in Table 11-6 have the potential to occur within the Kurnell development site.

Table 11-6: MNES with potential to occur within the Kurnell development site

MNES	Community or species	EPBC Act status	Survey result	Likelihood
TECs	Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and SEQ	Endangered	Does not meet condition thresholds required for listing under the EPBC Act due to small patch size.	Present
	Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically endangered	Does not meet condition thresholds required for listing under the EPBC Act due to small patch size.	Present
Threatened flora	Magenta Lilly Pilly	Vulnerable	70 species confirmed within the field survey extent	Present
	Leafless Tongue-orchid	Vulnerable	Not observed during surveys, however suitable habitat was identified in the field survey extent	Likely
Threatened fauna	Grey-headed Flying-fox	Vulnerable	Recorded flying over and foraging within Littoral Rainforest at Kurnell	Likely – foraging only
	Large-eared Pied Bat	Vulnerable	Species not recorded and the site does not support breeding habitat. However, species presence for foraging cannot be discounted due to presence of potential breeding habitat within two kilometres	Possible – foraging only

Migratory bird species

Based on the habitat assessment, 16 migratory terrestrial species are likely to have a transient presence within the development site due to the availability of suitable foraging habitats.

The beach and rocky foreshore areas at both La Perouse and Kurnell may also offer marginal habitat for some migratory wetland bird species.

No EPBC Act listed migratory bird species were identified during the field surveys and habitats within the study area are not considered significant for migratory species given the extent of more suitable habitat within the surrounding bay and coastline.

Migratory marine birds and marine species listed under the EPBC Act are outlined in Chapter 10 (Marine biodiversity).

An assessment of significance against the EPBC Act MNES Significant Impact Guidelines 1.1 (Australian Government, Department of the Environment, 2013) has been undertaken and is detailed in section 5.2.3 of Appendix I (Biodiversity Development Assessment Report). This indicated that the project is unlikely to have a significant impact on these species, therefore an assessment of potential impacts on MNES has not been provided.

11.3 Assessment of potential impacts

This section discusses the potential impacts on biodiversity values known to occur within the development site. A summary of the potential impacts to terrestrial biodiversity during construction and operation is provided in Table 11-7.

Table 11-7: Potential impacts to biodiversity

Biodiversity value	Potential impact	Project phase Construction	Operation
Direct impacts			
Native vegetation	Clearing of 0.06 ha of native vegetation, comprised of 0.01 ha of permanent impact and 0.05 ha of temporary impact	✓	
TEC	Clearing of 0.034 ha of Kurnell Dune Forest TEC, comprised of 0.004 ha of permanent impact 0.03 ha of temporary impact	✓	
Threatened fauna	Impacts to 0.05 ha of potential breeding habitat for Gang-gang Cockatoo, comprised of 0.01 ha of permanent impact and 0.04 ha of temporary impact.	✓	
	Impacts to 0.05 ha of potential foraging habitat for Large-eared Pied Bat, comprised of 0.01 ha of permanent impact and 0.04 ha of temporary impact.	✓	
	Impacts to 0.028 ha of potential foraging habitat for Eastern Cave Bat, comprised of 0.008 ha of permanent impact and 0.02 ha of temporary impact.	✓	
Indirect impacts			
Threatened fauna habitat	Habitat disturbance from light and noise	✓	✓
Native vegetation	Disturbance from weeds and pathogens	✓	
Prescribed impacts*			
General matters	Impacts to habitat connectivity	✓	
	Impacts to water quality, water bodies and hydrological processes	✓	
	Impacts associated with vehicle strikes	✓	✓

** Prescribed impacts are those that may affect biodiversity values in addition to or instead of, impacts from clearing vegetation. These are listed in clause 6.1 of the Biodiversity Conservation Regulation 2017 and include (but are not limited to) impacts on the habitat of threatened species or ecological communities (caves, rocks, human made structures, non-native vegetation), impacts on habitat connectivity, and impacts on water quality/hydrological processes.*

11.3.1 Impacts on existing environment

Direct impacts

An area of 0.06 hectares of native vegetation comprising three PCTs would be impacted during construction. About 0.009 hectares would be cleared at La Perouse and 0.051 hectares would be cleared at Kurnell. This vegetation is subject to high levels of existing disturbance from weeds and habitat modification, so its condition is predominantly low.

Proposed clearing works would result in a direct loss of 0.034 hectares of Kurnell Dune Forest TEC defined as PCT 661. Impacts to this TEC are not considered to constitute a Serious or Irreversible Impact under the BC Act due to the very small area of impact to highly modified examples of this PCT.

There would be no direct impacts to threatened flora species (Leafless Tongue Orchid or Magenta Lilly Pilly) from the project.

Vegetation clearing is summarised in Table 11-8 and shown on Figure 11-10 and Figure 11-11.

Table 11-8: Direct impacts to native vegetation

Plant community type	Vegetation zones	Vegetation condition	Location	Proposed clearing extent (ha)
1823 Bracelet Honey-myrtle - Heath-leaved Banksia - Scrub She-oak coastal cliffline scrub in the Sydney basin	VZ15	Low	La Perouse	0.009
661: Bangalay - Smooth-barked Apple - Swamp Mahogany low open forest of southern Sydney, Sydney Basin Bioregion	VZ1	Low	Kurnell	0.00003
	VZ3			0.0004
	VZ4			0.012
	VZ10			0.017
	VZ11			0.002
772: Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	VZ12	Low	Kurnell	0.024
Total				**0.06**

Figure 11-10: Direct impacts to native vegetation at La Perouse

Figure 11-11: Direct impacts to native vegetation at Kurnell

At Kurnell, it is expected there would be loss of habitat for the Gang-gang Cockatoo, the Large-eared Pied Bat and the Eastern Cave Bat as a result of the proposed vegetation clearing. While these species were not identified during field surveys, their presence could not be discounted based on presence of habitat. Table 11-9 shows the expected extent of impacts.

Table 11-9: Impacts to fauna species due to vegetation clearing

Species	EPBC Act status*	BC Act status	Habitat function impacted	Extent of impacts (ha)
Gang-gang Cockatoo	Not listed	Vulnerable	Potential breeding	0.05
Large-eared Pied Bat	Vulnerable	Vulnerable	Potential foraging	0.05
Eastern Cave Bat	Not listed	Vulnerable	Potential foraging	0.028

Indirect impacts

Potential indirect impacts as a result of construction and operation of the project would include habitat disturbance due to noise, vibration and lighting, disturbance from weeds and pathogens and impacts to tree protection and root zones. These impacts are generally considered to be negligible with the application of suitable design measures and construction controls.

Habitat disturbance from noise, vibration and lighting

Light, noise and vibration can impact breeding, foraging and roosting activities where fauna are located close to construction activities.

Vegetation and fauna habitats adjacent to the development site are likely to experience increased disturbance from noise and light during construction.

Permanent lighting associated with the project is likely to cause lighting impacts on the foreshore and forested habitat areas next to the foreshore. Lighting would be required at both wharves for safety reasons and may be required along Monument Track. The foreshore areas offer marginal habitat for threatened species and are not considered to support breeding. However, increased lighting may make shorebirds such as the Pied Oystercatcher and Sooty Oystercatcher more visible to predators when roosting overnight. It is understood that periodic feral predator control is undertaken within the Kamay Botany Bay National Park. This is likely to minimise this risk to shorebirds.

Increased insect activity associated with the lighting at the wharves may increase foraging opportunities for some microbat species. However, the increase in lighting within the forested habitats is likely to reduce habitat suitability for many species including slow-flying microbat species.

Disturbance from weeds and pathogens

There is potential for the introduction and spread of weeds, non-endemic species and pathogens during construction due to machinery movements, increased foot traffic and landscaping.

The introduction of pathogens (eg Root Rot and Myrtle Rust) has the potential to pose a risk to threatened flora and native vegetation if not managed properly via the implementation of site hygiene measures. Overall, considering the existing levels of site disturbance it is not expected that the project would result in any increased risk of weed or pathogen disturbance.

Impacts to tree protection zones or structural root zones

Construction activities such as earthworks or soil compaction and the installation of permanent utilities within the tree protection zones and structural root zones has the potential to impact on tree condition and health. Appendix J (Arboricultural Impact Assessment) outlines measures to be implemented to ensure the protection of trees during construction. All trees within the construction boundary would be retained except for six trees including:

- One African Olive tree near Monument Track at Kurnell

- Five juvenile trees (including Port Jackson Fig, Coast Banksia, Swamp she-oak) near the wharf-tie in area at Kurnell.

Prescribed impacts

Prescribed impacts are listed in section 6.1 of the BC Regulation. Potential prescribed impacts from the project include impacts on connectivity, impacts to water quality, water bodies and hydrological processes and impacts from vehicle strikes.

Impacts to habitat connectivity

The project generally avoids large adjoining habitat areas and is mainly located within existing cleared grassland and foreshore areas. Proposed vegetation clearing would be minimal and would largely be carried out in edge environments subject to high levels of disturbance and/or habitat modification. Therefore, impacts to habitat connectivity are considered negligible.

Impacts to water quality, water bodies and hydrological processes

Construction of the wharves would be carried out in Botany Bay and pile driving may result in localised increases in turbidity levels. This is discussed further in Chapter 10 (Marine biodiversity), including appropriate management measures.

The pavement works associated with the wharf tie-in areas and the car parking would result in a minimal increase in hardstand area. This is unlikely to result in a significant increase in pollutant loads and no additional stormwater management treatment is proposed.

Impacts associated with vehicle strikes

There may be some increased risk of fauna injury or mortality during construction due to collision with construction vehicles and machinery. This would be managed via the installation of temporary construction fencing and the implementation of fauna management procedures as part of a Biodiversity Management Plan within the Construction Environmental Management Plan (CEMP).

Ferry operations may pose a risk to marine fauna due to boat strike. These impacts are discussed further in Chapter 10 (Marine biodiversity), including appropriate management measures.

11.3.2 Key threatening processes

A key threatening process (KTP) is defined under the BC Act if it:

- Adversely affects threatened species or ecological communities, or
- Could cause a species or ecological communities to become threatened.

Similarly, the EPBC Act defines a “threatening process” as a process that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community. KTPs relevant to the project are listed in Table 11-10.

Table 11-10: KTPs relevant to the project

Key threatening process	Status	Comment
Clearing of native vegetation	BC Act EPBC Act	A total of 0.06 ha of native vegetation, including 0.034 ha of Kurnell Dune Forest TEC. Clearing works are considered largely negligible given their small scale and are unlikely to result in any increased fragmentation or edge effects.
Invasion and establishment of exotic vines and scramblers	BC Act	The development site is already subject to infestation from exotic vines and scramblers such as the Asparagus Fern and Moth Vine. Construction works may increase the risk of weed spread, however this would be managed through the implementation of construction hygiene measures.
Invasion of native plant communities by Bitou Bush and Boneseed	BC Act	The development site is already subject to infestation from Bitou Bush, particularly within the coastal scrub at La Perouse. Construction works may increase the risk of weed spread,

Key threatening process	Status	Comment
		however this would be managed through the implementation of construction hygiene measures.
Invasion of native plant communities by African Olive Olea *europaea subsp. Cuspidata*	BC Act	There is an existing infestation of African Olive within PCT 1778 at Kurnell. Construction works are unlikely to pose a risk of spread of this species as the works are located away from areas of infestation.
Invasion, establishment and spread of Lantana	BC Act	There is an existing Lantana infestation at both La Perouse and Kurnell. Construction works may increase the risk of weed spread, however this would be managed through the implementation of construction hygiene measures.
Predation by the European Red Fox	BC Act EPBC Act	The development site is likely to be visited by European Red Fox. Proposed lighting of foreshore areas may result in increased predator activity, particularly of shorebirds such as the Pied Oystercatcher and Sooty Oystercatcher. Predator control is carried out regularly within the Kamay Botany Bay National Park, however sensitive permanent lighting design will be considered during detailed design to minimise light spill and reduce the risk of predation.
Predation and hybridisation by feral dogs	BC Act	The development site is likely to be visited by feral dogs. Proposed lighting of foreshore areas may result in increased predator activity by feral dogs as described above for European Red Fox.
Predation by feral cats	BC Act EPBC Act	The development site is likely to be visited by feral cats. Proposed lighting of foreshore areas may result in increased predator activity by feral cats as described above for European Red Fox.

11.4 Environmental management measures

11.4.1 Avoid and minimise

Opportunities to avoid and minimise impacts to biodiversity values have been considered during the project planning and design stages.

As part of the strategic phase during the project development, the wharf locations and scope of the project were investigated based on preliminary environmental assessments (refer to Chapter 4 (Project development and alternatives)). The preferred location for the wharves and project scope was chosen to avoid and minimise impacts to biodiversity as follows:

- Using the location of the previous wharf structure to minimise disturbance of previously undisturbed lands
- Reducing the land-side amenities footprint to avoid potential impacts to native vegetation, threatened species and ecological communities
- Reconfiguring existing car parking areas at La Perouse to maximise space while limiting disturbance
- Removing the originally proposed car parking at Captain Cook Drive, Kurnell to within the Kamay Botany Bay National Park to avoid removal of vegetation along Captain Cook Drive
- Re-routing proposed utility connections at Kurnell south along Monument Track to avoid impacts to threatened flora.

The project design development has been influenced by the need to avoid and minimise biodiversity impacts, particularly avoiding native vegetation clearing. At La Perouse, there would be no impacts to native vegetation as a result of landside facilities for the wharf and the car parking upgrades. There would be 0.009ha of temporary impacts to an area of PCT 1823 due to the required location of a temporary crane platform.

At Kurnell, construction access, site compounds and services trenching have all been designed to minimise impacts to native vegetation and threatened fauna habitats. The construction compound and access road have been located as much as possible within existing cleared areas dominated by exotic grasses. There would be a small area (0.03ha) of impact to PCT 661 and Kurnell Dune Forest TEC as a result of the access road alignment. This would be limited to the ground layer of exotic grasses and all trees that comprise the canopy of this community would be retained.

An aboricultural assessment of the existing trees at Kurnell was carried out to determine potential impacts on trees. Tree survey data was used to understand the potential impacts on a patch of PCT661 and Kurnell Dune Forest TEC near Captain Cook Drive. The response was to avoid reconfiguring car parking in this area, and instead the car parking would be provided as part of the Kamay Botany Bay National Park Kurnell Master Plan by National Parks and Wildlife Services at Kurnell. This has resulted in avoiding impacts to the Southern Mahogany *Eucalyptus botryoides* and Swamp Mahogany *Eucalyptus robusta* trees that comprise this patch of native vegetation and TEC.

11.4.2 Offsets

Where impacts cannot be avoided or minimised, they can be offset. Section 7.2 of Appendix I (Biodiversity Development Assessment Report) provides an assessment of the project against the BC Act offsetting requirements under the Biodiversity Offset Scheme. Biodiversity credits necessary to address residual impacts associated with the project are provided in Table 11-11.

Table 11-11: Biodiversity credit requirements for the project

Credit class	PCT	Associated TEC	Direct impacts (ha)	Estimated number of credits
Ecosystem	1823 Coastal headland cliffline scrub	-	0.009	0
	661 Coastal sand littoral forest	Kurnell Dune Forest in the Sutherland Shire and City of Rockdale	0.034	4
	772 Coastal foredune wattle scrub	-	0.024	0
Species	Gang-gang Cockatoo	Potential breeding	0.056	6
	Large -eared Pied Bat	Potential foraging	0.056	6
	Eastern Cave Bat	Potential foraging	0.024	1

11.4.3 Manage and mitigate

The management measures that would be implemented to address potential impacts on terrestrial biodiversity are summarised in Table 11-12. Any ongoing pest and weed management carried out in the national park would continue to be the responsibility of National Parks and Wildlife Services as part of their wider program and has not been included.

Table 11-12: Environmental management measures for terrestrial biodiversity

Impact	ID	Environmental management measure	Responsibility	Timing
Risks to native flora and fauna during construction	B1	Measures to further avoid and minimise the construction footprint, native vegetation or habitat removal will be considered during the detailed design stage and implemented where practicable and feasible. Measures to avoid and	Transport for NSW	Detailed design

Impact	ID	Environmental management measure	Responsibility	Timing
		minimise impacts should be prioritised in the following order: a. Critical habitat b. Threatened species, endangered ecological communities or their habitat c. Native vegetation and habitat supporting flora and fauna connectivity and/or that supports other environmental objectives such as protecting water quality, hydrology or erosion and sediment controls d. Native vegetation of higher quality condition e. Other native vegetation.		
Habitat disturbance from light	B2	As a part of detailed design, opportunities to minimise disturbance of foreshore and forested habitats as a result of light spill are to be investigated. This will include: a. Minimising the number of proposed permanent lights and optimising their locations where possible so as to provide maximum setbacks to adjacent habitats b. Where lights cannot be avoided, use of lower impact globes, directional shields, timers, sensors or motion detectors.	Transport for NSW	Detailed design
Terrestrial biodiversity impacts	B3	Terrestrial biodiversity management measures will be included as part of the Construction Biodiversity Management Plan (BMP). As a minimum the BMP will include: a. Sensitive area maps that identify native vegetation, flora and fauna habitat, threatened species and endangered ecological communities b. Maps showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features (eg hollow-bearing trees), and areas for rehabilitation or re-establishment of native vegetation c. Site inductions and training to ensure awareness of requirements of the BMP and relevant statutory responsibilities. Site-specific training will be given to personnel when working in the vicinity of areas of identified biodiversity value that are to be protected. d. Requirements set out in the Roads and Traffic Authority (RTA) Landscape Guideline e. Procedures addressing relevant matters specified in the Biodiversity Guidelines - Protecting and managing biodiversity on RTA Projects (NSW Roads and Traffic Authority, 2011a) including but not limited to:	Contractor	Pre-construction and construction

Impact	ID	Environmental management measure	Responsibility	Timing
		• Pre-clearing, including the outcomes of final flora and fauna species checks, establishment of exclusion zones and on-ground identification of specific habitat features to be retained (such as hollow-bearing trees) • Vegetation clearing and bushrock removal, including staged habitat removal and any specified seasonal limits on clearing activities • Fauna handling and unexpected threatened species finds • Rehabilitation, revegetation, re-use of soils, woody debris and bushrock, and other habitat management actions • Weed and pathogen management • Unexpected finds procedure. f. Monitoring during construction and post-construction g. Adaptive management measures to be applied if monitoring indicates unexpected adverse impacts.		
Indirect impacts to retained trees through construction activities and placement of permanent infrastructure	B4	A consulting arborist is to carry out an assessment of all trees within the construction boundary that are proposed for retention in accordance with Australian Standard 4970: Protection of Trees on Development Sites. The arborist is to provide a report with recommendations on the viable retention of all native trees within the construction boundary of the mapped PCTs, and include recommendations for amending design or using alternate construction methods to reduce any impacts on retained trees.	Contractor	Pre-construction
Vegetation and habitat loss	B5	A Terrestrial Biodiversity Offset Strategy will be prepared in accordance with the NSW Biodiversity Offset Scheme (NSW Department of Planning, Industry and Environment (DPIE), 2020i). Biodiversity credits are required to be obtained for the following PCTs and fauna species: a. PCT 1823 – Coastal headland cliffline scrub b. PCT 661 – Coastal sand littoral forest c. PCT 772 - Coastal foredune wattle scrub d. Gang-gang Cockatoo e. Large-eared Pied Bat f. Eastern Cave Bat.	Transport for NSW	Pre-construction, construction and operation